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MEMOIRS OF THE

Institute of
Scientific and
Industrial
Research



Contents

Foreword	1
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Outline of ISIR

1. Research Activities	2
2. Education	20
3. International Exchange	21
4. Concluding Remarks	22

Activities of Divisions

Division of Information and Quantum Sciences	27
Division of Advanced Materials and Beam Science	44
Division of Biological and Molecular Sciences	59
Division of Next Industry Generation.....	74
Specially Appointed Laboratory	78
Division of Special Projects	80
ISIR-RIKEN Alliance Laboratory	87

Activities of Center

Nanoscience Nanotechnology Center	89
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Activities of Facilities	115
---------------------------------------	-----

List of Achievements	147
-----------------------------------	-----

Foreword

ISIR Pursues Target-Driven Basic Research Leading to Real Innovation

Yasushi Yagi

Director of the Institute of Scientific and Industrial Research

The Institute of Scientific and Industrial Research (ISIR) was founded in 1939 as a part of Osaka University with the aim of promoting basic science for the development of industry. Since then, ISIR has conducted interdisciplinary research in the fields of materials, information, and biological sciences. We play a leading role in the nanoscience and nanotechnology research through our Nanotechnology Center, which was established in 2002 and is Japan's first such center attached to a university.

As a nationwide research collaboration system, ISIR established the Network Joint Research Center for Materials and Devices and works in conjunction with five university-attached research institutes: Research Institute for Electronic Science (Hokkaido University), Institute of Multidisciplinary Research for Advanced Materials (Tohoku University), Chemical Resources Laboratory (Tokyo Inst. Tech.), ISIR (Osaka University), and Institute for Materials Chemistry and Engineering (Kyushu University). The Japan's first nationwide network research center provides a new framework for facilitating the inter-institute collaboration.

For industrial applications of innovative achievements, we have promoted cooperation between academia and industry through Industry-On-Campus in the newly constructed Incubation Building. To promote the globalization of basic innovative research, a research-collaboration agreement was reached between the Interuniversity Microelectronics Center (imec)—one of the world's largest nanotechnology research institutes—and ISIR in 2011.

This publication “Memoirs of the Institute of Scientific and Industrial Research (ISIR)” is our annual publication summarizing the scientific activities of ISIR. We hope this annual publication will be useful and stimulating for all researchers and young scientists outside as well as inside our institute.

Our world-level innovative basic research efforts address problems related to the environment, energy, medicine, and security and safety on studies in the fields of materials, information, and medical sciences along with those in nanotechnology and nanoscience. ISIR pursues a target-driven basic research leading to real innovation and inspire the future.

Outline of ISIR

1. Research Activities

1) History and Organization

The Institute of Scientific and Industrial Research (ISIR) was founded in 1939 as a part of Osaka University, based on the strong desire of the business leaders of private enterprises in Osaka area. The purpose of the Institute is to study science necessary for industry and their applications. Since then, the institute had developed into one of the leading research organizations for science and engineering in Japan.

In 1939 ISIR had only 3 departments, however it had increased research areas and laboratories in the fields of electronic engineering, computer science, metallurgy and inorganic chemistry, organic chemistry, biochemistry, and beam science.

Modern industry in this country is, however, coming to a major turning point. There is a strong requirement to develop interdisciplinary sciences, or new fields which are away from conventional area in order to advance basic and applied sciences coping with social changes.

Since this Institute has researchers in a wide variety of fields and is suitable for making a new organization for interdisciplinary areas, it was restructured in 1995 to an Institute with 6 divisions with 24 departments for the purpose of promoting sciences on materials, information and biology. For solving problems related to energy, earth ecology, aging and advanced information technology, interdisciplinary and comprehensive studies have been conducted in the Institute. From 2002 through 2006, we have awarded as the best group in 21st Century COE program that is originally the top 20 group plan in Japan. This involves the positive exchange between different laboratories which yield results of the global level with respect to material, information and biotechnology.

In 2002, Nanoscience and Nanotechnology Center has started after restructuring Research Center for Intermaterials and Radiation Laboratory. The new Center focuses its research on nanomaterials and devices, beam science for nanotechnology and industrial nanotechnology. In 2003, the Center Building was constructed. In the new Center Building, there is a Nanotechnology Process Foundry for supporting the nationwide research in the nanotechnology field.

In 2006, Materials Science & Technology Research Center for Industrial Creation between ISIR and IMRAM (Tagenken) in Tohoku Univ. has started and then expanded to the Post-Silicon Materials and Devices Research Alliance including RIES

(Denshiken) in Hokkaido Univ. and CRL (Shigenken) in TIT next year. In 2006, Academia Industry Relation Office (AIR-Office) has been settled in order to strengthen cooperation between the institute and industries. In 2008, Division of special project has been founded for promotion of research by young faculties.

In 2009, we have made a great restructuring since 1995 in order to develop the novel interdisciplinary research fields and exercise leadership in nanotechnology research field into 3 great divisions (Division of Information and Quantum Sciences, Division of Material and Beam Sciences, and Division of Biological and Molecular Sciences) and expanded Nanoscience and Nanotechnology Center. We newly established the Center for Research Education and Training and the Center for International Collaboration. Former Materials Analysis Center was joined with Electron Microscope Laboratory and restricted into the Comprehensive Analysis Center. Research Laboratory for Quantum Beam Science was separated from Nanoscience and Nanotechnology Center for facilitating the collaboration in the beam science field.

In order to establish a core for academia-industry collaboration and open innovation, we constructed the SANKEN Incubation Building including Osaka University's first on-campus rental laboratories for private corporations (Company Research Park) in 2010. ISIR Manufacturing Factory has been moved into the building. In addition, Nanoscience Techno-Core, Company Research Park and Osaka University Renovation Center was settled in the building.

In 2010, the Network Joint Research Center for Materials and Devices including ISIR, IMRAM, RIES, CRL and IMCE (Sendoken) in Kyushu Univ. has been started. ISIR is a headquarters of this 5 institutes network.

In 2011, research-collaboration agreement was reached between the Interuniversity Microelectronics Center (imec)-one of the world's largest nanotechnology research institutes- and ISIR.

Divisions	Departments
<u>Division 1</u> Information & Quantum Sciences	Photonic and Electronic Materials Semiconductor Electronics Advanced Electronics Intelligent Media Reasoning for Intelligence Knowledge Systems Architecture for Intelligence Quantum Information Photonics (Alliance Laboratory of ISIR, Osaka Univ. and RIES, Hokkaido Univ.)
<u>Division 2</u> Advanced Materials & Beam Science	Quantum Functional Materials Semiconductor Materials and Processes Metallic Materials Process Advanced Interconnection Materials Excited Solid-State Dynamics Accelerator Science Beam Materials Science
<u>Division 3</u> Biological & Molecular Sciences	Molecular Excitation Chemistry Synthetic Organic Chemistry Regulatory Bioorganic Chemistry Organic Fine Chemicals Structural Molecular Biology Cell Membrane Biology Biomolecular Energetics
<u>Next Industry Generation</u>	New Industrial Projection New Industry Generation System(s) Intellectual Property Research
<u>Specially Appointed Laboratory</u>	Innovative Nanobiodevice based on Single Molecule Analysis
<u>Special Projects</u> Laboratories of 1st Project Laboratories of 2nd Project	Laboratory of Microbiology and Infections Diseases Laboratory of Atomic Scale Materials Processing Laboratory of Cellulose Nanofiber Materials
Laboratories of 3rd Project	Beam Application Frontier Research Laboratory
<u>Alliance Laboratory</u>	Quantum Information Photonics (Alliance Laboratory of ISIR, Osaka Univ. and RIES, Hokkaido

Univ.)
Department of Disease Glycomics
(Alliance Laboratory of ISIR, Osaka Univ. and RIKEN)

.....
Research Centers

Nanoscience and Nanotechnology Center

Functional Nanomaterials and Nanodevices
Advanced Nanofabrication
Nanocharacterization for Nanostructures and Functions
Theoretical Nanotechnology
Soft Nanomaterials
Bio-Nanotechnology
Nanotechnology Environmental and Energy Applications
Nano-Intelligent Systems
Nanodevices for Medical Applications
Nanosystem Design
Nanodevice Characterization
Nanotechnology for Industrial Applications
Simulation for Nanotechnology
Nanoelectronics
Nano-Function Characterization
Nano-Medicine
Nano-Biology
Nano Information Technology

Nanofabrication Shop

Advance Nanotechnology Instrument Laboratory

Handai Multi-Functional Nanofoundry

Comprehensive Analysis Center

Research Laboratory for Quantum Beam Science

Center for Research Education and Training

International Collaboration Center
.....

Nano –Macro Materials, Devices and System Research Alliance

Next Generation Electronics Research Group
New Energy Harvesting Materials and Devices Research Group
Medical Treatment Materials and Devices Research Group
Environmental Harmonized Materials and Devices Research Group
.....

Service Facilities

Workshop
Laboratory for Radio-Isotope Experiments
Electronic Processing Laboratory
Office of Information Network
Academia Industry Relations Office

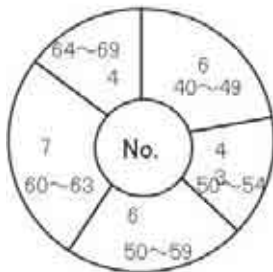
Technical

Administrative Office

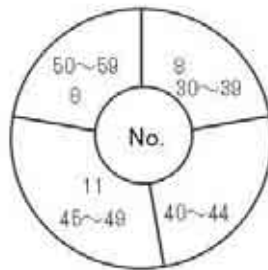
Public Relations Office
Library
Open Laboratory
Machine Group
Measurement Group
Facilities Planning Office
General Affairs Division
Research Cooperation Division

Staffs' Age (years old) –As of 3.31.2013

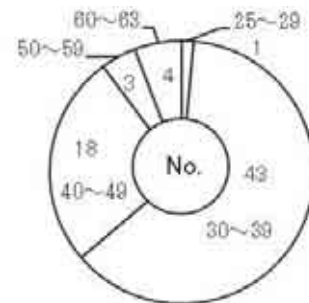
Professors



Associate Professors



Assistant Professors

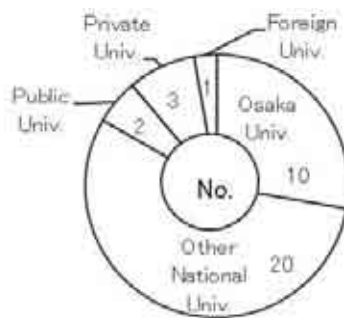


Staffs' Alma Mater –As of 3.31.2013

Professors



Associate Professors



Assistant Professors



2) Administration

Administration and management of ISIR are conducted by the Director elected from the full professors of ISIR. The term of the Director is two years. Reappointment is possible, but the Director can't be in the position for more than 4 years. At Present, Professor Yasushi Yagi is a Director. .

Important matters of ISIR are discussed and determined by the Faculty Council, which consists of the Director and all professors of ISIR. Various committees such as International Exchange, Self-Review, Circumstances and so on are working for each purpose.

Administration of the Institute-associated Centers is conducted by Director of

each Center and its Executive Committee.

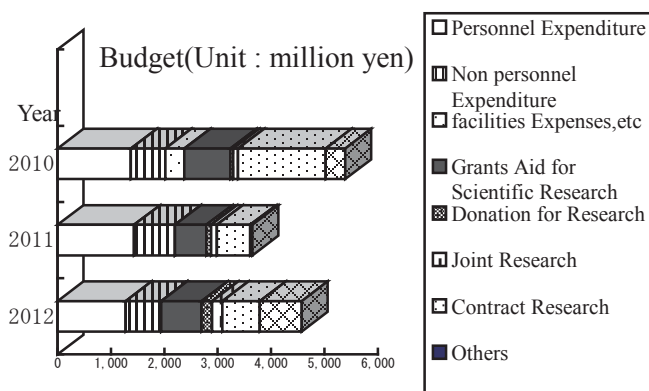
Evaluation Committee composed of outside experts in academic societies was established and the committee evaluated several items such as management, budget, facilities and research activities.

The new organization was highly evaluated, but with change of their structure to National University Agencies in April 2004, our management system needs reshaping. A Board of Directors under the Director has been formed, and Advisory Board has been set up to introduce opinions from outside into the Institute.

3) Research Budget

The budget of ISIR is mainly composed of Subsidy for operating expenses, Grants-in-Aid for Scientific Research of Ministry of Education, Sports, Culture, Science and Technology, Donations for Research, and Budget of Joint Research. The recent trend in the expenditure of ISIR is as follows.

Grants-in Aid for Scientific Research of Ministry of Education, Culture, Sports, Science and Technology are delivered to researchers and the total budget in 2012 is 758,095,000yen.



Donation for Research

Donation for Research is accepted after the Judgement of Committee and the amount are as follows.

(Unit : kilo yen , () Number)

Division Year	Information and Quantum Sciences	Advanced Materials and Beam Science	Biological and Molecular Sciences	Nanoscience and Nanotechnology Center
2012	124, 610 (9)	49, 150 (23)	10, 990 (11)	8, 770 (9)
Division Year	Special Projects	Others	Total	
2012	6, 700 (6)	2, 900 (6)	203, 120 (64)	

4) Cooperative Research

Cooperative Researches and Contract Researches in the fiscal year 2012-2013 are as follows: Cooperative Researches are carried out with 66 organizations and the budget for the fiscal year 2012-2013 is 190,212,000 yen. The number of Contract Researches is 39 and the budget for the fiscal year 2012-2013 is 704,241,000 yen.

5) International Research

Department of Semiconductor Electronics	AIXTRON	Germany	Growth of Graphene
	MERK	Germany	Graphene Bio Sensor
Department of Advanced Electron Devices	imec	Belgium	organic semiconductor
	Brussels University	Belgium	organic semiconductor
	Erlangen University	Germany	organic semiconductor
Department of Intelligent Media	Peking University	China	Computer Vision
	Microsoft Research Asia	China	Computer Vision
	Drexel University	U.S.A	Computer Vision
	Monash University	Austraria	Clustering and classification Methods based on Data Mass Density Estimation
	Joseph Fourier University	France	Abstraction Method of Smart Phone Log by Using Data Mining
	University of Helsinki	Finland	Estimation of causal orders in the presence of latent confounding variables
	Max Planck Institute	Germany	Machine Learning for Genome-Wide Association Study
Department of Knowledge Systems	The Laboratory for Applied Ontology (LOA), ISTC-CNR	Italia	Unified definition of function
	Aalborg University Copenhagen	Denmark	Ontology of culture and its applications
	Busan National University of Education	Korea	Learning support systems based on ontology of instructional theories
Department of Architecture for Intelligence	TELECOM ParisTech	France	Embodied Agents and Empathic Computing
	De La Salle University	Philippine	Empathic Computing by using Empathic Computing

Department of Architecture for Intelligence	De La Salle University	Philippine	Empathic Computing for Rhythm
	De La Salle University	Philippine	Empathic Computing for Stress
	De La Salle University	Philippine	Empathic Computing for Background Music
Department of Quantum Functional Materials	University of California, San Diego	U.S.A	Magneto-optics measurements of topological insulators
Department of Semiconductor Materials and Processes	Slovak Academy of Science	Slovak Republic	Improvement of semiconductor device characteristics by use of new chemical methods
	Innner Mongolian Normal University	China	Application of nitric acid oxidation method to semiconductor devices
	Hanyang University	Korea	Application of defect passivation cleaning method to semiconductor devices
Department of Advanced Hard Materials	Inha university	Korea	Development of fabrication technique of lotus Cu
	University of Maribor	Slovenia	Analysis of compressive properties of lotus-type porous iron
Department of Excited Solid-State Dynamics	University College London	U.K	Excited-surface science
Department of Beam Materials Science	Institute for Planetary Research	Germany	Masurement of time structures of the THz-FEL using a fast superconducting bolometers
	Synchrotron Light Research Institute	Thailand	Upgrade of the accelerator system for synchrotron radiation
	Fraunhofer IISB	Germany	Study on 6.67nm Extreme Ultraviolet Lithography
	TSMC(Taiwan Semiconductor Manufacturing Company)	Taiwan	Electron beam resist characterizations
	Universite de Sherbrooke	Canada	Radiation chemistry of high temperature/pressure and supercritical water
	Université Paris-Sud	France	Radiation-induced synthesis of metal nanoparticles in ethers THF and

			PGMEA
Department of Molecular Excitation Chemistry	Korea University	Korea	New dye sensitized solar cell
	Korea University	Korea	Polymer-type photovoltaic cell
	Korea University	Korea	S2 emission of organic dyes
	POSTECH	Korea	Photocatalytic reaction of titanium oxide mesocrytals
	POSTECH	Korea	Superstructures of metal nanoparticle-doped titanium oxide
	POSTECH	Korea	Decomposition of organic pollutants by singlet oxygen-generating photocatalyst
Department of Synthetic Organic Chemistry	RWTH Aachen University	Germany	Development of enantioselective Rauhut-Currier reaction using asymmetric organocatalyst
	Bourgogne University	France	Development of asymmetric organocatalyzed aza-Morita-Baylis-Hillman reaction
	Bielefeld University	Germany	combination of biocatalyst and organocatalyst for innovative molecular transformation
Department of Regulatory Bioorganic Chemistry	National University of Singapore	Singapore	Rapid detection of Chikungunya virus
	The Hospital for Sick Children	Canada	Mechanistic analysis of trinucleotide repeat disease
Department of Organic Fine Chemicals	Chemical Genomics Centre, Max Planck Society	Germany	Modulation of 14-3-3 protein functions by organic small molecules
	University of South Florida	U.S.A	Bivalent dual inhibitors for disrupting protein-protein interactions of prenyltransferases
Department of Cell Membrane Biology	Hadassah, Hebrew university Medical center	Israel	Analysis of SPNS2 mutation identified in patients with a neurological syndrome
Department of Biomolecular Science and Engineering	Alberta University	Canada	Development of functional indicators

Department of Biomolecular Science and Engineering	Oxford University	U.K	Development of functional iPS cells
Department of Functional Nanomaterials and Nanodevices	National Research Council	Italia	Creation of Oxide Nano Electro-Mechanical Systems and Evaluation of their Physical Prpperties
	MESA+ Institute for Nanotechnology, University of Twente	Netherlands	Cubic nanotemplates for electrodeposition
Department of Advanced Nanofabrication	Tsinghua University	China	Development of the femtosecond time resolved diffraction and microscope
Department of Nanocharacterization for Nanostructures and Functions	University of Notre Dame	U.S.A	ETEM observation of nanomaterials under catalytic reaction conditions
	Utrecht University	Netherlands	Structural transformation of gold nanorods in gases
	Lawrence Berkeley National Laboratory	U.S.A	High resolution TEM observations of Au nanoparticles supported on metal oxides catalysts
	FEI Company	U.S.A	Development of a high resolution environmental TEM
	Los Alamos National Laboratory	U.S.A	Structural changes of complex oxides under radiation environments
	University of Tennessee	U.S.A	Development of radiation tolerant materials by nanostructure control
	Pacific Northwest National Laboratory	U.S.A	Modification of functional oxide materials by high-energy ion irradiation
Department of Theoretical Nanotechnology	Ludwig-Maximillian-Universität München	Germany	Magnetism and x-ray spectroscopy in transition-metal alloys and compounds
	Northwestern University	U.S.A	First-principles study of transition-metal oxides
	Seoul National University	Korea	Electronic structure of transition-metal oxides
	CNR-SPIN, Italy	Italia	Theoretical study on multiferroics
	Ecole Polytenique	France	Superconductivity search on boron

			solids
Department of Theoretical Nanotechnology	Dresden University of Technology	Germany	Material search of boron crystals
Department of Soft Nanomaterials	University of Michigan Ann Arbor	U.S.A	Organic Thin-film Solar Cells
Department of Bio-Nanotechnology	Uppsala University	Sweden	Theoretical studies on DNA manipulations
	Rutgers University	U.S.A	Theoretical studies on DNA manipulations
Laboratory of Microbiology and Infectious Diseases	Institut National de la Recherche Agronomique	France	Regulation of drug efflux pumps in Salmonella
	Ghent University	Belgium	Mechanism of Salmonella resistance to egg white
	University of Hong Kong	Hong Kong	Pysiological function of multidrug efflux pump
	Tierärztliche Hochschule Hannover	Germany	Mechanism of Salmonella resistance to triclosan
	Ohio State University	U.S.A	Autopagy induced by Anaplasma

6) Symposia, Seminars, Workshops and Lectures

2012/4/16	Printed Electronics Association
2012/6/4~5	imec-Handai International Symposium 2012
2012/6/26~29	3rd ASM Conference on Antimicrobial Resistance in Zoonotic Bacteria and Foodborne Pathogens in Animals, Humans, and the Environment
2012/7/3~4	Advanced Nanopatterning Materials and Processes Workshop
2012/7/24	Printed Electronics Association
2012/8/8~11	The 9th Annual Meeting of Particle Accelerator Society of Japan
2012/8/17~18	The Photobiology Association of Japan
2012/9/3~7	21st Computational Materials Design Workshop
2012/9/23~28	The 17th International Conference on Molecular Beam Epitaxy
2012/9/27	Workshop for organic photovoltaic devices
2012/10/8~11	Asian Computational Materials Design Workshop
2012/10/11	Printed Electronics Association

2012/10/15	Fluorescence Imaging and MRI : enzyme-responsive probes that operate in the off-on mode
2012/10/16~19	2012 Paradigm Innovation in Biology: Novel Strategy and Thinking
2012/10/26	Osaka University nano-consortium Workshop: Functional oxide nano-electronics
2012/11/16	The 3rd Workshop on Environmental Electron Microscopy
2012/11/19	Joint symposium of "Spying minority in biological phenomena" and "Bio Assembler"
2012/11/22	68th Symposium on a special topic and subsequent conference for presenting results of research activities made by the members of the Institute
2012/12/6	Osaka University nano-consortium Workshop:Functional oxide nano-electronics
2012/12/7	2012 2nd workshop in the Research Laboratory for Quantum Beam Science
2012/12/13~14	Topological Quantum Phenomena in Condensed Matter with Broken Symmetries, 10th Intensive-Interactive Meeting "Topological Superconductivity / Superfluidity"
2012/12/21	Problems of Segmentation
2013/1/4~5	The 7th International Workshop on Robust Computer Vision
2013/1/9	in vivo imaging of dynamics in hippocampal neuronal circuits
2013/1/22	The 16th SANKEN International Symposium 2012/ The 11th SANKEN Nanotechnology Symposium
2013/1/22	Printed Electronics Association
2013/2/5	Workshop:Osaka University nano-consortium Functional oxide nano-electronics
2013/2/10~11	ISIR Intra-University Collaboration Meeting
2013/2/13~14	2012 International Symposium on Extreme Ultraviolet Lithography
2013/2/14~16	Asian Computational Materials Design Workshop
2013/2/22	Material Search Tasted on Noble Structural Prediction Algorithm
2013/2/22	Workshop [A-4] of Network Joint Research Center for Advanced Materials and Devices
2013/3/4~8	22nd Computational Materials Design Workshop
2013/3/5	Workshop on MDR efflux pumps and Salmonella
2013/3/8-3/9	2012 Year-end report meeting of Funding Program for World-Leading Innovative R&D on Science and Technology
2013/3/14	Nanoscale Molecular Devices Seminar
2013/3/14~15	IPSJ SIG-CVIM: Computer Vision and Image Media
2013/3/21	Science Café
2013/3/22	Molecular Science for Interface Devices
2013/3/25	Workshop:Osaka University nano-consortium Functional oxide nano-electronics
2013/3/26	PKU EECS-OU ISIR ICT Collaborative Laboratory Seminar

Other Lectures and Seminars

2012/4/4	David W.L. Cheung	Department of Computer Science, Hong Kong University	Professor	Security Protection and Integrity Verification for Frequent Itemset Mining
2012/4/25	Hubertus Ebert	Universität München	Professor	Ab-initio studies on spin-orbit induced properties of magnetic solids
2012/5/2	Stefan Bluegel	Peter Grünberg Insitut (Jülich)	Professor	Orbital-dependent exact exchange: implementation and application within the all-electron FLAPW method
2012/5/10	Hubertus Ebert	Universität München	Professor	Infulence of spin-orbit coupling on the transport properties of magnetic and non-magnetic transition metal alloys
2012/5/10	Karl Scheidt	Northwestern University	Professor	New Discoveries using Carbene Catalysis
2012/5/23	Hubertus Ebert	Universität München	Professor	Calculation of angle-resolved photo emission spectra within the one-step model of photo emission-recent development
2012/6/1	Motoshi Suzuki	Nagoya Univ., Graduate School of Medicine	Associate Professor	Development of novel treatment for cancer using unity and diversity of the property of tumor cells
2012/6/7	Cholwich Nattee	Thammasat University	Assistant Professor	Ensemble Learning Techniques and Positive Unlabeled Learning for Thai Text Processing
2012/6/15	Shuji Hisaeda, Noriaki Uesaka	Perkin Elmer, Kyowa Hakko Kirin	International Marketing, Manger, Chief researcher	ChemBioOfficeSeminer
2012/6/25	D. Arenas	University of North Florida	Assistant Professor	Informal Overview of Optics Research at University of North Florida
2012/7/2	A. Rahman	Universiti Sains Malaysia	Professor	Utilization of Malaysia Natural Gas for the Production of Carbon Nanotubes

2012/7/19	Pier Giorgio Cozzi	Bologna University	Associate Professor	Lewis acids Catalyzed Friedel-Crafts Reactions with Ferrocene Alcohols: From Quantum Cellular Automata to new Effective Organocatalysts
2012/7/23	Jaejun Yu	Seoul National University	Professor	Spin-orbit coupled ground state of Ir-oxides: from Jeff=1/2 state to topological insulator to quantum magnets
2012/7/28	Yasuyuki Igarashi	Faculty of Advanced Life Science, Hokkaido University	Specially Appointed Professor	Sphingomyeline synthase SMS2 : function and pathology
2012/8/20	Noriko Otani	Tokyo City University	Associate Professor	Generation of Chord Progression Using Harmony Search Algorithm for a Constructive Adaptive User Interface
2012/8/31	Tomokazu Matsue	Tohoku University	Professor	Biosensing and bioimaging using Micro-Nano electrode
2012/9/13	Prof. Samson A. Jenekhe	University of Washington	Professor	Advances in Polymer Semiconductors for Thin Film Transistors and Organic Photovoltaics
2012/9/17	Nino Shervashidze	Max Plank Institute for Intelligent Systems	Research Staff	Scalable kernels for machine learning on graphs
2012/9/21	Yuden Teraoka	Japan Atomic Energy Agency	Group leader	Surface reaction dynamics illuminated by high brilliance and high energy-resolution synchrotron radiation for ultra-thin film formation processes
2012/9/24	Jianbo Shi	University of Pennsylvania	Associate Professor	Computer vision
2012/9/28	Esko I. Kauppinen	Aalto University School of Science	Professor	Direct Dry Printing (DPP) of SWCNT Thin Films for Flexible Electronics Applications
2012/10/12	Yuden Teraoka	Japan Atomic Energy Agency	Group leader	Ultra high vacuum, its necessity and applications

2012/10/15	Jens Hasserodt	University of Lyon	Professor	Fluorescence Imaging and MRI : enzyme-responsive probes that operate in the off-on mode
2012/10/16	Hiroko Seki	Chiba University	Specially Appointed Associate Professor	Comprehensive Analysis CenterSeminar
2012/10/26	Yuden Teraoka	Japan Atomic Energy Agency	Group leader	Outline of synchrotron radiation beamlines
2012/11/9	Yuden Teraoka	Japan Atomic Energy Agency	Group leader	Fundamental aspects on X-ray photoemission spectroscopy
2012/11/16	Jo de Boeck	imec	senior vice president	imec Exective Overview
2012/11/16	Paul Heremans	imec	director/fellow	Organic Devices and Flexible Electronics
2012/11/27	Alexandre Termier	Laboratoire d'Informatique de Grenoble, Universite Joseph Fourier	Associate Professor	A condensed representation for periodic patterns: the Core Periodic Patterns
2012/11/29	Yuden Teraoka	Japan Atomic Energy Agency	Group leader	Applications of X-ray photoemission spectroscopy
2012/12/20	Kazuyuki Sakamoto	Chiba University, Graduate School of Advanced Integration Science	Associate Professor	Electronic polarized bands at solid surfaces
2012/12/25	Mikio Tanabe	Martin-Luther-Universität Halle-Wittenberg	Group leader	Structural identification of a solute transport pathway in a Neisserial menigitidis outer membrane protein and Gram negative bacteria
2012/12/21	Kota Miura	European Molecular Biology Laboratory	Scientist & IT Engineer	Problems of Segmentation

2013/1/9	Masaaki Sato	RIKEN BSI	Research Scientist	in vivo imaging of dynamics in hippocampal neuronal circuits
2013/1/21	Paolo Borone	Institute CNR-SPIN	Researcher	Emergent trends in ferroelectrics: electronic ferroelectricity and Rashba effect
2013/3/4	Mitsuhiro Arisawa	Hokkaido University	Associate Professor	Development of Self-assembled Multi-layer Palladium Nano Particles and Its Application to Drug Discovery
2013/3/8	Kazumi Kitta	National Agriculture and Food Research Organization	Senior Research Fellow	GMO detection method

7) Public Information Activity

Public information activity of ISIR in 2012 is as follows:

- Bulletin of ISIR 2012 (in both Japanese and English)
- Memoirs of the Institute of Scientific and Industrial Research, Osaka University Vol.69 2012 (in English)
- Annual Report of ISIR (in Japanese)
- SANKEN News Letters, 46-48(in Japanese)
- Report on SANKEN Techno Salon 2012 (in Japanese)
- WWW home-page (<http://www.sanken.osaka-u.ac.jp/>)
(English version is available.)

8) Research Reports

The number of scientific and technological papers published in 2012 is 374. The details are described in the part of activity of divisions and facilities.

9) Scientific Awards

K. NAGASHIMA	The 60th JSAP Spring Meeting PHOTO CONTEST AWARD	2013/3/30
M. TSUTSUI	CSJ(Chemical Society of Japan) Presentation Award 2012	2012/4/12
T. YANAGIDA	Funai Foundation for Information Technology H23 Funai Research Award	2012/4/14
K. NAGASHIMA	Funai Foundation for Information Technology H23 Funai Research	2012/4/14

	Award for Young Scientist	
T. YANAGIDA	MEXT The Young Scientists' Prize	2012/4/17
K. NAGASHIMA	The Japan Science Society H23 Sasakawa Research Award for Young Scientist	2012/4/19
T. IDE	The Japan Institute of Light Metals Poster Award	2012/5/19
M. KRIENER S. SASAKI	International conference on topological quantum phenomena poster award (MEXT grant-in-Aid for scientific research on innovative areas "topological quantum phenomena in condensed matter with broken symmetries")	2012/5/20
K. SUGANUMA	Emerald Group Publishing Limited Highly Commended Award	2012/5/31
H. KOGA	Best Paper award of the Society of Fiber Science and Technology	2012/6/6
T. MATSUZAKI	Award for the best poster presentation at the 29th joint symposium in 2012, organized by AOMA and technical committee on measurement of mechanical quantities in SICE	2012/6/8
T. WASHIO	JSAI 2011 Best Paper Award	2012/6/14
Y. KAWAHARA	JSAI Incentive Award	2012/6/14
M. TSUTSUI	The 10th Annual Meeting of Society of Nano Science and Technology Best Young Presenter Award	2012/6/15
S. YAMASAKI	Outstanding Student Poster (112th ASM General Meeting)	2012/6/16
S. YAMASAKI	ASM Student Award (112th ASM General Meeting)	2012/6/16
S. SASAKI	Gordon and Betty Moore Best Poster Award	2012/6/27
Y. MUROYA	Division of Water Chemistry, Atomic Energy Society of Japan Poster Award	2012/7/11
M. TANE	Osaka University Presidential Awards for Encouragement	2012/8/1
Y. YAGI Y. MAKIHARA	The 15th Meeting on Image Recognition and Understanding (MIRU2012) Excellent paper award	2012/8/7
S. YAMASAKI	10th Physical Pharma Forum 2012 - The Next Generation -, Encouragement Award for Young Researchers	2102/8/7
H. KOGA	The 43rd The Society of Fiber Science and Technology Summer seminar Poster Award	2012/8/8-10
T. KONDOH K. KAN	Poster Award, The 9th Annual Meeting of Particle Accelerator Society of Japan	2012/8/10
T. ARAKI	ICFPE Student Poster Award	2012/9/8
T. NAGAI	12th ECS Meeting, special prize for poster	2012/9/12

T. TACHIKAWA	The JPA Award for Young Photochemists	2012/9/13
T. TOIGAWA	Poster Award, Meeting of young scientist on radiation chemistry	2012/9/14
I. NOZAWA	Young Scientist Award and Poster Award, 2012 Fall Meeting of Atomic Energy Society of Japan	2012/9/21
K. SUGANUMA	FY2012 Industrial Standardization Award	2012/10/15
K. MATSUMOTO K. INOUE K. MAEHASHI Y. OHNO	MNC 2011 Award for Outstanding Paper	2012/10/31
K. NAGASHIMA	MNC 2011 Award for Young Author's Award	2012/10/31
T. SUZUKI	Kansai Branch Award in Synthetic Organic Chemistry, Japan	2012/11/1
K. KAN	Poster Award, 4th Asia Pacific Symposium on Radiation Chemistry (APSRC-2012)	2012/11/1
K. KAIHATSU	International Symposium on Micro-Nano Mechatronics on Human Science-2012, Best Paper Award	2012/11/7
M. NUMAO	ICCE2012 Best Technical Design Paper Award	2012/11/30
K. NAGASHIMA	8th Handai Nanoscience and Nanotechnology International Symposium Young Researcher Best Poster Award December10-11	2012/12/11
S. YAMASAKI	Koichi Suzuki Memorial Award The 85th Annual Meeting of the Japanese Biochemical Society	2012/12/16
Y. YAGI Y. MUKAIGAWA I. MITSUGAMI	IWRCV2013(The 7th International Workshop on Robust Computer Vision) Best Poster Award	2013/1/5
T. MAJIMA	BCSJ Award Article	2013/1/15
K. KAWAI	BCSJ Award Article	2013/1/15
K. SUGANUMA M. NOGI H. KOGA T. INUI	The 16th SANKEN International Symposium/The 11th SANKEN Nanotechnology Symposium Best Poster Award	2013/1/23
T. TOIGAWA	The 16th SANKEN International Symposium/The 11th SANKEN Nanotechnology Symposium Best Poster Award	2013/1/23
K. NAGASHIMA	Inoue Research Award for Young Scientists	2013/2/4
M. NOGI	Osaka prefecture Smart Energy Business Competition 2012	2013/2/27
R. MIZOGUCHI K. KOZAKI	Linked Open Data Challenge Japan 2012 Life Science Award	2013/3/7

M. TANE	Best Presentation Award (MEXT Grant-in-Aid for Scientific Research on Innovative Areas Materials Science on Synchronized LPSO Structure -Innovative Development to Next-generation Lightweight-structural Materials-)	2013/3/19
C. MITSUI	73rd The Japan Society of Applied Physics Presentation Award	2013/3/27
K. NAGASHIMA	The 60th JSAP Spring Meeting Photo Contest Award	2013/3/30

2. Education

ISIR accepts graduate students (188) from the Graduate Schools of Science, Engineering, Engineering Science, Pharmaceutical Science, Information Science and Technology, and Frontier Biosciences, and also researchers for special training, including those from industry and from abroad.

Staff members also belong to various Faculties: Faculty of Science, Faculty of Engineering, Faculty of Engineering Science, Faculty of Pharmaceutical Science, Faculty of Information Science and Technology, and Faculty of Frontier Biosciences. Some members belong to two Faculties. They give lectures for graduate and undergraduate students in each Faculty.

Number of graduate students as of March 31, 2013 is as follows.

Field Course	Science	Engineering	Engineering Science	Pharma- ceutical Science	Information Science and Technology	Frontier Biosciences	Total
Master Course	41	42	16	4	14	1	118
Doctor Course	21	31	6	1	9	2	70
Total	62	73	22	5	23	3	188

Number of students who had obtained Master's or Doctor's Degree in 2013 is as follows.

Field Degree	Science	Engineering	Engineering Science	Pharma- ceutical Science	Information Science and Technology	Frontier Biosciences	Total
Doctor Degree	5	11	0	0	1	0	17
Master Degree	15	23	0	1	4	0	43
Total	30	34	0	1	5	0	60

3. International Exchange

1) Exchange Agreement

At Present, academic exchange agreements are concluded with the following 27 organizations.

- Faculty of Natural Science, Otto-von-Gueriche University Magdeburg (Germany)
- Pukyong National University, Basic Science Research Institute (Korea)
- Forschungszentrum Jülich GmbH (Germany)
- University College London (U.K.)
- College of Natural Sciences, Pusan National University (Korea)
- Research Institute of Industrial Science, Hanyang University (Korea)
- College of Science, National Taiwan University (Taiwan)
- Centre National de la Recherche scientifique : CNRS (France)
- Rwth Aachen University (Germany)
- College of Natural Science, Chungnam National University (Korea)
- Peking University, The School of Electronics Engineering and Computer Science (China)
- College of Science, National Taiwan Normal University (Taiwan)
- Faculty of Science, University of Geneva (Switzerland)
- Inner Mongolia Normal University (China)
- College of Science and Technology, Korea University (Korea)
- Department of Physics, Indian Institute of Technology Delhi (India)
- University of Augsburg (Germany)
- Kyungwon University, Gachon BioNano Research Institute (Korea)
- College of Computer Studies, De La Salle University (Philippine)
- School of Environmental Science and Engineering/Department of Chemical Engineering, Pohang University of Science and Technology (Korea)
- Department of Chemistry, Korea Advanced Institute Science and Technology (Korea)
- Faculty of Science, Assiut University (Egypt)
- Interuniversity Micro Electronics Center (Belgium)
- University of Bordeaux 1 (France)
- Faculty of Chemistry, Bielefeld University (Germany)
- The Biotechnology Institute, University of Minnesota (U.S.A)
- Korea Institute of Ceramic Engineering and Technology (Korea)

2) Foreign Researchers and Students

Number of foreign researchers and students staying in ISIR as of March 31, 2013 is 92 in total. Details are, Assistant Professor(include of specially appointed staffs) (9), Specially Appointed Researcher(10), Part-time Employee (21), Graduate Students (39:Doctor Course,22, Master Course,17),Distinguished Research Student(4). Their nationalities are: China(35), Korea(15), Thailand(5), Philippine(4),India(4),Indonesia(4), Viet Nam(4), Bangladesh(4), Russia(3), Taiwan(2), France(2), Mexico(2), U.S.A.(1), Brazil(1), Germany(2), Myanmar (1) ,Malaysia (1), Egypt(1),Turkey(1),Costa Rica(1)

Foreign visitors in 2012 are as follows:

Germany (14), Korea (12), China(10) , U.S.A. (9), Belgium(8), France(6), Italia(3), India(2), Nepal(1),Bangladesh(1), Malaysia (1), Hong Kong(1), Canada(1), Mexico(2), Indonesia(1), Thailand(1), Netherland(1), Croatia(1),Slovak(1), Finland(1), Australia(1), New Zealand (1), Egypt(1)

Total 80.

3) International Conferences and Symposiums

Number of presentations (plenary, invited, oral and poster in various international conferences and symposia) by staff of ISIR is 689 in total.

Number of ISIR staffs who have been working as committee members of International Conferences or Editorial Board of international academic journals are 203 in total. For more details, see the part of activity of divisions and facilities.

4. Concluding Remarks

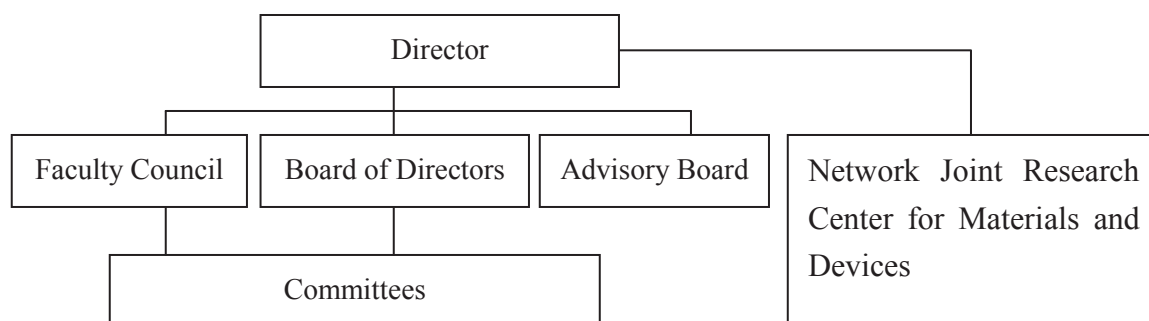
(1) Organization and Management System

After the reorganization in April 2009, ISIR has three major research divisions, Division of Information and Quantum Sciences, Division of Materials and Beam Sciences, and Division of Biological and Molecular Sciences, and one permanent research center "Nanoscience and Nanotechnology Research Center". In addition, ISIR contains two divisions for special purposes named "Division of Next Industry Creation" and "Division of Special Project Research". The latter division contains independent laboratories supervised by associate professors with limited terms selected from young assistant professors of ISIR for promotion of young scientists. ISIR also has two research supporting centers, "Comprehensive Analysis Center" and "Research Laboratory for Quantum Beam Science". Inter-institute project research, "Materials Science & Technology Research Center for Industrial Creation" and "Post-Silicon Materials and Devices Research Alliance" has been successfully finished in 2009 and

the new inter-institute collaboration named “Strategic Alliance Project for Creation of Nano-Materials, Nano-Devices and Nano-Systems” on the basis of the Network Joint Research Center for Materials and Devices has been started in 2010. In the ISIR, the following facilities are also installed; Workshop, Office of Information Network, Laboratory of Radio-isotope Experiments, Library, Academia-Industry Relation Office, Public Relations Office and Technical Division.

Management of ISIR is performed by the Director and the Board of Directors supervised by the Faculty Council composed of all ISIR professors. Advisory Board has been set up to introduce opinions from outside into the Institute. Advisory Board has been set up to introduce opinions from outside into the Institute.

【Management Organization of ISIR】



(2) Research Activities

In 1997, Harmonized Materials Research Group was designated as one of the Centers of Excellence (COE) of Ministry of Education, indicating the high research activity of the Institute.

From 2002 through 2006, we have awarded as the best group in 21 Century COE program that is originally the top 20 group plan in Japan. This involves the positive exchange between different laboratories which yield results of the global level with respect to material, information and biotechnology.

In 2005, Materials Science & Technology Research Center for Industrial Creation has launched as a joint center between ISIR and Institute of Multidisciplinary Research for Advanced Materials, Tohoku University. It was expanded to Post-Silicon Materials and Devices Research Alliance for collaboration with four university institutes in 2006.

In 2010, nationwide Network Joint Research Center for Materials and Devices including five university institutes has been started. ISIR is a headquarters of the network.

In 2011, Research Collaboration Agreement was reached between Interuniversity

Microelectronics Center(imec) and ISIR.

ISIR's research environment as facilities and equipments has been becoming better. A new building was constructed in 2001 and 2003 to the increased number of scientists and the development of Nanotechnology, respectively and Nanoscience and Nanotechnology Center started in April 2002. In addition, the total repair of the old buildings into the earthquake-resistant structures has been completed in 2010. A new building named "SANKEN Incubation Building" has been completed in 2010 for open innovation by academia-industry collaboration.

(3) Education

Considering objective of ISIR, supporting the graduate and undergraduate education is one of the important missions.

ISIR has about 200 graduate students coming from 6 different graduate schools and faculties such as Science, Engineering, Engineering Science, Pharmaceutical Science, Frontier Biosciences and Information Science and Technology.

In 2009, we have set up the Centre for Research Education and Training in order to promote the ISIR original education on research. We already have ISIR original lecture "Nano Engineering" in Graduate School of Engineering. We aim to expand the ISIR original lectures authorized by various graduate schools in Osaka University as a sub-program.

The Sanken Techno-Salon is one of forums to exchange information between our staffs and the people from industries specializing in electronics, organic chemicals, semiconductors, drugs, etc. We have also seminars for providing seeds of new technologies to the industrial communities. We aim to grow researchers and students with the best humanity, capable of innovation of their specific fields of research from basic point of view.

(4) Contribution to Societies

As the fast-paced advancement of science and technology and the rapid alteration of social and industrial structures, we must further recognize as the Institute open to society and industry. We consistently strive to deepen our cooperation with society through positively opening of facilities, intellectual properties and achievements to meetings (ex. Sanken Techno Salon), publications and website. Through them, we will be able to transfer our industrial seeds for new technology and exchange ideas for new materials. They have been highly evaluated that we have done joint researches with other university/industry.

In April 2006, AIR-office (Academia Industry Relations Office) has been settled in order to strengthen cooperation between the Institute and industries.

In 2008, Research Association of Industry and Science (RAIS), which is ISIR-supporting association having a history of 70 years, was reorganized, set up bureau office in ISIR and the bureau chief was adopted in order to promote and support the academia-industry cooperation.

In 2010, “Company Research Park” opens in the new SANKEN Incubation Building as Osaka University’s first rental laboratories for business enterprises.

(5) International Exchange

International Exchange is one of indispensable elements for our Institute. We are trying to open the door widely to invite more researchers and students from other countries, and we have 3 kind of international exchange, academic exchange, student exchange and branches in France and USA. At present (March, 2012), 83 foreign researchers, students and others join in the Institute. International Conferences sponsored by our Institute have been held twice a year since 1998. It’s so important to release our results towards all over the world and have a chance to exchange opinions with foreign scientists.

In 2009, International Collaboration Center was started for promoting the foreign exchange. The center consists of several collaborative laboratories between foreign universities have been set up or in preparation as follows: ICT Collaborative Laboratory between the School of Electronics Engineering and Computer Science, Peking Univ. and ISIR, Collaborative Laboratory between College of Science and Technology, Korea Univ. and ISIR, and Collaborative Laboratory between Faculty of Mathematical and Physical Sciences, Univ. College of London and ISIR in Areas Relating to Excited Surface Science.

(6) Future Plan and Prospect

In 2010, nationwide “Network Joint Research Center for Materials and Devices” has been started. It is a greatest collaboration network between university institutes in Japan. ISIR plays a leading role in the network as the headquarters. At the same time, our SANKEN Incubation Building was opened for the core of academia-industry collaboration.

In 2011, the time has come to advance to the next step for ISIR. We promoted international collaboration with imec for open innovation. In order to respond with flexibility to our quickly changing society, along with the rapid development of science

and technology, we must understand our role of society and in order to stay effective and relevant Institute for industries, we must make independent researches and release widely our intellectual properties and achievement.

Keeping development of science and technology in Japan, we must cultivate researchers capable of producing academic and professional results that will benefit the people living on this planet. ISIR grow researchers and students who can active in the world.

You can see about ISIR on the following URL. (<http://www.sanken.osaka-u.ac.jp/>) The Institute of Scientific and Industrial Research keeps making efforts toward higher level contribution to science and industries, and keeps learning.

Activities of Divisions

Division of Information and Quantum Sciences

Outlines

The advent of the digital society where tremendous amount of information is electronically accessible has brought the intelligent information processing technologies indispensable. This division consists of eight departments; Information Science Departments (Knowledge Systems, Intelligent Media, Architecture for Intelligence, Reasoning for Intelligence), Quantum Science Departments (Photonic and Electronic Materials, Semiconductor Electronics, Advanced Electron Devices, and Quantum Information Photonics [Alliance Laboratory of ISIR, Osaka Univ. and RIES, Hokkaido Univ.]). The former four and the latter four departments aim to establish fundamental techniques to support the advanced digital society in terms of software and hardware technologies respectively. The departments on the former software technologies work on the task of computerizing the intelligent human information processing capability to help solving difficult engineering problems and assist intellectual activities. The departments on the latter hardware technologies pursue various approaches in the fields of electronic materials design and tailoring, surface physics, nanometer scale materials fabrication and characterization, semiconductor nanostructures for quantum devices, semiconductor-based new bio/chemical sensors, organic materials and biomolecules

We challenge to output world-widely significant achievements under our systematic cooperation, and further collaborate with researchers of domestic and overseas universities, research institutes and private companies. Moreover, we educate many graduate students belonging to Graduate School of Science (Department of Physics), Graduate School of Engineering (Department of Electrical, Electronic and Information Engineering, Department of Applied Physics), Graduate School of Engineering Science (Department of Materials Engineering Science), and Graduate School of Information Science and Technology (Department of Computer Science, Department of Information and Physical Sciences) under the aim to grow young researchers having both advanced knowledge and wide research scopes.

Achievements

- * Crystal growth, characterization and device application of new semiconductors
- * Quantum nanodevices and biosensor application using graphene and nanochube
- * Development of solution-crystalized organic transistors with the highest mobility
- * Development of a goal-oriented tablet-style knowledge browsing tool and its deployment in practical training of novice nurses in a hospital
- * Dense 3D Reconstruction Method Using a Single Pattern for Fast Moving Object
- * Introduction of sensors to Constructive Adaptive User Interfaces
- * Knowledge discovery from complex data, causal analysis and combinatorial discovery
- * The photonic quantum circuit combining single-photon-level optical nonlinearities.

Department of Photonic and Electronic Materials

Associate Professor: Shigehiko HASEGAWA
Assistant Professor: Shuichi EMURA
Assistant Professor: Yi-Kai ZHOU
Post Doctoral Fellow: Daivasigamani KRISHNAMURTHY
Graduate Students: Kotaro HIGASHI
Junichi KUKUCHI
Masaru YONEOKA, Mariko KIMURA
Masaaki SANO, Sota SANO, Akihiro YAMAGUCHI
Undergraduate Student: Nurassyakirin BIN HASBI
Support Staff: Ikuko ISHITANI

Outlines

The department of Photonic and Electronic Materials makes research on materials, mainly semiconductors and related materials, and processing on them. Four steps are required in materials research, that is, materials design, materials synthesis (crystal growth) and processing, materials characterization, and device application. In materials design, study on finding required characteristics by changing the combination and ratio of atoms is conducted. In materials synthesis, study on molecular-beam epitaxy growth is mainly carried out. In materials characterization, structure investigation by electron diffraction, X-ray diffraction, STM, EXAFS and Raman scattering, optical characterization by photoluminescence, optical absorption and so on, electrical characterization by Hall measurement, and magnetic characterization by SQUID are carried out. In device application, basic researches on photonic devices, electronic devices, and spintronic devices are conducted.

Current Research Projects

1. Crystal Growth and Properties of Diluted Magnetic Semiconductors

Diluted magnetic semiconductors are gathering great interest as a candidate for new functional materials. In 2012, GaDyN-based double-barrier magnetic tunnel junctions (DB-MTJs) were grown by radio frequency plasma assisted molecular beam epitaxy (RF-MBE). GaDyN-based DB-MTJs with the 3-, 5-, and 8-nm-thick middle magnetic layers were grown. It was confirmed that the Dy ions were incorporated into the Ga sites by the x-ray absorption fine structure (XAFS) analysis and no secondary phase such as DyN can be observed by X-ray diffraction (XRD) measurement. The PL spectra of the DB-MTJs sample with 5-nm-thick middle magnetic layer and the GaN template at 4K are shown in Figure 1. Compare to strong PL spectrum from GaN template, a sharp peak at 390 nm was observed. This new peak was assigned from structure defect caused by large radii of Dy ions in the GaN. Ferromagnetic behavior was confirmed for the samples at room temperature. Figure 2 shows the saturation magnetization as a function of the middle GaDyN layer thickness. Circle indicates the magnetic field applied in-plane and triangle is perpendicular to the sample surface. It is found that the magnetization per unit volume show a change with increase the thickness of the middle GaDyN layer. This phenomenon suggests that interlayer interaction is found to be existing in the GaDyN/GaN DB-MTJs structure at room temperature.

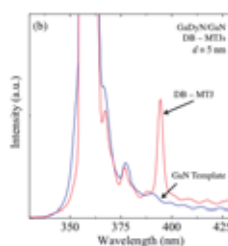


Figure 1: PL spectra for the DB-MTJs.

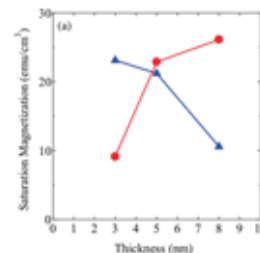


Figure 2: Saturation magnetization for the DB-MTJs samples.

2. Spin Injection from Ferromagnets into III-Nitride Semiconductors and Nanoscaled Characterization of Their Magnetic Properties

Spin injection from ferromagnets into III-Nitride semiconductors and dilute magnetic semiconductors (DMSs) is a very important subject to realize semiconductor spintronic devices as well as to investigate magnetic properties of DMSs using spin-polarized scanning tunneling microscopy (SP-STM). SP-STM was used to investigate current-voltage (I-V) characteristics of Fe islands epitaxially grown on GaN. It was found that tunnel magnetoresistance images of Fe islands derived from the I-V characteristics reflected the direction of their magnetization. In 2012, we grew and characterized Fe₄N on GaN as one of promising novel materials for ferromagnetic electrodes to GaN. It was found that γ' -Fe₄N was grown on GaN with the epitaxial relationship of GaN(0001)[11-20]//Fe₄N(111)[1-10]. STM measurement revealed that the γ' -Fe₄N epitaxial layer surfaces were atomically flat. In addition, the γ' -Fe₄N epitaxial layer showed ferromagnetism at room temperature. The saturation magnetization M_s was about 1500 emu/cm³, the coercivity was about 100 Oe, and the ratio of remanent magnetization M_r to M_s was 85%. Considering the recent theoretical prediction that γ' -Fe₄N has half metallic band structures, the present findings provide the evidence that γ' -Fe₄N is one of promising materials for ferromagnetic electrodes as spin injectors into III-nitride semiconductors.

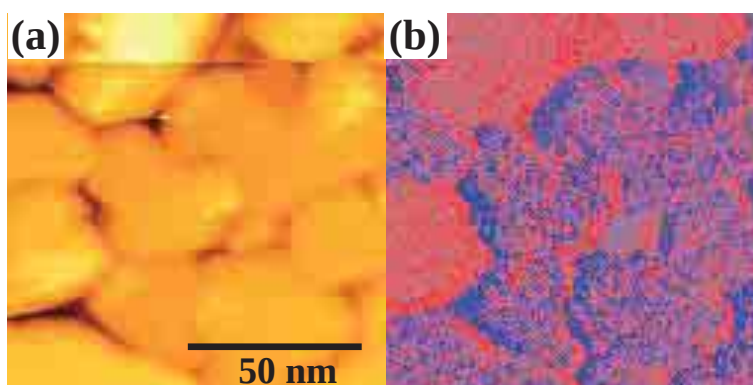


Figure 3: Topographic (a) and tunnel magnetoresistance (b) images of Fe islands

3. XAFS Characterization of New Functional Materials

XAFS and XANES are spectroscopy-based new characterization techniques for analyzing atomic scale structures of materials and is only one technique directly analyzing the atomic arrangements/coordination for amorphous materials as well as very low density elements in materials. Furthermore, this research technique also has an advantage of specific element selectivity. The atomic arrangements/coordination in the new functional materials, GaCrN and GaGdN, has been characterized and it was showed that the Gd (Cr) atoms substitutionally occupy the group III sites. In 2010, GaGdN/AlGaIn and GaDyN/AlGaIn multi-quantum well (MQW) structures and the MQW in rod form including Gd or Dy are vigorously examined on the coordination of Gd (Dy) by the XAFS and XANES method. As the new results, i) we found the gettering effect in the GaDyN/AlGaIn MQW structures. The doped ion Dy is favorable to gather at the interfaces of GaDyN and AlGaIn. ii) A vacancy of nitrogen ion adjacent to the Gd ion was found from the analysis of XANES spectrum. The simulation of the XAFS spectra around the Gd L_{III} -edge indicates the nitrogen vacancy at the one of the three equivalent legs. This effort opens the new technique to identify the vacancy and to decide the coordination environment of the vacancy. Now, we push forward elaboration and generalization in this technology more.

Department of Semiconductor Electronics

Professor: Kazuhiko MATSUMOTO
Associate Professors: Koichi INOUE, Kenzo MAHASHI
Assistant Professor: Yasuhide OHNO
Post Doctoral Fellows: Takafumi KAMIMURA
Guest Researcher: Masato MIYAKE
Graduate Students: Yusuke YAMASHIRO, Shogo OKAMOTO, Kenta GUMI,
Yusuke FUJII, Takashi IKUTA, Keisuke KOSHIDA
Nursakinah Binti Mohd Zaifuddin
Under Graduate Students: Kohei SEIKE, Masatoshi NAKAMURA
Supporting Staff: Reiko YAMAUCHI

Outlines

Semiconductors quantum structures, where electrons and photons play remarkable roles owing to quantum effects, are expected to show superior properties. We study the basic problems in the fabrication and the characterization of such quantum structures in the atomic scale. The research activities include applications to new devices based on the quantum effects with the coherent ballistic transport of carriers and electron-photon interactions.

Carbon nanotubes (CNTs), especially single-walled carbon nanotubes (SWNTs), and single-layer graphene, are promising materials to realize quantum-effect devices because of their unique nano-structures. As a sensor of single charge or spin with the high sensitivity, the formation and characterization of field-effect transistors (FETs) and single-electron devices using carbon nanotubes and graphene are studied using thermal chemical vapor deposition method, Raman scattering spectroscopy, scanning probe microscopy, and photoluminescence spectroscopy.

Current Research Projects

Immunosensors Based on Graphene Field-Effect Transistors Fabricated Using Antigen-Binding Fragment

To realize the antigen-antibody reaction for specific protein sensing using graphene field-effect transistors (G-FETs), the antigen-binding fragment (Fab), which is a component of conventional antibodies, was functionalized onto the graphene channel surface. Since the height of the Fab is approximately 3 nm, the antigen-antibody reaction is expected to occur inside the electrical double layer in the buffer solution. After functionalization of Fab onto the

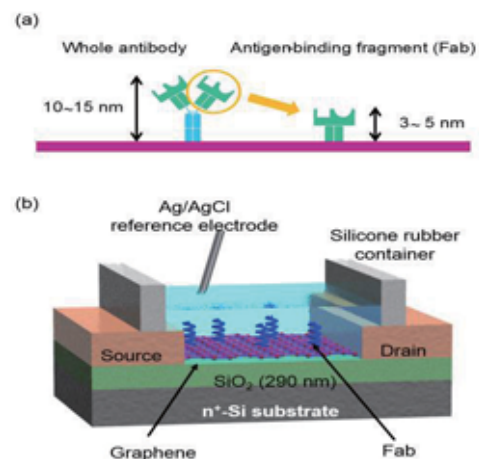


Fig. 1. Schematic illustration of (a) whole antibody and antigen-binding fragment (Fab) and (b) electrolyte-gated CNTFET sensor

G-FET, the transfer characteristics shifted in the positive gate-voltage direction, indicating that the Fab was successfully modified onto the graphene surface. Then, the drain current changed after injecting the target proteins, and the dissociation constant was estimated to be 2.3 nM from the concentration dependence. These results indicate that the Fab-modified G-FETs have high potentials as highly sensitive biological sensors fabricated on the basis of the antigen-antibody reaction.

Carbon Nanotube-Based Floating Gate Memory

Carbon nanotube (CNT)-based floating gate memory with high-k dielectrics was fabricated for low-power-consumption devices owing to increase the electric field intensity in the tunneling layer of memory devices. The memory with high-k dielectrics of Al_2O_3 layer achieved larger hysteresis as compared to the memory with SiO_2 layer. The results were well explained by simple electric field calculations using cylindrical capacitor model. Furthermore, memory operation at lower pulse-voltage was

demonstrated based on the memory with Al_2O_3 layer. The results indicate that CNT-based floating gate memory with high-k dielectrics is a promising candidate to fabricate low-power-consumption memory.

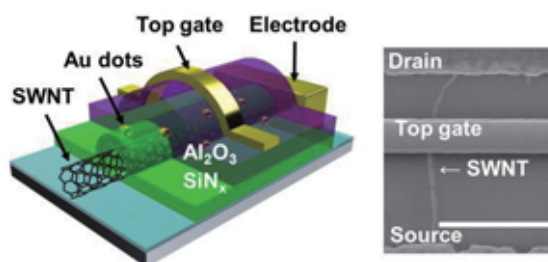


Fig. 2. Schematic of floating-gated CNTFET memory and (b) SEM image of SWNT bridging source and drain electrodes.

Sensor Applications Based on Chemical Vapor Deposition-Synthesized Graphene

We have successfully fabricated a pH-sensor array based on chemical vapor deposition (CVD)-synthesized graphene. As large scale monolayer graphene is synthesized by using this method, the size and the position of graphene can be controlled. Therefore, after transferred the graphene onto SiO_2/Si substrates, graphene field-effect transistor (FET)-array was produced. Sensing characteristics of CVD-synthesized graphene-based device were investigated using three buffer solutions with different pH value. The electrical measurements reveal that most of graphene FETs show the similar characteristics where the drain current increases stepwise with increasing pH value. This will lead to the realization of the fabrication of multiplex hand-held chemical and biological sensors based on CVD-synthesized graphene.

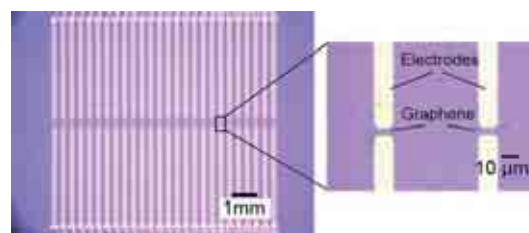


Fig. 3. Optical image of fabricated graphene-FET array.

Department of Advanced Electron Devices

Professor:	Jun TAKEYA
Associate Professor:	Koichi SUDOH, Toshihiro OKAMOTO
Guest Associate Professor:	Mayumi UNO
Assistant Professor:	Takafumi UEMURA
Specially Appointed Assistant Professor:	Chikahiko MITSUI
Research Fellow:	Ken-ichi Sakai, Wei Ouyang, Masakazu YAMAGISHI, Yugo OKADA, Kazumoto MIWA, Yuri HIROSE
Research Assistant:	Naoko NANBA, Yuki TANAKA, Kazumi YOSHIMOTO
Graduate Students:	Kengo NAKAYAMA, Katsumasa NAKAHARA, Junshi SOEDA, Kenjiro MIYAKE, Shin KITAOKA
Supporting Staff:	Satoko TSUCHIYA, Midori FUJII

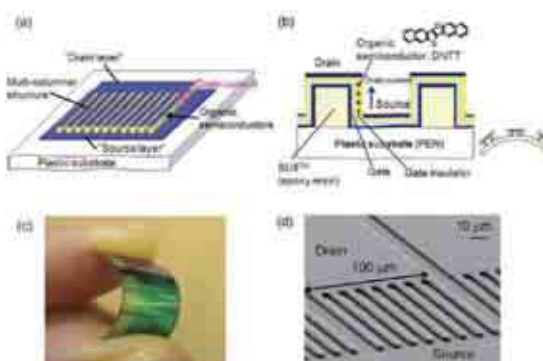
Outlines

Facing to the global environmental change and rapidly aging society in many countries, innovative technologies are anticipated to emerge in order to sustain our comfortable way of living even in such circumstances. Next-generation electronic devices, therefore, are required to diverse functions to help human life minimizing their burden to the environment in their production processes. Organic electronics are attracting much attention as a practical candidate to meet the requirement because such devices can be fabricated by printing at a low cost without processes at high temperatures. In addition, their mechanical flexibility appends further attractiveness, enabling unique devices that fit human shapes, for example. In Department of Advanced Electron Devices, we have been developing new organic transistors and organic photovoltaic cells, which are two of the fundamental devices for organic electronics.

Current Research Projects

High-Speed Flexible Organic Field-Effect Transistors with a 3D Structure

High-speed, flexible organic field-effect transistors with a 3D structure are fabricated on a plastic substrate in which vertical channels are formed to realize high response speed. With the benefit of short channel lengths, the fabricated transistors show fast dynamic switching within 250 ns, which corresponds to 4 MHz operation, even with the modest carrier mobility of $0.2 \text{ cm}^2/\text{Vs}$ in organic semiconductors deposited on the vertical sidewalls.



Air-Stable and High-Performance *n*-type OFETs

High-mobility and air-stable *n*-type organic field transistors based on solution-crystallized N,N'-1H,1H-perfluoro-butylidicyanoperylene carboxydi-imide (PDIF-CN₂) are developed. Electron mobility as high as 1.3 cm²/Vs is achieved owing to the almost-perfect periodic crystal packing. In Addition, a complementary-inverter circuit using the solution processed OFETs is demonstrated. For the *n*-type transistor, the present PDIF-CN₂ device was utilized. A p-type transistor of a solution-crystallized C₈-BTBT OFET was also fabricated using a solution-crystallized method. A typical inverter response with high DC gain was observed.

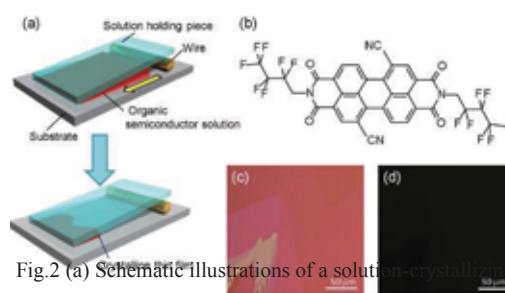
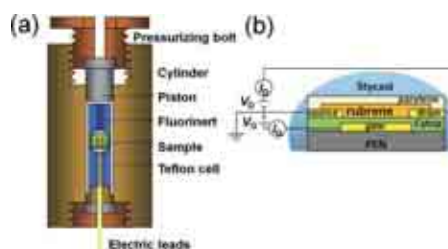


Fig.2 (a) Schematic illustrations of a solution-crystallizing method. (b) Molecular structure of PDIF-CN₂ (c, d) Optical and polarized microscope images of a PDIF-CN₂ crystalline film.

Charge Transport Properties of Organic Semiconductor under High Pressure

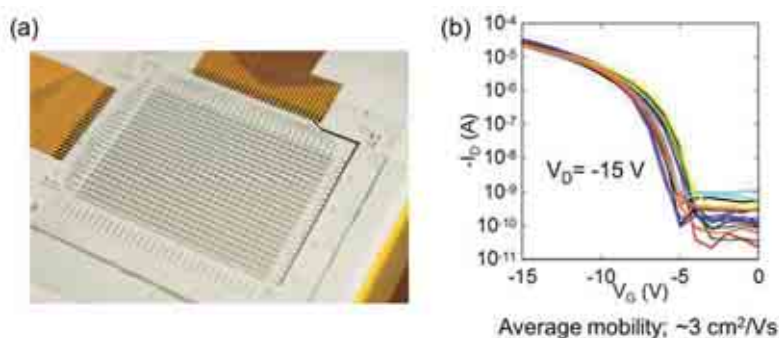
The method of studying the effect of hydrostatic pressure on organic semiconductors is established employing precise measurement of both four-terminal conductivity and Hall coefficient on high-mobility rubrene single-crystal transistors. It turned out that enhanced intermolecular charge transfer causes an increase in the mobility of the bandlike charge carriers by 20% GPa up to 600 MPa, which is typically one order of magnitude larger than that in inorganic semiconductors.



cell (b) Device structure of Rubrene FETs

Solution-Processed Organic Active-Matrix Backplane for Driving LC Display

Organic field-effect transistors are regarded as an important technology for a broad range of applications such as flexible displays and other large-area imaging devices. In this study, organic active-matrix backplane for driving a LC display are demonstrated with high-mobility solution-crystallized organic transistors. The size of the display is 2.3 inch in diagonal. The number of pixels is 30 × 23 and the pixel size is 1.5 mm × 1.5 mm. The pixel transistors are made by air-stable compound of 2,9-didecyldi-naphtho [2,3-b:2',3'-f]thieno[3,2-b]thiophene with a solution-crystallized method. Average mobility of pixel transistors is about 3 cm²/Vs, which is the fastest switching performance among the reported organic active matrix backplanes.



(b) Transistor characteristics of pixel transistors.

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Outlines

The studies in this laboratory focus on computer vision and media processing including basic technologies such as sensor design and camera calibration, and applications such as an intelligent system with visual processing functions. Some of our major research projects are development of a novel vision sensor, including an omnidirectional mirror, calibration of an omnidirectional vision system, video analysis for endoscopic diagnosis assistance, measurement of detailed reflectance properties, gait identification, modeling of environments.

Current Research Projects

Person Re-identification using Score-level Fusion of Color and Gait Features

In this research, we propose a method of person re-identification using STHOG feature and color feature. Matching scores for both features are calculated with phase synchronization and they are fused by linear-logistic regression by considering



Fig. 1. Person re-identification result

the observation views. We confirmed the effectiveness of the proposed method by experiments using public gait database and gait images originally captured in the university (Fig. 1).

Gait-based Person Authentication by Wearable Cameras

In this paper, we propose a gait-based person authentication by wearable cameras (Fig. 2), and evaluate its accuracy. In contrast to previous methods using motion sensors, we utilize wearable cameras for personal authentication by examining motion during walking obtained from visual information. This motion appears to provide a valid representation of the gait of the wearer. The performance of our method was experimentally evaluated with 39 subjects, revealing an EER of 5.6%.

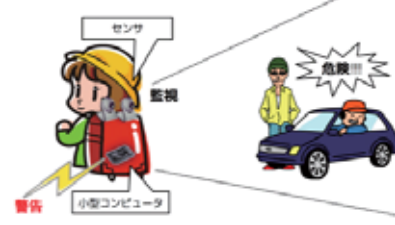


Fig. 2. Wearable sensor-based surveillance

Enhanced Photometric Stereo with Multispectral Images

We introduce a technique based on multispectral images aimed at improving Lambertian photometric stereo. Many photometric stereo algorithms assume Lambertian reflectance, but deviations from this ideal produce errors in shape reconstruction. To alleviate this problem, we exploit the wavelength-dependence of material reflectance. Based on the observation that reflectance at certain wavelengths for a given object is more Lambertian than at others, we propose a method for identifying such wavelengths by a matrix rank analysis, and use them to achieve more accurate photometric stereo (Fig. 3). We merge reconstruction results from different wavelengths to produce the final surface normal map.

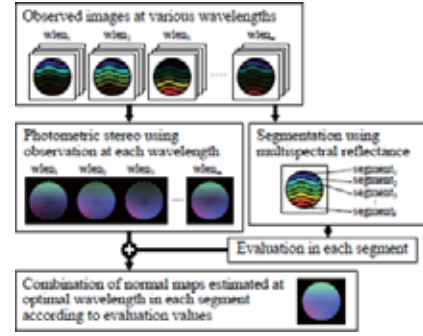


Fig. 3. Multispectral photometric stereo

Point Cloud Transport

In this paper we propose a method for temporal interpolation of a point cloud undergoing occlusions and topological changes. The point cloud is first merged into fine clusters, which are then further merged into coarse clusters for each source and target shape. In conjunction with trash box bins to cope with occlusions, a coarse correspondence between a source and a target shape is found that minimizes the transportation cost in the earth mover's distance framework. Subsequently, a fine correspondence is found in a similar way based on the coarse correspondence constraint to suppress locally isolated motion. Finally, the source and target point clouds are transported based on the fine correspondence. Experiments with point cloud sequences captured by a Kinect range finder show promising results.

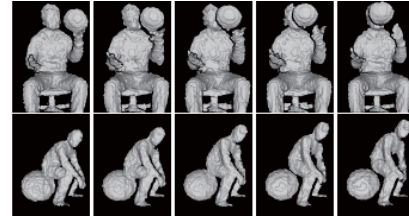


Fig. 4. Result of point cloud transport

Department of Reasoning for Intelligence

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Outlines

We, humans, extract variety of knowledge from given data by the full use of our reasoning. However, such reasoning ability of humans is so limited that most of the massive and complex data, called “big data,” acquired through computer network are wasted without any humans' inspection. To provide efficient remedies to this difficulty, our department studies novel reasoning approaches to extract knowledge from the big data by using computers. These techniques are named data mining and machine learning. We also study the application of these techniques to variety of fields such as science, information network, quality/risk management, medicine, security, marketing and finance. Currently, we work on the following four research projects.

Current Research Projects

Knowledge discovery from extremely high dimensional data

Data consisting of massive variables (extremely high dimensional data) representing numerous events and/or states became available by developments of computer network, ubiquitous sensing and scientific measurement technologies. Examples are sales data of a large scale shopping center under various conditions, global climate data consisting of various and massive meteorological measurements and the profile data of thousands of gene expressions in biological systems. We study novel techniques to estimate some important information and discover useful knowledge from such data acquired from large scale and complex structured systems. In this year, we studied an advanced Monte Carlo method for probabilistic search, reasoning and estimation in data and state spaces having thousands of dimensions. Based on this technique, we also investigated a new method for discovering and estimating rare events which occur with very low probabilities, and obtained more efficiency and accuracy than the conventional methods.

Knowledge discovery from graph sequence data

A graph is a powerful data expression that can be used to represent arbitrary

relations among entities. In addition, graph sequences can be used to model dynamic changes of objects for many real world applications. For example, in a transition-based parser of Natural Language Processing, a transition sequence can be represented by a graph sequence where each graph, vertex, and edge respectively correspond to a state, word, and dependency. In this year, we developed methods for mining rules for rewriting from states reaching incorrect final states to states reaching the correct final state, and developed methods for adequately applying the rules using a machine learning method for dependency analysis of Japanese and English sentences. In addition, we confirmed that our methods using the rules retains the advantage of the transition-based dependency parser that is the linear time complexity and improves the parsing accuracy.

Discovering hidden causal structures in data

We develop advanced statistical methods for discovering useful causal structures in data. Such a causal structure is estimated in the form of a graph or a diagram that graphically represents causal relations in an objective system so that it is easily understandable by application experts. The key idea is to extract considerably more information from data than conventional approaches by utilizing non-Gaussianity of data. The idea of non-Gaussianity distinguishes our research from previous works on this line. A promising application is neuroimaging data analysis such as functional magnetic resonance imaging (fMRI) and magnetoencephalograph (MEG). Our method can be applied to brain connectivity analysis. One could model the connections as causal relations between active brain regions. Gene network estimation from microarray data in bioinformatics would be another promising application. Our framework also is a new useful alternative to financial data analysis in economics and traditional questionnaire data analysis in psychology and sociology. In this year, we developed a method for learning causal orders that is robust against latent confounders. Existence of latent confounders is a major difficulty in causal discovery. We proved the validity of the new method under much weaker assumptions than previous works.

Combinatorial approach to knowledge discovery from high-dimensional data

Against a backdrop of accelerating progress of data acquisition technologies, there are more scenes where we deal with high-dimensional data in a variety of engineering problems, such as bioinformatics, natural language processing and image data processing. Such data processing often requires combinatorial computation, where we select the subset of all dimensions that optimizes some criteria. One example is the problem where we seek to find a small number of genes most related to some disease or symptom in gene sequence data consisting of a huge number of genes. But this kind of computation often becomes intractable in practice because of combinatorial explosion caused by the high-dimensionality of data. In this year, we developed a formulation that can incorporate prior information on combinatorial structures in problems into its calculation and developed efficient algorithms applicable to such problems based on discrete structure of data, especially submodularity (discrete convexity). And, we aimed at discovering important knowledge in a variety of applications by applying the developed algorithms to real-world data.

Department of Knowledge Systems

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Outlines

This division has been run under the philosophy that it contributes not only to the promotion of knowledge science but also to prosperity of the real world by the feedback of the research results to it in the information era. The major topic includes an investigation of Ontological Engineering to establish basic theories and technologies for the next-generation knowledge science. The current research projects include: methodology for ontology development and its support environment based on basic theories of ontological engineering, sharing of technical knowledge, intelligent educational/training systems, and ontology-aware authoring systems. In 2011, an EU's international collaborative research project: EuJoint with distinguished researchers in ontological engineering and philosophy has been continued. By intensive discussions, we have obtained several remarkable results about the issues described below.

Current Research Projects

1. Ontology: Theoretical Foundation of Knowledge Engineering

We theorized about the fundamental issues on ontology from both scientific and engineering viewpoints. One of the most remarkable achievements is the fact that a book on "Ontological Engineering" has been published from Ohm-sha Ltd. in January, 2005 which is the first book on the topic in Japan. Furthermore, a new book "Theory and Practice of Ontological Engineering" has been published in April, 2012 which discusses the latest result on ontological theories and practical application of them. These results are implemented using HOZO, an environment for ontology building/utilization, has been developed in our department. The latest achievements include the following; 1) We developed an extended function of HOZO to publish ontologies as Linked Open Data (LOD) which is widely used for publishing and sharing data on the Web. 2) Using the function, we have published a disease ontology developed based on an ontological theory of causal chains, as LOD. It got "Life science prize" in Linked Open Data Challenge Japan 2012. 3) We developed an ontology for comprehensive systematization of abnormal states in every clinical division. 4) We developed an ontology of gene in the collaboration with experts of RIKEN. It enable us

can comprehensive conceptualization of gene which is discussed in various meanings in genomics. 5) As a part of the EuJoint project, we have investigated an innovative theory of roles by employing the notion of meta-role and on a new theory of parts. 6) We released an upper ontology named YAMATO, which we have been investigating for years, on the home page of HOZO.

2. Systematization of Functional Design Knowledge

Aiming at promotion of sharing of knowledge about functionality of artifacts among engineers, we have developed an ontology-based modeling framework. The framework has been deployed successfully in some manufacturing companies. Based on the framework, a functional knowledge externalization and sharing tool named OntoloGear was developed as a software product. We have also developed a phase-oriented model of function along the product life-cycle and an evolutionary model along the evolutionary history of creatures. In 2012, as a part of an international collaboration research, we have identified a common core definition of artifact function and biological function and jointly published the result as an international conference paper.

Furthermore, we have generalized this framework into a goal-oriented modeling framework for procedural knowledge. In the collaborative research with public hospitals, we have described models of the nursing procedures and developed a tablet-style knowledge browsing tool as described below. In addition, we have identified an essential definition of the concept of “services” and made a comprehensive evaluation of the definitions of services.

3. Methodology for Building Learning Support Systems

The goal of research on intelligent educational systems is to implement the intellectual capability of human teachers on computer systems. Huge efforts have been devoted to the research for the last two decades. However, the research field has not been growing methodologically because of lack of theoretical foundation. In this research project, we have investigated the essential structure of a variety of educational tasks in detail and have proposed of Ontology-Awareness aiming at marriage of learning and educational theories and technology. The latest achievements include the following; 1) investigations of the effectiveness of our authoring system and multi-agent system for ICT education design in lesson plan design and refinement with real teachers in Tokyo and Okayama, 2) integration of ontologies for individual and collaborative learning, and 3) bottom-up refinement of teacher-made lesson plans using semi-automatic interpretation and its evaluation.

4. Academic-Industrial Alliance for Ontology-based Application Design Theory

Along with the progress of the ontology engineering technologies for both fundamental and developmental theories, the importance of theories for ontology-based application design/development is increasing. To realize practical design/development theories for building applications, we have been promoting several academic-industrial alliance research projects. This year, we focused on an application of the procedural knowledge modeling technology described above to practical training of novice nurses. Cooperating with domain experts, we investigated problems to be solved and improved the ontology-based knowledge browsing tool on tablet computers. It has been deployed in a real training course in Osaka Kouseinenkin hospital

Department of Architecture for Intelligence

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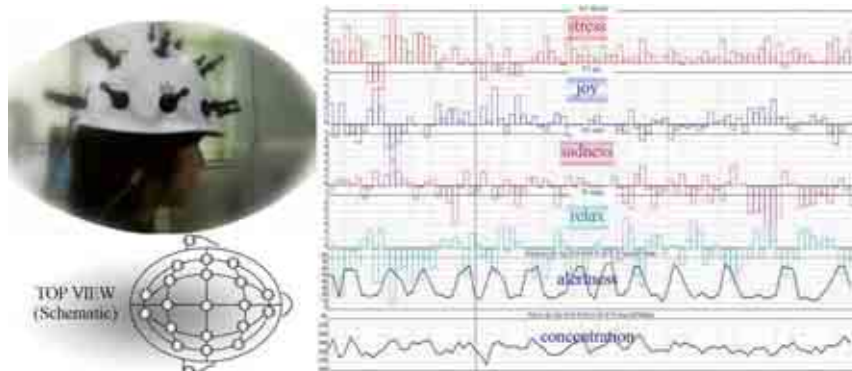
Outlines

The main research objective is to explore basic technology for computer systems, which support human learning and understanding, beyond conventional artificial intelligence. We particularly focus on the process of human-computer interaction to discover and create architecture of intelligence for such systems. We try to produce highly original research with findings from cognitive science, psychology, education, and computer science. Principal issues addressed are as follows: 1. Constructive Adaptive User Interfaces, 2. Intelligent Tutoring System, and 3. Intelligent Ubiquitous Sensor-Networks.

Current Research Projects

Constructive Adaptive User Interfaces

This department is developing a computer with learning ability, for which it researches efficient learning algorithms, acquisition of background knowledge for learning, application to Intelligent Tutoring Systems. These are applied to adaptive user interfaces. The conventional adaptive user interfaces only select a good response out of some previously given ones. Although this helps to use interfaces, such as a navigation system, it is not sufficient to stimulate human intelligence or creativity. The department has developed a method to compose a new content adaptively. This technology enables automatic acquisition of human feelings, and



automatic music composition system adapted to personality and emotion of its user.

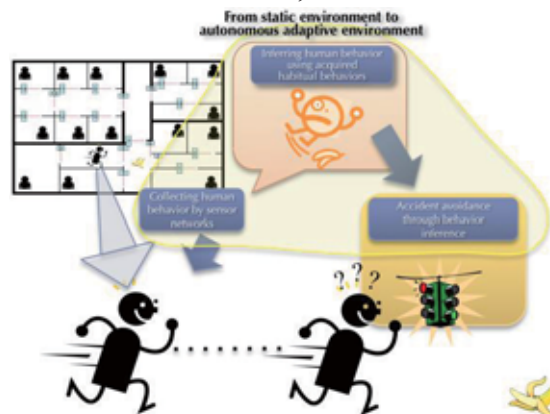
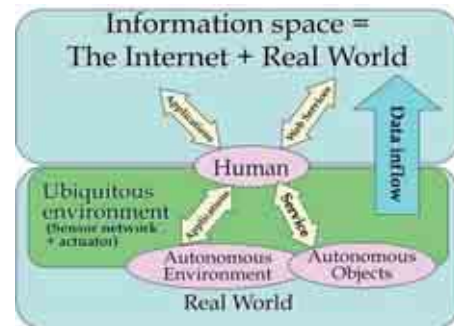
Intelligent Tutoring System

To have an instructional plan guide the learning process is significant to various teaching styles and an important task in an ITS. Though various approaches have been used to tackle this task, the compelling need is for an ITS to improve on its own the plans established in a dynamic way. We hypothesize that the use of knowledge derived from student categories can significantly support the improvement of plans on the part of the ITS. This means that category knowledge can become effectors of effective plans. We have conceived a Category-based Self-improving Planning Module (CSPM) for an ITS tutor agent that utilizes the knowledge learned from learner categories to support self-improvement. The learning framework of CSPM employs unsupervised machine learning and knowledge acquisition heuristics for learning from experience. We have experimented on the feasibility of CSPM using recorded teaching scenarios.

Intelligent Ubiquitous Sensor-Networks

In recent years, progress in computer technology, the appearance of IPv6, the development of various radio technology including IEEE802.11, and the practical use of radio-tags like RFID have greatly activated studies of ubiquitous computing like sensor-networks. But, the purpose of many proposed ubiquitous systems is to present information of the virtual-world like the Internet to humans living in the real-world by using physical properties like monitors and loudspeakers, etc. On the other hand, our purpose is to construct a framework to enable flexible and real-time interaction between humans and the real-world. Keyword is resonance. Each human has his own natural frequency, which is a metaphor for personality or daily habitual behaviors. In the proposed framework, each human behavior reacts with the environment and the environment performs sensor-data mining and extracts each human's natural frequency.

The real-world that we assume in this study is homes and offices, etc., where daily habitual behaviors of humans are easy to extract. So, we call the real-world “the environment.” The environment learns the daily habitual behaviors of each human, and performs the most suitable interaction to whoever should receive it. To embody this interaction framework, the environment must be an autonomous action entity, and it is



necessary to construct this entity as a massively multi-agent system to enable management and control of various broadly dispersed sensors and physical properties for interaction and to enable real-time interaction with humans. To begin with, we have set up several interaction devices between humans and the environment as well as various kinds of many sensors.

Department of Quantum Information Photonics

(Alliance Laboratory of ISIR, Osaka Univ. and RIES, Hokkaido Univ.)

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Post Doctoral Fellow:	Masayuki OKANO
Post Doctoral Fellow:	Shanthi SUBASHCHANDRAN (-2012.9.30)
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Outlines

By using quantum nature of light, it is predicted that we can drastically enhance the performance of information processing (Quantum Computer), secure communication (Quantum Cryptography) and even sensing (Quantum Metrology). We carry on experimental researches into the realization and the application of the novel states of light, by generating individual single photons and controlling the quantum correlation between these photons. Toward the perfect control of single photons, we investigate nano-scale photonic structures for optical quantum devices and single photon sources. Using those devices, we are constructing quantum optical systems and optical quantum circuits for quantum information processing, quantum metrology and quantum lithography. Our research topic also includes the generation and characterization of entangled photons, single molecular spectroscopy, and highly efficient single photon detectors.

Current Research Projects

Experimental demonstration of adaptive quantum state estimation

We recently succeeded in demonstrating “adaptive quantum state estimation” using photons, where measurement method of photons is optimized each time with the measurement results. Photons, generated from a heralded single photon source using parametric down-conversion, were prepared to be a specific linearly polarized state and the

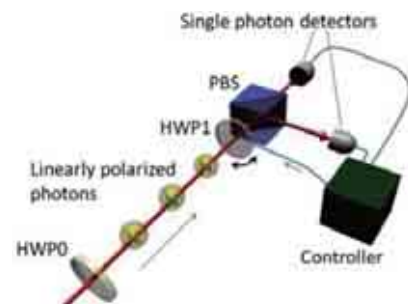


Fig. 1 : Experimental setup for adaptive quantum state estimation

polarization angle of the photon was estimated using the method. A sequence was carried out with 300 input photons and the sequence was repeated 500 times. By analyzing the experimental data, we have exactly verified the optimality of the adaptive quantum state estimation (strong consistency, asymptotic efficiency). It has been found that the precision of the adaptive quantum state estimation outperforms the conventional state tomography. It is thus expected that the adaptive quantum state estimation will provide a useful methodology in the broad area of quantum information processing, communication, and metrology.

Generation of ultra-broadband parametric fluorescence toward mono-cycle entangled photon pair source

Mono-cycle entangled photon pair is a two-photon state where two photons arrive within the ultra-short time, which is about an optical cycle. We have realized a broad parametric fluorescence. We have manufactured 10%-chirped quasi-phase matched device and realized the world-largest bandwidth (820nm-width, 194 THz in frequency) of parametric fluorescence. Figure 2 shows frequency spectra measured by a superconducting single photon detector. The observed bandwidth spans an octave from 788 nm to 1610 nm. This state lets us achieve the time correlation of 4.4 fs, which is close to mono-cycle, by our calculation with proper dispersion compensation. With these results, various applications can be expected such as ultra-high resolution of quantum optical coherence tomography.

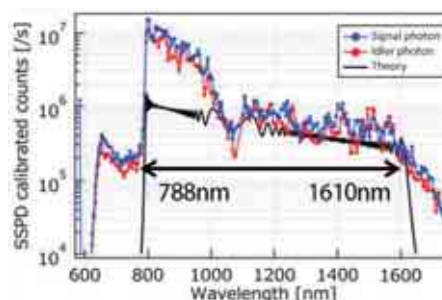


Fig. 2 : Frequency spectra of ultra-broadband parametric fluorescence

Highly efficient coupling of photons from nanoemitters to single mode fibers using optical nanofibers

Coupling fluorescence of nanoemitters to single mode fibers is very important for developing quantum cryptography network in future secure communication networks. So far, we succeeded in coupling 7.4 % of the total emitted photons from single QDs to single mode fibers by placing those QDs onto the optical nanofibers (300-nm diameter). However, these QDs have notorious drawbacks for applications to single photon sources, i.e. fluorescence intermittency and broad spectral emission line. To overcome these difficulties, we have employed nitrogen vacancy (NV) centers in nanodiamonds. NV centers are very promising nanoemitters showing blinking-free emission and life-time limited very narrow emission line. The NV-coupled nanofiber has provided 689,000 Hz single photon emission rate in the single mode fiber, the highest value ever reported.

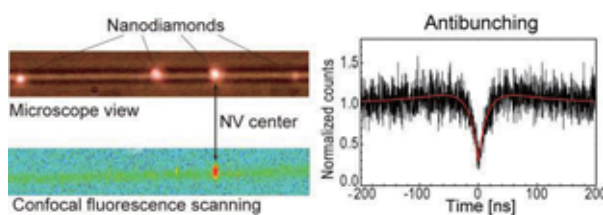


Fig. 3 : (Left) NV centers on the nanofiber and (right) the antibunching of its single photon emission.

Division of Advanced Materials and Beam Science

Outlines

This division is composed of seven departments with the following research fields: Quantum Functional Materials, Advanced Interconnection Materials, Semiconductor Materials and Processes, Metallic Materials Process, Excited Solid-State Dynamics, Beam Materials Science, and Accelerator Science. We aim to generate novel and highly functional materials, which provide basis of future developments in several important fields of information, energy, environmental and medical technologies. Emphasis is placed both on establishment of full understanding of fundamental mechanisms of the functions and on evolutionary progress of material processing, including hybridizing different kinds of materials which are well designed and controlled with respect to their structures, dimensions, and physical and chemical properties. We also aim to develop new sources of quantum beams with high brightness and quality, and use the quantum beams in a new field of beam-induced materials science.

Achievements

- Developments of topological insulators and elucidation of their basic properties
- Explorations of topological superconductors and other novel superconductors
- Fabrication of ultra-low reflectivity poly-crystalline Si surfaces by structure transfer method
- Low temperature formation of ultra-high quality SiO₂ layer by use of nitric acid oxidation method, and improvement of Si solar cell and TFT characteristics
- Development of continuous-casting technique for producing lotus-type porous metals by thermal decomposition of compound gasses
- Creation of lotus-type porous Al with high porosity
- Development of Ag-based inks and characterization of their basic properties
- Clarification of Sn whisker growth mechanism and developing high-temperature solders
- Direct observation of ultrafast structural phase transition of Si using time-resolved transmission electron diffraction
- Ultrafast dynamics of holes injected into Si valence band using two-photon photoemission spectroscopy
- Development of L-band RF photocathode
- Characterization of free-electron laser coherence
- Development of resist processes for extreme ultraviolet lithography
- Chemical reactions induced in condensed matter by quantum beam

Department of Quantum Functional Materials

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Post Doctoral Fellow:	Zhi REN, Fan YANG
Research Fellow	Mario NOVAK
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Supporting Staff:	Yukari NAKAMURA

Outlines

The research of the Department of Quantum Functional Materials focuses on growth of high-quality single crystals and top-notch transport measurements of novel materials, such as topological insulators or topological superconductors. Our emphasis is on precise and systematic measurements of basic physical properties, which allows one to unveil the peculiar electronic states of novel materials. This is achieved by combining the expertise in solid-state physics and applied chemistry. Our goal is two-fold: Creating innovative materials for solving urgent issues of the human society, while exploring fundamental new physics in condensed matter.

Current Research Projects

Basic research of Topological Insulators and Topological Superconductors

Topological insulator (TI) is an emerging class of materials that host a new quantum-mechanical state of matter where an insulating bulk state supports an intrinsically metallic surface state that is "topologically protected" by a Z_2 topological invariant. Intriguingly, the resulting metallic surface state is "helically spin-polarized" (i.e., right- and left-moving electrons carry up and down spins, respectively) and consist of "massless Dirac fermions" (i.e., the energy of quasiparticles is linearly dependent on the momentum). Those peculiar properties of the surface state open exciting new opportunities for novel spintronics devices with ultra-low energy consumptions. Even more exotic state of matter is a topological superconductor, which is predicted to bear Majorana fermions on the surface. Majorana fermions are peculiar in that the particles are their own antiparticles, and they were originally conceived as mysterious neutrinos. Currently their realization in condensed matter is of significant interest because of their novelty as well as the potential for quantum computation.

1) Achieving surface quantum oscillations in topological insulator thin films of Bi_2Se_3

We have developed a new protocol for the MBE-growth of the prototypical topological insulator Bi_2Se_3 and succeeded in growing world-best thin films (in terms of the size of the atomically flat terraces and transport properties) of this material. Our films are of sufficiently high quality to consistently present Shubnikov-de Haas oscillations, which has so far been difficult to achieve in topological insulator

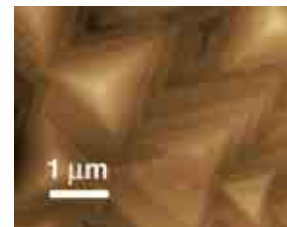


Fig. 1 AFM image of a Bi_2Se_3 thin film grown by MBE. Large, atomically flat terraces demonstrate its high quality.

thin films.

2) Demonstration of the "topological protection" in transport properties of epitaxial Bi_2Se_3 thin films

We have discovered in topological-insulator thin films that the metallic transport through the topological surface state is suddenly diminished when the film thickness becomes so thin that a 3D-to-2D crossover takes place. Such a dimensional crossover causes the 2D surface state to lose its topological protection, which in turn degrades the transport through the surface; in this sense, it is a striking manifestation of the topological protection.

3) Experimental Discovery of "topological crystalline insulator"

Recently, existence of a conceptually new class of topological materials called "topological crystalline insulator" has been theoretically proposed, and its possible realization in the narrow-gap semiconductor SnTe was suggested based on first-principle calculations. We have experimentally discovered that SnTe is indeed such a new topological material hosting an *even number* of Dirac cones in the Brillouin zone (as opposed to an odd number of Dirac cones in topological insulators). One can consider topological crystalline insulators to be cousins of topological insulators; namely, the topological surface in the former is protected by a point-group symmetry of the crystal, while in the latter it is protected by the time-reversal symmetry. Our experimental discovery widens our scope of topological materials.

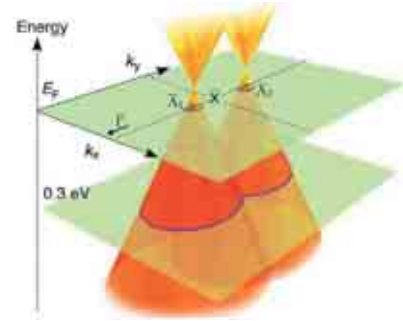


Fig. 2 Schematic picture of the peculiar "double Dirac cone" energy-band structure found in the topological crystalline insulator SnTe.

4) Discovery of a new candidate topological superconductor

Last year, we discovered that a superconducting doped topological insulator, $\text{Cu}_x\text{Bi}_2\text{Se}_3$, is possibly the first example of a time-reversal-invariant topological superconductor which hosts massless and helical Majorana fermions on the surface. However, this material turned out to be intrinsically inhomogeneous, which hindered detailed studies of the possible topological superconductivity. This year, we have discovered that a superconducting doped topological crystalline insulator, $\text{Sn}_{1-x}\text{In}_x\text{Te}$, presents a signature of surface Majorana fermions and, hence, this system is also a possible example of a time-reversal-invariant topological superconductor. Since this material is homogeneous and is 100% superconducting (as opposed to a limited superconducting volume fraction in $\text{Cu}_x\text{Bi}_2\text{Se}_3$), $\text{Sn}_{1-x}\text{In}_x\text{Te}$ offers a new and robust playground for studying the possible topological superconductivity. Furthermore, similarities between $\text{Cu}_x\text{Bi}_2\text{Se}_3$ and $\text{Sn}_{1-x}\text{In}_x\text{Te}$ point to a useful guiding principle for the search of topological superconductivity.

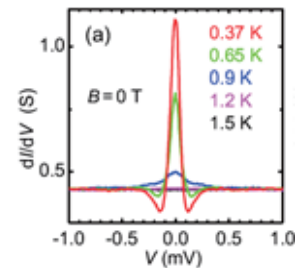


Fig. 3 Zero-bias conductance peak observed in the differential conductance spectra on $\text{Sn}_{1-x}\text{In}_x\text{Te}$, demonstrating the possible occurrence of topological superconductivity in this material.

Department of Semiconductor Materials and Processes

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Outlines

The modern society is based on semiconductor technology. Our research is aiming to improve the characteristics of semiconductor products including crystalline Si solar cells, thin film transistors (TFT), and LSI and to develop semiconductor devices with new structures. For this purpose, we have developed new semiconductor chemical processes such as low temperature Si oxidation method by use of nitric acid and room temperature defect passivation method. Semiconductor devices and materials studied in this department are: 1) Si solar cells, 2) Si nanoparticles produced from Si swarf, 3) metal-oxide-semiconductor (MOS) devices for LSI, 4) thin film transistors (TFT) for display devices.

Current Research Projects

Fabrication of Low Reflectivity Poly-Crystalline Si Surfaces by Structure Transfer Method

A method to fabricate low reflectivity poly-crystalline Si (poly-Si) surface structures for solar cells has been developed by use of the surface structure chemical transfer (SSCT) method. In the SSCT method, Si wafers immersed in H_2O_2 plus HF solutions were contacted with a Pt mesh, resulting in transfer of the mesh structure to the Si surfaces (Figure 1a) and the formation of a nanocrystalline Si layer with 100-150 nm thickness (Figure 1b). Figure 2 shows the reflectivity of poly-Si surfaces. With no treatment, the reflectivity was ~40 % (curve a), and it decreased to ~20 % by acid etching (curve b). After the SSCT method, the reflectivity became less than 2 % (curve c). This ultra-low

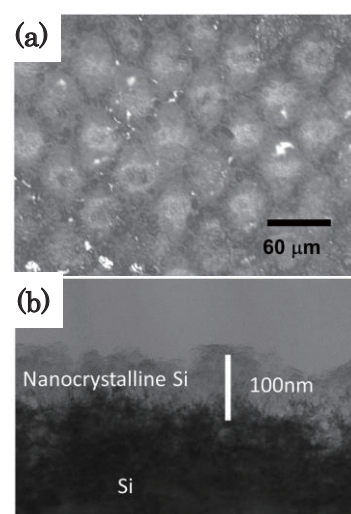


Figure 1 Optical micrograph (a) and cross-sectional TEM micrograph (b) of crystalline Si after the SSCT method.

reflectivity results from the formation of a nano-crystalline Si layer. Using the SSCT method, a six inches wafer can be treated within 20 s. Applying the SSCT method to pn-junction crystalline Si solar cells with no anti-reflection layer, a high short-circuit photocurrent density of 37.4 mA/cm^2 was obtained under AM 1.5 100 mW/cm^2 irradiation. We have also developed a method of passivation of nano-crystalline Si/Si structure, and the minority carrier lifetime exceeding $300 \mu\text{s}$ is achieved from p-type single crystalline Si.

Nitric acid oxidation of Si (NAOS) method for improvement of electrical characteristics of crystalline Si solar cells and thin film transistors (TFT)

An ultra-thin (i.e., 1.1-1.4 nm) SiO_2 layer with excellent electrical properties can be formed at low temperatures below 120°C by the nitric acid oxidation of Si (NAOS) method, and its interface state density is found to be less than $1 \times 10^{10}/\text{cm}^2\cdot\text{eV}$ from C-V and G-V measurements. By the formation of the NAOS SiO_2 layer between the Si substrate and the Si nitride anti-reflection layer, the relative conversion efficiency of the n-type single crystalline Si-based pn-junction solar cells was increased by 10 %.

The leakage current density of the NAOS SiO_2 layer with 1.3 nm thickness was approximately one order magnitude lower than that for 1.5 nm thermally grown SiO_2 layer formed at 900°C . We have produced TFTs with a 1.4 nm NAOS SiO_2 /8.6 nm CVD SiO_2 stacked gate oxide layer. Figure 3 shows the drain current vs. source-drain voltage. The I-V curves show saturation behavior with a high current density even at 1 V, indicating that the TFT can be operated at 1 V. The consumed power is proportional to the square of the driving voltage, and that for the fabricated TFT is 1/144 that of commercial TFT operated at 12 V. The on- and off-current were $\sim 10^2$ and 10^{-7} A , respectively, resulting in the high on/off ratio of 10^9 . In the sub-threshold regions, the drain current increased rapidly with the gate voltage, and the sub-threshold swing (S-value) was estimated to be 70~80 mV/dec, close to the theoretical limit of 60 mV/dec. The low S-value was attributable to i) thin gate oxide thickness, and ii) low interface state density.

Changes in Minority Carrier Lifetime of Hydrogen-Terminated Si Surfaces in Dry- and Wet-Air

Minority carrier lifetime of HF-treated Si(100) surfaces decreases in wet-air more rapidly than in dry-air. XPS measurements show that OH and O are mainly included in Si by keeping in wet-air and dry-air, respectively. OH cannot form network, and thus backbonded OH generates Si dangling bonds. On the other hand, backbonded O can form Si-O-Si networks, leading to the higher lifetime due to lower defect density. When the atmosphere is switched from dry-air to wet-air, the lifetime greatly decreases, and the workfunction increases, indicating formation of backbonded OH. [Original paper 3]

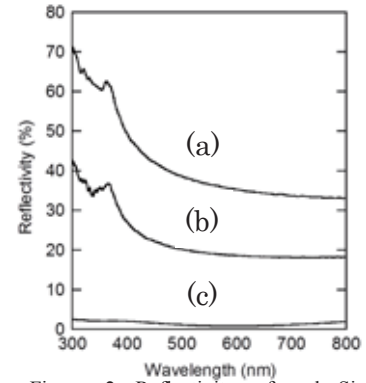


Figure 2 Reflectivity of poly-Si surfaces: a) as-sliced, b) after acid etching, c) after the SSCT method.

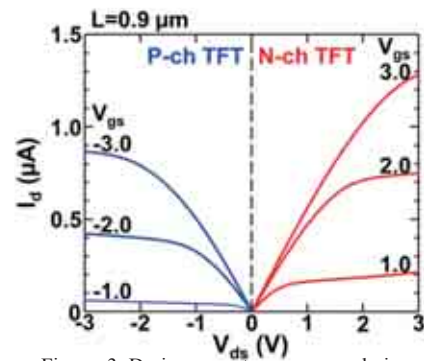


Figure 3 Drain current vs. source-drain voltage curves for TFT with 1.4 nm NAOS SiO_2 /8.6 nm CVD SiO_2 stacked gate oxide layer.

Department of Metallic Materials Process

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Outlines

Metals are fundamental materials indispensable to various structural and functional materials. The main purpose of this department is to investigate physics of metallic materials and develop novel processing of the metallic materials. The department has undertaken the following several topics of the metallic materials science and engineering. Lotus-type porous metals (lotus metals) developed by this department are unique materials which exhibit extraordinary superior mechanical strength.

In order to develop light-weight structural materials with various functions originating from porous structure, lotus TiAl-Nb intermetallic compounds were fabricated, and their compressive deformation behaviors were investigated at room temperature. In addition, for the purpose of the development of lotus metals with superior energy absorption, the formation mechanism of a plateau stress region was investigated using the Hopkinson pressure bar method for porous carbon steels.

Furthermore, we are studying the elastic properties of titanium alloys developed for biomedical applications, to develop the titanium alloys with low Young's modulus comparable to that of human bone. In this year, we clarified the relationship between the ω transformation and elastic properties of Ti-Nb-Ta-Zr-O alloys.

Current Research Projects

Fabrication of Lotus-type Porous TiAl-Nb Intermetallic Compounds and their Compressive Deformation Behaviors

Lotus-type porous Ti- x Al-8Nb ($x = 45, 48, \text{ and } 49 \text{ at\%}$) alloys (i.e., intermetallic TiAl-Nb compounds) with cylindrical pores oriented along one direction were prepared by unidirectional solidification in a hydrogen and helium gas atmosphere. It was revealed that pore formation in the alloys was closely related to their solidification processes. In the case of the alloy with $x = 45 \text{ at\%}$, a primary solidified β (bcc) phase with high hydrogen solubility suppressed the formation of pores during solidification. On the other hand, in the case of the alloy with $x = 49 \text{ at\%}$, the formation of the primary β phase was suppressed by the increase in Al concentration. As a result, cylindrical pores elongated along the solidification direction were formed. In the case of the alloy with $x = 48 \text{ at\%}$, β phase was formed during the solidification. However, the amount was decreased by the increase in Al concentration, and thus, the cylindrical pores were formed. After being heat treated, the lotus TiAl-Nb alloys exhibited a fully lamellar structure composed of α_2 -Ti₃Al and γ -TiAl phases. These porous TiAl-Nb alloys with lamellar structures and directional pores exhibited superior compressive properties parallel to the direction of the pores, because a concentration of stress hardly occurs

around the cylindrical pores.

Formation Mechanism of a Plateau Stress Region in Dynamic Compression of Lotus Carbon Steel

Dynamic compressive deformation behaviors of lotus carbon steels (S30C and S45C) was investigated using the Hopkinson pressure bar method. Figure 1 shows the dynamic compressive stress-strain curves in direction (a) parallel and (b) perpendicular to the pore direction. In the dynamic compression parallel to the pore direction, a plateau stress region appears in the as-cast lotus S45C and S30C carbon steels. This is because the formation of brittle cracks drastically decreases the work hardening coefficient. On the other hand, a plateau stress region with wide strain region does not appear in the dynamic compression perpendicular to the pore direction. This is because the pores are densified in the initial stage of stress strain curves, which leads to the steep increase in the flow stress with increasing strain.

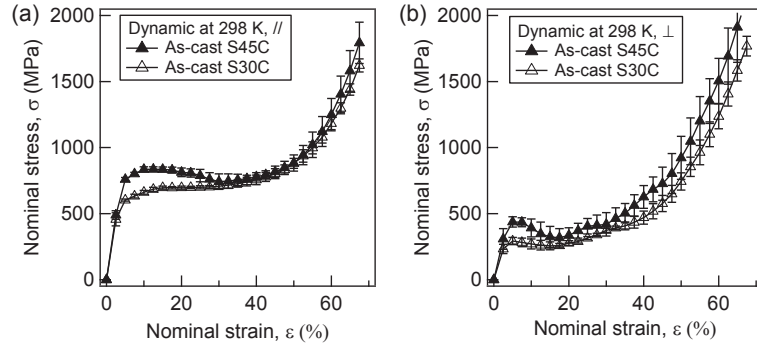


Fig. 1 Dynamic compressive stress-strain curves of lotus-type porous carbon steels in direction (a) parallel and (b) perpendicular to the pore direction.

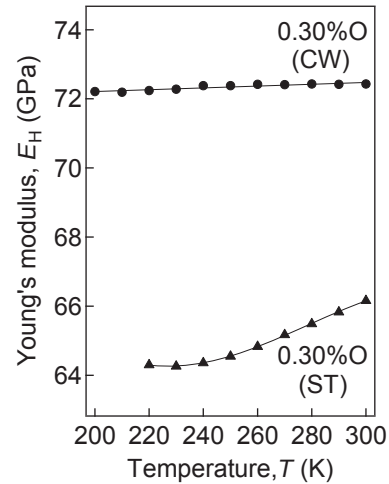


Fig. 2 Temperature dependence of Young's modulus of cold worked Ti-36Nb-2Ta-3Zr-0.30O mass% alloys.

Correlation between Elastic Properties and ω Transformation in Cold Worked Ti-Nb-Ta-Zr-O Alloys

The ω transformation and its correlation with elastic properties were investigated in cold worked Ti-36Nb-2Ta-3Zr- x O mass% alloys with low β phase stability, referred to as gum metal. It was revealed that the Young's modulus of solution-treated (ST) $x = 0.30\%$ alloy decreases upon cooling, whereas the Young's modulus of cold-worked (CW) $x = 0.30\%$ alloy is almost constant regardless of the change in temperature; cold working was not applied to solution-treated alloy. Importantly, the Young's modulus of cold-worked alloy is clearly higher than that solution-treated alloy. Transmission electron microscope observation clarified that the enhancement of Young's modulus by the cold working is caused by the formation of ω phase by the cold working. The formation of ω phase also affects the temperature dependence of Young's modulus of cold-worked alloy.

Department of Advanced Interconnection Materials

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Outlines

Through nanotechnologies and knowledge for organic/inorganic materials, we are conducting the development of environmentally conscious fine technologies for electronics packaging area, i.e., lead-free soldering, die-attach materials, Tin whiskers and conductive adhesives, and the composite materials based on metals and intermetallic compounds.

Current Research Projects

Highly Sensitive Antenna Using Inkjet Overprinting with Particle-Free Conductive Inks

We reported on highly sensitive antennas using additive patterning of particle-free metallo-organic decomposition silver inks. Inkjet overprinting of metallo-organic decomposition inks onto copper foil and silver nanowire line produced antenna with mirror surfaces. As a result, the overprinted antennas decreased their return losses at 0.5 – 4.0 GHz and increased the speed of data communication in WiFi network.



Fig. 1. Demonstration of Internet Web page access via the modified client adapter with the overprinted inverted F antenna.

Development of direct bonding using sputtered Ag films

We propose an alternative method based on the direct Ag film bonding that can be processed in a considerably low temperature without applying pressure for electronic packaging in order to achieve higher integration of integrated circuits (ICs). The direct bonding, which is traditional process, essentially requires

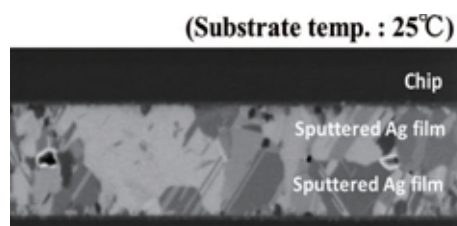


Fig. 2. Cross-sectional SEM image of bonding area at low substrate temperature.

considerably high bonding temperature and pressure that involves potential reliability risks particularly for advanced thin and fine-pitch ICs. Bonding strength of specimens deposited at low temperature (25 °C) has reached up to high strength. In low substrate temperature, it was observed that the interface between chip and substrate cannot be recognized (Fig.1).

Effects of minor elements on the interfacial reaction between Zn and Cu substrate during thermal aging

The thickness of IMC layers at joining interface has an apparent relation to the joint reliability, understanding IMC growth mechanisms is an important key for die-attachment. Therefore, the interface between the Zn-alloys and Cu substrate are investigated in detail, focusing on IMC growth. The joint interface with minor elements added Zn reduces the growth rate of IMCs. In particular, 0.1 wt.% Cr addition in pure Zn solder remarkably suppresses the IMC growth, and improves the shear strength after thermal aging. In sum, the additive Cr shows beneficial effects for suppressing IMC growth and improves shear strength after the thermal aging. Zn-0.1Cr solder alloy is hence expected to enhance the joining reliability in SiC die-attachment.

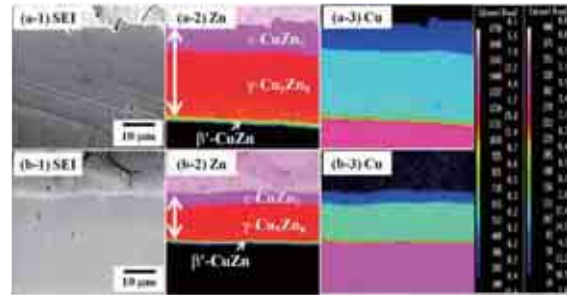


Fig. 3. EPMA mapping analysis of the Zn/Cu interface and Zn-0.1Cr/Cu interface.

Grain texture optimization in Sn-Ag-Bi-In solder under current stress by adding trace amount of Co and/or Ni

High current durability of Sn-Ag-Bi-In has investigated with 10 kA/cm² of current density by adding Co and/or Ni. Tin-based solder has different Copper diffusion coefficient in beta-Sn matrix upon axes. Preferentially, the differences are considered to see in the trace according to the added element. The distribution of intermetallic compound between copper electrode and beta-Sn matrix is confirmed by BSE-SEM. Grain size and textures (c-axis) are observed by EBSD. By adding micro element results are confirmed due to the grain refinement and texture control sample added Co. Each sample are adopted with current density 10 kA/cm² and heated up 100 °C temperature. With additional Co elements, EM resistance of the solder joint has improved as twice before with microstructural evolution.

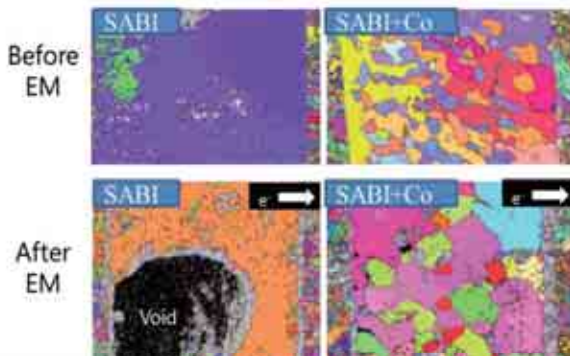


Fig. 4 Microstructure evolution with SABI and additional trace amount of Co before and after current stress (EM).

Department of Excited Solid-State Dynamics

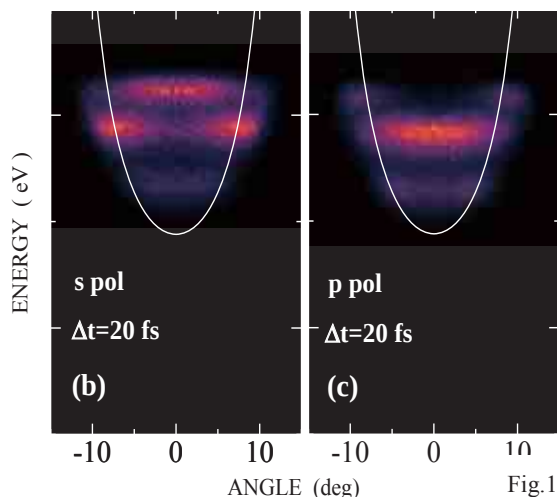
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Outlines

For fabricating highly functional nano-structured devices in future technology, it is essential to establish the ways to control structures and compositions of materials at the atomic level. In this department, we aim to establish the fundamentals for controlling the modes of atomic binding in solids via excitation-induced atomic reactions. For this purpose, we have carried out extensive experimental studies in the following three categories:

- 1) the primary processes of the photoinduced structural phase transitions,
- 2) ultrafast carrier dynamics on semiconductor surfaces,
- 3) excitation-induced structural changes of semiconductor surfaces,

In our studies, the main emphasis is placed on direct experimental determination of photoinduced changes of electronic and lattice systems at ultrafast temporal domains and at the atomic levels. As topics in the first category, we have studied the photoinduced phase transition in low dimensional crystals, like quasi one-dimensional organic solids and two-dimensional solids like graphite. As topics of the second categories, we have studied carrier dynamics on Si surfaces by means of femtosecond two-photon photoemission spectroscopy. And as the third topic, we have studied laser- or low-energy electron induced structural changes of clean surfaces of Si and InP by means of not only the direct imaging of the surface atomic structure and its changes by STM. Also, in order to reveal direct determination of crystalline structural changes in femtosecond temporal domains, we have successfully constructed a ultrafast high-energy electron diffractometer with 100-fs temporal resolution.



Current Research Projects

1. Ultrafast carrier dynamics in semiconductors and on their surfaces studied by femtosecond two-photon photoemission spectroscopy

The excitation induced structural instabilities are triggered by several modes of ultrafast relaxation of electronic excited states, like carriers, excitons, and electron-hole

plasma. In order to elucidate the dynamics of photogenerated surface carriers, which play crucial roles in several photoinduced reactions in solids and on solid surfaces, it is essential to study the ultrafast carrier dynamics with resolving their evolutions in momentum and energy spaces. Use of femtosecond laser for pump and probe pulses has a strong advantage for resolving the carrier dynamics directly. In particular, the new system based on a tunable OPA laser for pump pulses of 50-fs temporal width and on a two-dimensional imaging detection of photoelectrons with respect to energy and momentum has opened a new breakthrough for the studies.

By probing electrons populated in the conduction band of Si or GaAs, we have elucidated directly the ultrafast processes of intra- and inter-valley relaxation and energy relaxation of highly excited hot electrons. Furthermore, by using 6-eV probe photons, we can study the dynamics of photogenerated holes in bulk valence band, which can be probed as a time-dependent small depression of occupied- state photoemission intensities. A typical result is shown in Fig.1, where the nascent distribution of hot electrons injected by 2.20-eV fs pulses in GaAs are imaged as a function of kinetic energy and emission angle representing parallel momenta. Depending on the time delay after generation, electron distribution changes significantly; a quasi-equilibrated distribution is established at 2.5 ps after excitation at the bottom of the conduction band (CBM). The result provides new light for understanding photoinduced effects in semiconductors.

2. Ultrafast structural dynamics of solids by transmission electron diffraction with 100-fs temporal resolution

In order to reveal ultrafast structural dynamics involved in photo-induced structural phase transformation, we constructed an electron diffractometer with transmission mode and with ultrafast temporal resolution less than 100 fs.

Our diffractometer uses relativistic electron beams generated by fs-laser triggered RF photocathode, and collimated beams are dispersed on the phosphor screen to display the diffraction patterns.

Important point to be emphasized is that a single-shot diffraction images can be measured clearly, thus making it possible to study irreversible processes of structural changes. In Fig.2, we show typical results measured for order-disorder transformation of Au, which show the ultrafast melting induced by laser excitation at 3.20 eV. Based on the theoretical analysis combining ab-initio calculation and classical molecular dynamics, we find that the mechanism of melting changes from heterogeneous to homogeneous melting, and that at the highest fluence of 108 mJcm^{-2} , non-thermal melting is induced, where electronic effects on atomic potential play crucial role in the disordering process. The diffractometer is now under reconstruction to achieve greatly higher performances toward ultrafast atomic imaging.

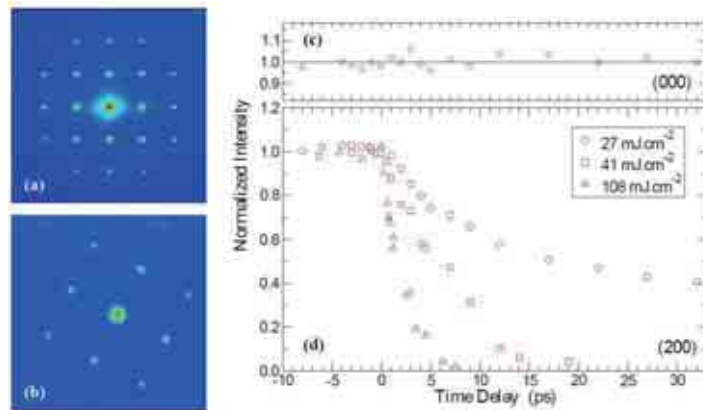


Fig.2

Department of Accelerator Science

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Hiroki OHSUMI, Masaki YAGUCHI

Outlines

Particle accelerators are widely used from basic science to industrial applications. In this department, we conduct research on accelerators with the object of producing quantum beams, including the high-brilliant electron beam and light. Because new kinds of quantum beams extend the world we can see with, they will be used in a large variety of fields extending from basic research to applications. To put it concretely, we conduct researches on production of a highly brilliant electron beam with a linear accelerator and related beam dynamics, development of an infrared FEL as well as applications to study on solid state physics or relevant fields using coherent radiation, and SASE (Self-Amplified Spontaneous Emission) in the infrared region.

Current Research Projects

Upgrade of the L-Band Electron Linac

The L-band linac accelerates an electron beam using 1.3 GHz high power RF pulses provided by a klystron. As a switch to provide high voltage and high current pulses to the klystron, a thyatron is commonly used in the klystron modulator. The thyatron, however, has limitations in stability and reproducibility because it is a kind of gas-filled discharge tube. We, therefore, have developed a solid-state switch in exchange for the thyatron, aiming to make operation of the linac and the FEL stable. We use static induction (SI) thyristors, maximum specifications of which are 3.2 kV and 5 kA for pulses shorter than 10 μ s. We measured its turn-on time and resistance to be 200 ns and 0.1 Ω , respectively, which are sufficient to switching devices for a klystron modulator. Ten devices are connected in series and 6 such units are connected in parallel to meet specifications of 25 kV and 5 kA to a 5 Ω load for the switch in the L-band klystron modulator. When this switch is used for FEL in conditions of 20 kV, 4 kA, and 10 Hz, the pulse-to-pulse fluctuations of the high voltage applied to the klystron are measured to be 0.015 %, which is less than a half of the value obtained with the thyatron.



Fig.1. Solid-state switch for the klystron modulator of the L-band electron linac using SI thyristors.

Development of Free Electron Laser

The THz-FEL operates in the frequency range from 2 to 12 THz (25 to 150 μm) at high power reaching saturation. FEL gain is one of the principal characteristics presenting its performance. It is defined as the growth rate of the light pulse amplified once by an electron bunch. We, in the past, measured the FEL macropulse using a Ge:Ga detector with a time resolution of ~ 10 ns, and derived the gain from its shape of the leading edge. It turned out, however, that the output signal of the detector showed saturation behavior for the high power input and the linear response was lost. We, therefore, has developed a new method to obtain

power evolution of the FEL macropulse using a Si bolometer, which measures the macropulse energy owing to its slow response, by varying the number of FEL amplifications. Fig. 2 shows the energy evolution of the FEL macropulse as a function of the electron pulse length or the number of FEL amplifications. We have measured the energy evolution of the FEL macropulse over 9 orders of magnitude.

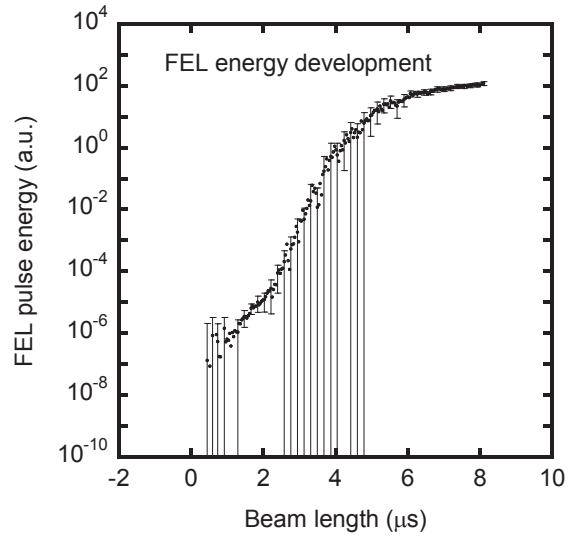


Fig. 2. Energy development of the FEL macropulse . The macropulse energy is measured using a silicon bolometer by varying the pulse length of the electron beam or equivalently the number of FEL amplifications.

Application of High Intensity THz Radiation

We conduct study on application and performance evaluation of a THz camera in collaboration with NEC. The camera is not equipped with an external trigger function, which is necessary to capture images synchronously with high power pulsed THz sources, including the THz-FEL. The FEL is operated synchronously to a subharmonic of the AC power line frequency, usually at 10 Hz made from 60 Hz, whereas the THz camera takes pictures at 29.875 Hz, so that these frequencies are slightly different. In addition, a holding time constant of microbolometers comprising the imaging device is chosen so that persistence of vision does not result in adverse effects in 30 Hz operation.

As a result, such effects are observed that part of the image of FEL lacks and that image intensities vary. In order to correct these adverse effects, we have developed a method to construct a correct image from more than 240 consecutive images using a computer software program. Fig. 3 shows a transverse profile of an FEL beam at a frequency around 3 THz using the new method. An interference pattern around the beam profile may be clearly seen in Fig. 3.

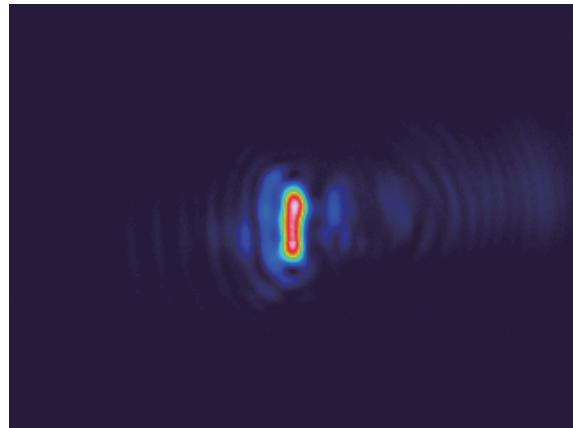


Fig.3. Beam profile of FEL corrected for asynchronous photographing using the THz camera.

Department of Beam Materials Science

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Graduate Students: Mayu FUJIKAWA, Yoshitaka KOMURO, Tomohiro YAMAZAKI

Outlines

The industrial application of quantum beam will rapidly expand in the field such as high-volume production of semiconductor devices. Cancer therapy using ionizing radiation has also attracted much attention. In Department of Beam Materials Science, the radiation-induced chemical reaction and reaction field have been investigated using state-of-the-art quantum beam (electron, extreme ultraviolet radiation, laser, synchrotron radiation, X-ray, g-ray, ion beam). We have studied the chemical reaction system from the energy deposition on materials to the expression of material function. On the basis of these studies, we have designed a noble chemical reaction system.

Current Research Projects

Formation of Nanoscale Reaction Field Using Combination of Top-down and Bottom-up Nanofabrication

We present a novel and simple method of fabricating patterned arrays of gold (Au) nanoparticles on a nanoscale reaction field by combining electron beam lithography and self-assembly techniques. We succeeded in the forming a nanoscale reaction field consisting of a single Au nanoparticle or Au nanoparticles on water-soluble dithiol self-assembled monolayer (SAM) nanopatterns such as line and space patterns and dot patterns. Spherical Au nanoparticles were immobilized above the Au nanopatterns with a gap of a few nanometers and supported by two types of water-soluble dithiols. A difference in the attachment behaviors of Au nanoparticles between two dithiol was clearly observed. The patterned nanoscale reaction field is highly controllable and we believe it will contribute to studies on the observation of single biomolecules such as DNA, peptides, nucleic acids, proteins, and cells.

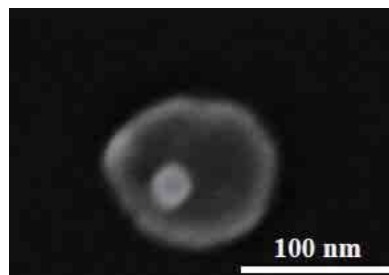


Fig. 1. Immobilized Au nanoparticles

Reaction of Nitric Oxide with the [2Fe-2S] Cluster of SoxR Protein by Pulse Radiolysis

Nitric oxide (NO) is a key signaling molecule in a diverse array of cellular processes, ranging from essential roles in signal transduction in the nervous system to blood pressure regulation and involvement in the immune response. In activated macrophages, NO can be a powerful toxic agent that kills pathogenic bacteria. The bacterial transcriptional regulators, all of which contain an iron-sulfur cluster, are involved in coordinating physiological responses to NO, are involved in coordinating physiological responses to NO. SoxR in *Escherichia coli* is activated by direct modification of the [2Fe-2S] centers by nitric oxide (NO) to form a protein-bound dinitrosyl-iron

complex, but little is known about the kinetics and mechanism of cluster nitrosylation. Here, we investigated the reactions of NO with [2Fe-2S] clusters of SoxR using pulse radiolysis in Fig. 2. Upon pulse radiolysis of a deaerated solution of SoxR in the presence of sodium nitrite, a biphasic change in absorption, consisting of a slow phase and a faster phase, was observed. The ratio of the slower phase to the total absorbance changes was dependent on the molar ratio [NO]/[SoxR]. On the basis of these results, we propose that the faster phase corresponds to the reaction of the first NO molecule with [2Fe-2S] of SoxR, followed by the reaction of the second NO molecule. The second-order rate constant of the faster process was $1.3 \times 10^8 \text{ M}^{-1} \text{ s}^{-1}$. A possible pathway for the reaction is shown in Scheme I. The reaction of the first NO equivalent leads to elimination of 1 mol-equivalent of sulfur and formation of a mononitrosyl iron complex. Addition of the second equivalent of NO results in elimination of a second mol-equivalent of elemental sulfur and formation of a dinitrosyl complex. The break-up of the dimer by addition of another 2 equivalents of NO yields the corresponding DNIC.

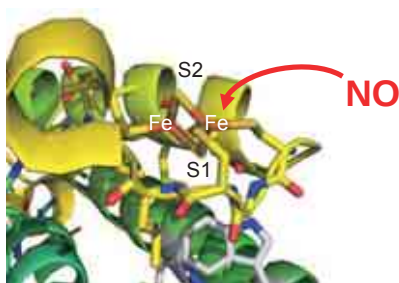
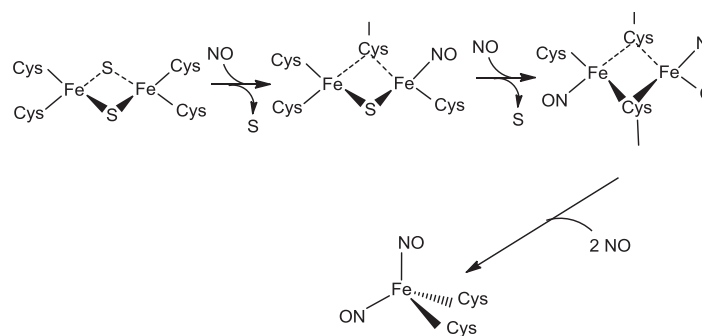


Fig. 2. Reaction of NO with SoxR



Scheme I. Possible reaction pathways for [2Fe-2S] clusters with NO

Study on Radiolysis of Water at Extreme Conditions

The radiolysis of water at high temperature and high pressure (HTHP) conditions was investigated by a picosecond pulse radiolysis and a Monte-Carlo simulation. In these decades, γ - and ns pulse- radiolysis techniques have intensively been applied to the HTHP study, nevertheless the detection of the primary species was mostly restricted to indirect methods such as scavenging methods and product analysis because of their high reactivity. In this work, it was targeted to develop a new ps pulse radiolysis system employing a ps electron accelerator and a fs laser. Pulse-probe spectroscopy made it possible to trace the ps kinetics of hydrated electron (e^-_{aq}) directly at elevated temperatures up to supercritical state. Interestingly, the decay kinetics exhibited a significant temperature dependence, getting faster with increasing temperature. The results were also analyzed by Monte-Carlo simulation that explained some important information on physicochemical- and chemical- process, such as electron thermalization distance (inhomogeneous spatial distribution), time dependent yield $g(e^-_{aq})$, and fast diffusion reactions between reactants. A relatively minor reaction at 25°C ($e^-_{aq} + \text{H}_3\text{O}^+ \rightarrow \text{H} + \text{H}_2\text{O}$) gradually competes with the predominant one ($e^-_{aq} + \text{OH} \rightarrow \text{OH}^-$) with increasing temperature, consequently become predominant at $>250^\circ\text{C}$, leading to increase of $g(\text{H})$ and $g(\text{OH})$ at HTHP.

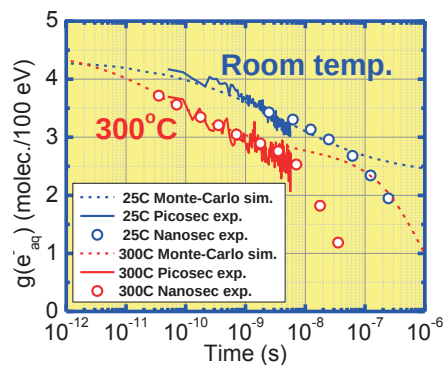


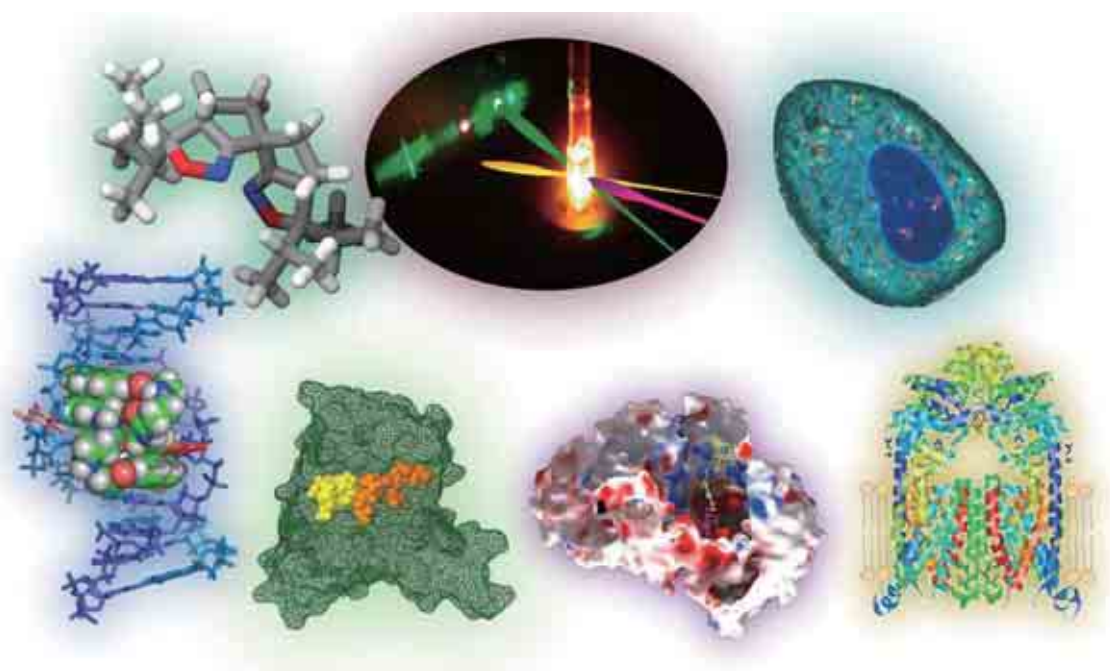
Fig.3. Fast decay kinetics of the hydrated electron at high temperatures

Division of Biological and Molecular Sciences

Outlines

The Molecular Science Group of this division is composed of four departments; Dept. of Molecular Excitation Chemistry, Dept. of Synthetic Organic Chemistry, Dept. of Regulatory Bioorganic Chemistry, and Dept. of Organic Fine Chemicals. The research field of the Molecular Science Group covers organic chemistry, physical chemistry, catalytic chemistry, surface chemistry, beam-induced chemistry, materials chemistry, bio-functional molecular chemistry, and chemical biology. The division also has a Biological Science Group, which is composed of three departments; Dept. of Structural Molecular Biology, Dept. of Cell Membrane Biology, and Department of Biomolecular Science and Engineering. These departments are engaged in research in various fields of biological science including molecular enzymology, signal transduction, membrane transport, and the mechanism of gene expression.

Within each department, own research topics are ongoing. Joint projects involving several departments are also underway.



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Outlines

"Beam-induced molecular chemistry" based on photo- and radiation-induced chemistry of organic compounds has been investigated from both basic and beam-functional points of view. The research topics are underway with respect to developments of new beam-controlled chemistry, new synthetic chemistry, and new molecular devices and functional materials.

1. Formation and reactivities of reactive intermediates in photochemistry and radiation chemistry, and photochemistry of reactive intermediates
2. Multi-beam chemistry with irradiation by two-color laser-laser and electron pulse-laser flash
3. Multiple-photon chemistry of organic compounds using UV, visible, and infrared lasers
4. Beam-controlled chemistry of artificial biomolecules such as modified DNA and proteins

Current Research Projects

Multi-beam Chemistry

Multi-beam chemistry has been studied using pulse radiolysis-laser flash photolysis combined method, two-color two-laser photolysis and three-color three-laser photolysis. Photochemistry of reaction intermediates and short-lived chemical species generated from the reaction induced by the first beam excitation of a starting molecule (two-step excitation method), and moreover, photochemistry of other chemical species generated from the reaction of the short-lived intermediate induced by the second beam excitation (three-step excitation method) can be studied. This year, we have investigated inter- and intramolecular electron transfer from the excited state of naphthalimide radical anions. Charge delocalization processes in star-shaped oligofluorenes were also investigated by means of radiation chemical methods. From the comparison with the theoretical calculation, structural relaxations upon redox processes were clarified. Furthermore, size-dependence of π -electron delocalization in cycloparaphenylenes was revealed by means of Raman spectroscopy. In addition, excess electron transfer in DNA conjugated with photosensitizing electron donor has been clarified.

Hole transfer dynamics in DNA

We investigated the hole-transfer rate constants (k_{ht}) in locked nucleic acid (LNA) and 5-Me-2'-deoxyzebularine (**B**)-modified DNA. An increase in the rigidity of DNA by LNA modification resulted in the suppression of hole transfer, causing a decrease of more than two orders of magnitude in k_{ht} . On the other hand, the replacement of C with **B**, which increases the flexibility of base pairing, increased k_{ht} by more than 20-fold. These results further supported the notion that hole transfer in DNA is a conformationally gated process, and that charge-transfer dynamics in peptide that take place under similar physiological conditions are regulated by the dynamics of the conformational changes of peptides. We clearly demonstrated that hole-transfer efficiency in DNA can be increased by increasing DNA flexibility by weakening the base-pair association, which may help in the design of artificial bases of those exhibits with higher hole-transport properties than those of natural bases.

Single-Molecule, Single-Particle Spectroscopic Studies on the Mechanisms of Photocatalytic Reactions

Heterogeneous photocatalysts have both potential and demonstrated applications for use in the water-splitting reaction that produces hydrogen, the degradation of organic pollutants, the surface wettability conversion, etc. We investigated the properties of superstructures of TiO_2 to understand the inter-relationship between structural ordering and photocatalytic performance. The nanoplate anatase TiO_2 mesocrystals were newly synthesized by a topotactic structural transformation. The TiO_2 mesocrystals displayed the superstructure of crystallographically ordered alignment of anatase TiO_2 nanocrystals with high surface area. The photoconductive atomic force microscopy, time-resolved diffuse reflectance spectroscopy, and single-molecule fluorescence spectroscopy were utilized to determine the charge transport properties of TiO_2 mesocrystals. It was found that such a superstructure of TiO_2 could largely enhance charge separation and had remarkably long-lived charges, thereby exhibiting greatly increased photoconductivity and photocatalytic activity.

Hole Trapping of G-quartets in G-quadruplex

G-quadruplex (G-q) has been an emerging topic for developing DNA-based molecular electronic devices because of its ability as an electron carrier, its unique hole trapping property, and its high conductance. In hole transfer in DNA, hole trapping is an important process to determine the overall efficiency of hole migration in DNA. We investigated the hole transfer and trapping in G-q using a laser flash-photolysis and pulse radiolysis. We found that G-quartet of G-q has the lower oxidation potential compared with that of a single isolated G, two or three consecutive G bases. The result reveals that the charge separation in riboflavin-modified G-q (Rf-G-q) takes place efficiently between Rf and G to give $\text{Rf}^{\cdot-}\text{-G-q}^{\cdot+}$ due to the excellent hole trapping ability of planar G-quartets. This means that G-q can serve as traps of oxidative damage in the genome. In addition, charge recombination of $\text{Rf}^{\cdot-}\text{-G-q}^{\cdot+}$ occurs in the time scale of 0.7 ns to yield Rf in the triplet excited state.

Department of Synthetic Organic Chemistry

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Supporting Staff:	Ayaka HONDA

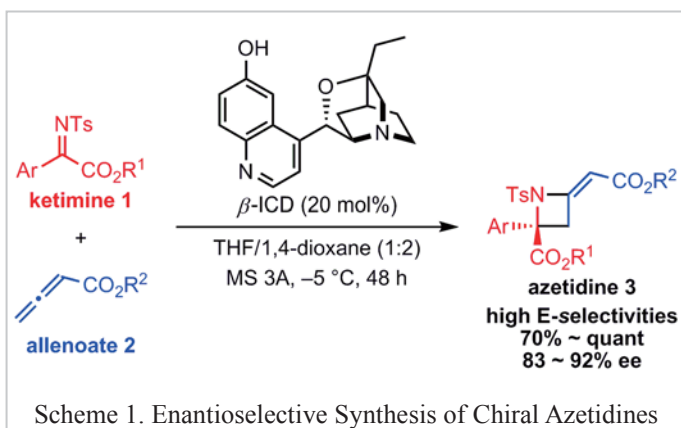
Outlines

Asymmetric synthesis, a phenomenon fine-tuned to perfection by nature, forms the central theme of our research efforts. We have been interested in the design and syntheses of a novel class of chiral ligands that are unique in promoting new asymmetric reactions. The mechanisms of these organic reactions are also studied by means of physical organic techniques. Novel chiral spiro ionic liquids and organocatalysts have been synthesized with a focus on developing environmentally benign asymmetric processes.

Current Research Projects

Facile Synthesis of Optically Active Azetidines by Using Organocatalyst

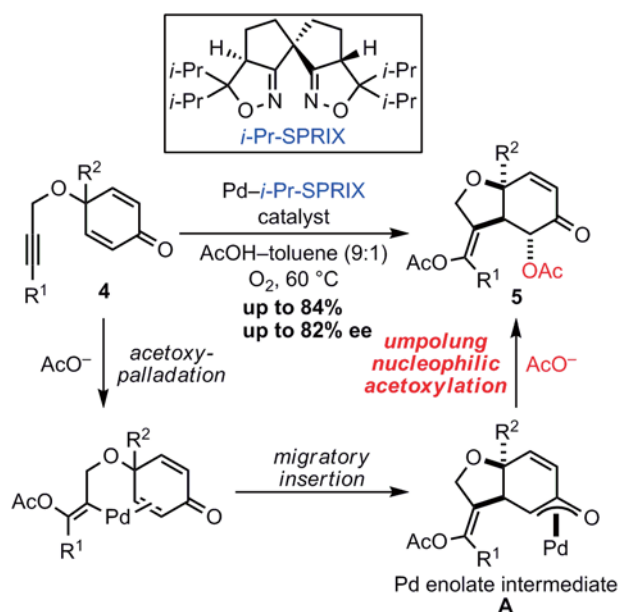
Chiral azetidines, which represent an important class of four-membered *N*-heterocycles, have received much attention because of their utility as a ligand and their biological and pharmaceutical activities. However, the synthetic approaches to enantiomerically enriched azetidines are generally multistep processes. Ketimines are considerably less reactive and unstable than aldimines, and enantioface differentiation of



ketimines is more difficult because of the smaller steric and electronic differences between the two substituents on the prochiral carbon. Herein, we have succeeded in developing the organocatalyzed formal [2+2] cycloadditions of *N*-tosyl α -ketimine esters **1** with allenates **2** furnishing azetidines **3** with a tetrasubstituted stereogenic carbon. In the chiral multifunctional organocatalyst β -ICD-mediated formal [2+2] cycloadditions, *E*-selective and (*R*)-configured azetidines **3** were obtained in good to excellent yields with high enantioselectivities irrespective of the electronic nature of substituent groups on the aromatic ring of ketimines **1** (Scheme 1).

Discovery of Umpolung Reactivity of Pd Enolates

Spiro bis(isoxazoline), abbreviated as SPRIX, are an effective ligand in various Pd-catalyzed enantioselective oxidative reactions. In the course of the development of new asymmetric catalysis using SPRIX, we have found an *umpolung* nucleophilic attack on a Pd enolate that usually reacts with electrophiles such as aldehydes. Thus, treatment of alkynyl cyclohexadienone substrates **4** with Pd-SPRIX catalyst in a 9:1 mixture of acetic acid and toluene under an oxygen atmosphere furnished diacetoxylation benzofuranones **5** in high yields. This unusual cyclative diacetoxylation turned out to proceed enantioselectively in the presence of optically pure SPRIX ligand (Scheme 2).



Scheme 2. Umpolung Reaction of Pd Enolate

Development of New Chiral Spiro-type Ligands Bearing Imidazole Donors

We have succeeded in the development of new chiral spiro-type ligands bearing imidazole donor sites, which are derived in 2 steps from the already established spirobilactam compound. The utility of these new ligands was verified through a complexation study and application to an enantioselective catalysis.

Green Powder-phase Oxidation Using Apatite Powder

We have developed a green powder-phase oxidation reaction for an organic compound, which has such advantages that the system does not require any organic solvent which may adversely affect the global environment, has a high product yield, and enables to reuse a catalyst and the like. The oxidation reaction is performed with the powder mixture comprising of a tungstate catalyst powder dispersed on apatite powder, and the added liquid reactants, an organic compound and aqueous hydrogen peroxide. We co-developed a convenient equipment for the powder oxidation system, in which one work cycle of H₂O₂-oxidation, product isolation, and reuse of the catalyst/apatite is repeatedly performed. By use of the equipment, halogen-free epoxides were easily prepared in 100 g amount per one batch.

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Research Assistance: Maki KIMURA, Yasue HARADA, Ayako Sugai, Miho Kawabata (~2012.9), Chihiro HIRATA (2012.4~)
Supporting Staff: Yuriko YAGUCHI

Outlines

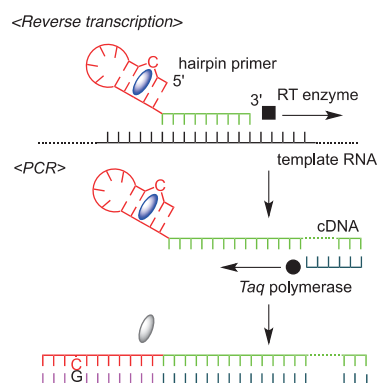
We have studied on "Chemical Biology" and "Nano-Technology" based on synthetic organic chemistry. For chemical biology, we focused our attention on 1) molecular design of mismatch binding ligands, and 2) in vitro selection of RNA aptamer binding specific nucleic acid structure. Because DNA is not only a genetic materials but also an important organic materials consisting of C, H, O, N, and P atoms with ability of spontaneously forming a double helix. To use DNA as precision organic materials in nano-technology, we have studied on the chemical properties of DNA and on the synthesis of chemically modified DNA.

Current Research Projects

Development of Gene Detection Technology (RT-PCR)

We have reported a hairpin primer PCR (HP-PCR) method using primer having a hairpin tag at the 5'-end and a fluorescent dye 2, 7-diamino-1, 8-naphthylidine derivative (DANP) which bound to the cytosine-bulge (C-bulge) embedded in the hairpin tag. As the PCR proceeds, the hairpin tag in the primer was opened up and disappeared, leading to the decrease of the fluorescence. This HP-PCR provides extremely high allele specificity in allele specific HP-PCR.

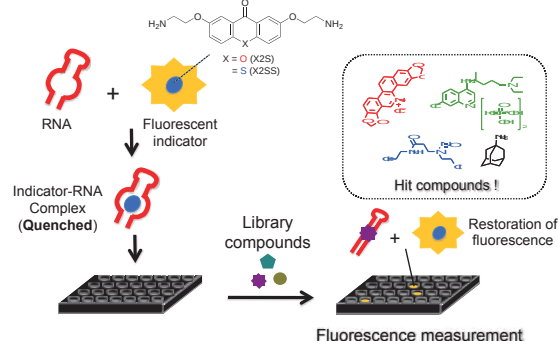
The specific primer of a virus having a hairpin tag at the 5'-end was used as RT and PCR primers. The virus-RNA template was transcribed by reverse transcriptase with the hairpin primer, and the resulting cDNA was amplified directly by HP-PCR (RT-HP-PCR). Using the RT-HP-PCR, we succeeded in demonstrating the detection of virus-RNA in one-tube. The RT-HP-PCR selectively detected virus-RNA extracted from the patient serums containing contaminant materials, and the method could be applicable for the quantitative detection of virus. [Original Paper 10]



Fluorescent Displacement Assay for the Detection of RNA-ligand Interactions

We have developed a fluorescent displacement assay for detecting RNA-ligand interaction. The assay uses fluorescence detection and requires no covalent labeling of RNA, which is more convenient method for detecting the interaction between RNA and small molecules. We have designed and synthesized several 2,7-disubstituted xanthone and thioxanthone derivatives

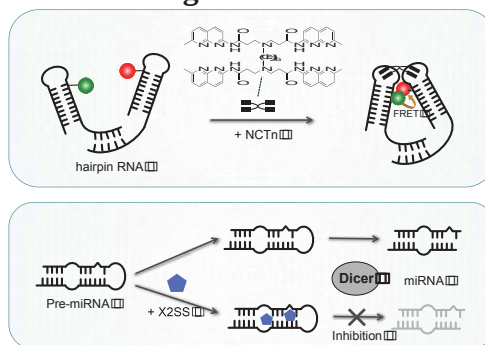
as fluorescence indicators. Those xanthone and thioxanthone derivatives are non-fluorescent when bound to RNA but fluoresces when they are displaced from RNA upon ligand binding. We have applied the fluorescent displacement assay for the screening of a large chemical library to find the molecules that bind to specific miRNA precursors. **[Original Paper 1]**



Modulation of RNA Structure and Functions by RNA-Binding Small Molecules

We have developed the small-molecule ligands that specifically bind to mismatched base pairs in DNA. Among those ligands, NCTn (Naphthyridine Carbamate Tetramer) have shown to bind to CGG/CGG sequences in a loop region of RNA hairpin, and stabilized the loop-loop interaction of two RNA molecules.

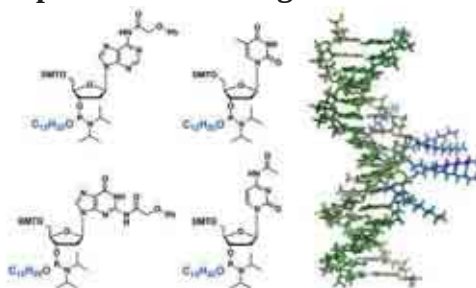
Recently, bis(2-aminoethoxy) thioxanthone (X2SS), one of the fluorescent indicators that we have developed, have shown to be a potential inhibitor of pre-miRNA processing to miRNA by Dicer. This result indicate that X2SS has an advantage as the fluorescent indicator, since a ligand that competes for X2SS binding site of pre-miRNA would be readily used as an inhibitor for pre-miRNA processing. **[Original Paper 7]**



Novel Amphiphilic DNA Containing Dodecyl Phosphotriester Linkages

We have synthesized a new amphiphilic DNA containing an internal hydrophobic region consisting of dodecyl phosphotriester linkages (dod-DNA). dod-DNAs of any arbitrary sequence can be synthesized by standard automated solid-phase synthesis using a set of four nucleoside dodecyl phosphoramidites.

When multiple dodecyl groups were introduced into both strands of a DNA duplex in a face-to-face arrangement, the resulting duplex was strongly stabilized by the interstrand hydrophobic interaction. The hydrophobic zipper formation provides a tightly associated, electroneutral, and highly hydrophobic region in the originally hydrophilic DNA duplex. As the hydrophobic properties can be adjusted by varying the encoded sequence, dod-DNA is an easy-to-design amphiphilic molecule for controllable vesicles and membrane biotechnology. **[Original Paper 2]**



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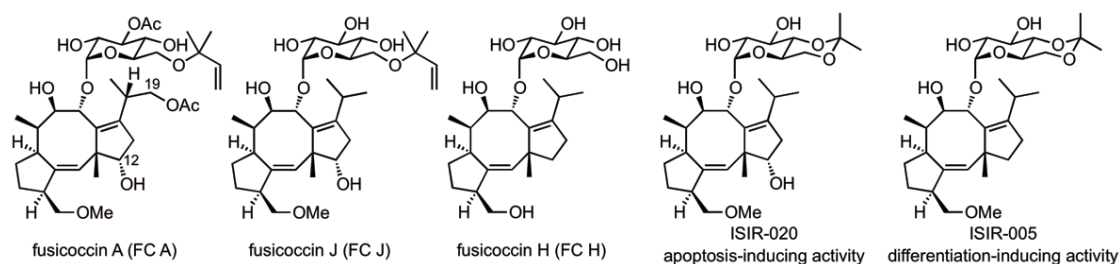
Outlines

The major goal of this department is to identify promising lead compounds for drug discovery. Based on chemical proteomic approaches, our research interests focus on the rational design and synthesis of small organic compounds that potentially modulate/inhibit protein-protein interactions. These compounds are also utilized as a tool in our chemical genomic study to elucidate intracellular signaling pathways.

Current Research Projects

Production of Useful Biosynthetic Intermediates of Fusicoccin by Manipulation of Biosynthetic Genes of the Fusicoccin-producing Fungus

Our recent structure-activity relationship studies on fusicoccane diterpenoids have revealed that the elimination of 19-hydroxy group of fusicoccin A (FC A) converted it to apoptosis inducing agents for many cancer cell lines, and that both 12- and 19-hydroxy groups need to be removed for differentiation-induction activity on human promyelocytic leukemia cells. Therefore, fusicoccin J (FC J) and fusicoccin H (FC H) are more useful as starting materials for semisynthetic preparation of this class of compounds, such as ISIR-020 and ISIR-005.



Since FC J and FC H are biosynthetic intermediates of FC A, these could be obtained predominantly as metabolites of fusicoccin-producing fungus, *Phomopsis amygdali*, by engineering biosynthetic genes. To this end, we have dissected the whole biosynthetic machinery for FC A in *P. amygdali* and functional analysis of all 13 gene products has confirmed that *orf10* and *orf13* are genes of P450s that introduce 12- and 19-hydroxy groups, respectively. We therefore disrupted *orf10* and *orf13* genes by homologous recombination. As anticipated, each disruptant efficiently and cleanly produces FC H

(500 ~ 600 mg / 1 L of medium) and FC J (> 850 mg / 1 L of medium), respectively. Thus, these bioengineering approaches successfully opened the way for supplying the large amount of the key intermediates, which can be used for further synthetic studies toward FC-based pharmaceuticals.

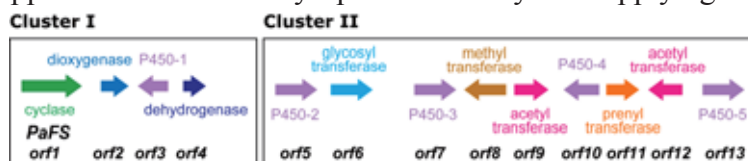


Fig. 1. Biosynthetic genes responsible for FC A production.

Cell-based Evaluation of Guanidine Group-containing Farnesyltransferase Inhibitors Designed for Disrupting K-Ras Protein-protein Interactions

Disease-related intracellular protein-protein interactions (PPIs) possess great potential as drug targets, however, inhibiting flat and featureless interfaces with drug-like molecules remains a difficult challenge. Ensuring binding selectivity to the surface while maintaining appropriate molecular size is an issue to be addressed for developing cell permeating PPI inhibitors. To that end, we designed a new series of bivalent compounds derived by covalent linking of the peptidomimetics consisting of a 4-amino benzoic acid and various gallate derivatives possessing differently positioned guanidine groups. These compounds were found to notably inhibit the interaction between farnesyltransferase (FTase) and K-Ras4B protein model peptide in vitro. Cell based assay using human bladder carcinoma cells demonstrated that FTase activity was suppressed by compound 2 at 10 μ M. Furthermore, introducing a phenyl group into the peptidomimetic moiety in 2 significantly improved the cell activity approximately by two-orders, resulting in a compound possessing submicromolar inhibitory potency in cells. This compound may serve as a potential antitumor agent targeting oncogenic K-Ras PPIs.

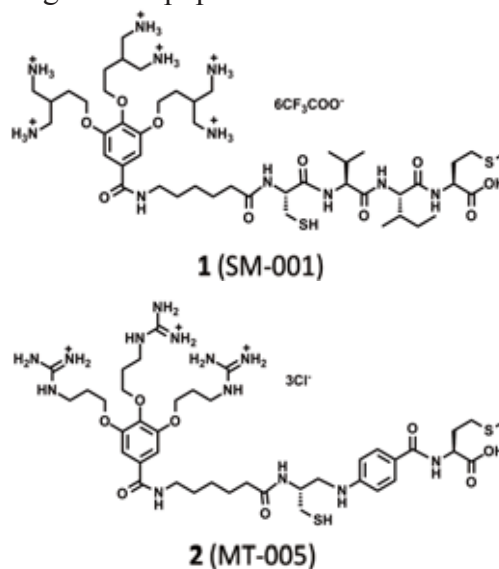


Fig. 2. The first- (1) and the second (2) generation of FTase inhibitors.

Synthesis of Novel Peptide Nucleic Acids for Effective Identification of Single Nucleotide Polymorphism in Disease-related Genes

Methods for indentifying single nucleotide polymorphisms (SNPs) in disease-related genes is important in the area of gene diagnosis. We chemical modified the backbone or nucleobase of peptide nucleic acid (PNA), a DNA/RNA analogue, and aimed to developed a method for an effective recognition of SNP.

The introduction of a rigid intercalator to the backbone of 12mer PNA selectively increased the hybridization stability with its complementary sequence approximately 8 $^{\circ}$ C. On the other hand, the substitution of thymine base of PNA to our newly developed thiouracil base selectively decreased the hybridization stability with its non-complementary sequence approximately 2 $^{\circ}$ C/base. We are developing a method for effective recognition of disease-related SNPs using these two methodologies.

Department of Structural Molecular Biology

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Specially Appointed Researcher	Hiroto ITO
Supporting Staff:	Mayuko MURAI

Outlines

The research of this laboratory is focused on the biochemical and molecular biological studies on various enzymes. Their active-site structures and catalytic mechanisms are being investigated by site-directed mutagenesis, various spectroscopies, and X-ray crystallography. Previous conspicuous findings are the copper ion-dependent, post-translational modification mechanism for the biogenesis of the topa quinone cofactor in copper amine oxidase and the very unique structure of quinohemoprotein amine dehydrogenase (QHNDH) containing a novel built-in type quinone cofactor and internal thioether crosslink structures. Furthermore, we determine crystal structures of the protein domains involved in the bacterial two-component signal transduction system (TCS) and elucidate the mechanisms of signal sensing and transcriptional regulation. Furthermore, we have developed hollow bio-nanoparticles displaying various bio-recognition molecules, which are expected to be an ideal vector for the tissue- and cell type-specific gene and drug delivery system.

Current Research Projects

An Unique Peptide Crosslinking Enzyme Is Essential for Biogenesis of Quinohemoprotein Amine Dehydrogenase

Quinohemoprotein amine dehydrogenase (QHNDH) is an $\alpha\beta\gamma$ heterotrimer present in the periplasm of several gram-negative bacteria and catalyzes the oxidative deamination of various aliphatic amines such as *n*-butylamine for assimilation as carbon and energy sources. The γ -subunit of mature QHNDH contains a protein-derived quinone cofactor, cysteine

tryptophylquinone, and 3 intrapeptidyl thioether cross-links between Cys and Asp or Glu residues. Previously, we have shown that an Fe-S cluster containing

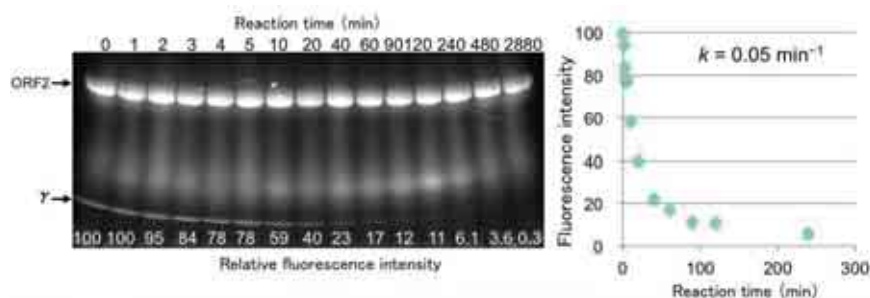


Fig. 1 Kinetic analysis of cross-link formation with NAM

protein encoded in the second ORF of the *n*-butylamine-utilizing operon of *Paracoccus denitrificans* (termed ORF2) has an essential function in the cross-link formation of the γ -subunit. In this study, we investigated the reaction mechanism of ORF2 for the formation of intra peptidyl thioether bond, which is generally very unfavorable by a chemical method. An active ORF2 protein can be successfully purified under strictly anaerobic conditions when it is produced with *E. coli* expression system by coexpression with the γ -subunit. Over 80% of the crosslinks of the γ -subunit is estimated to be formed with the purified ORF2 protein after the Fe-S cluster is regenerated. The formation of the thioether bond can be assayed with MALDI-TOF mass spectrometry followed with SH group blocking by iodoacetamide. NAM (*N*-(9-acridinyl)maleimide) labeling enables easy and quantitative detection of the cross-link formation on SDS-PAGE. HPLC assay of the reaction products indicated that S-adenosylmethionine (SAM) was degraded to 5'-deoxyadenosine and methionine. These facts indicate that ORF2 protein belongs to the radical SAM supper family. The ORF2 protein can be applied to a molecular tool to construct the multiple cyclic peptides.

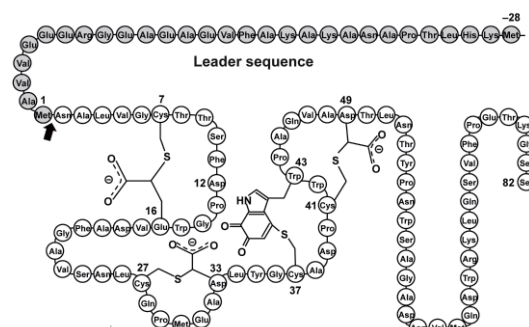


Fig. 2 Intra peptidyl cross-links formed in γ -subunit

Development of Novel Antibiotics Effective for Multiple Drug Resistant Bacteria

The two-component signal transduction system (TCS), composed of a trans-membrane sensor histidine kinase (HK) and a cytosolic response regulator (RR), is one of the major bacterial signal transduction systems. In a typical TCS, an HK is able to sense an exterior signal, transduces it inside the cell across the membrane, and finally autophosphorylates its conserved histidine residue. Inside the cell, the phosphoryl group is transferred to the conserved aspartic acid residue of the cognate RR. The majority of RRs act as DNA-binding transcriptional regulators in a phosphorylation-dependent manner and control expression of the genes involved in the adaptation for the initial environmental changes. In this study, we found the first antibiotics that function as an inhibitor (signermycin B) for WalK, essential HK for bacterial viability, by screening *Streptomyces* extracts. Signermycin B exhibited antimicrobial activity against many gram-positive bacteria including drug-resistant bacteria methicillin-resistant *Staphylococcus aureus*, and vancomycin-resistant *Enterococcus faecalis*. Various assay showed that signermycin B binds to the dimerization domain but not the ATP-binding domain of WalK and inhibits WalK phosphorylation activity. Since TCS is a signal transduction system that is absent in human and signermycin B is not competitive against a common energy molecule ATP, signermycin B is potentially low risk for side effect on human body. These results exhibit that signermycin B is a seed for new generation of antibiotics targeting the bacterial signal transduction system.

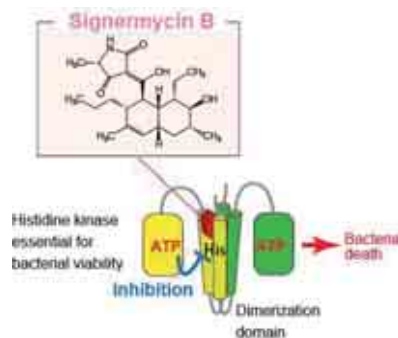


Fig. 3 Inhibition mechanism of signermycin B

Department of Cell Membrane Biology

Professor: Akihito YAMAGUCHI
Associate Professor: Tsuyoshi NISHI
Assistant Professor: Ryosuke NAKASHIMA
Specially Appointed Assistant Professor: Keisuke SAKURAI
Graduate Students: Seiji YAMASAKI, Masaki YAMASAKI, Yumiko MATSUYAMA, Suguru YAMASAKI, Katsuhiko HAYASHI
Supporting Staff: Aiko FUKUSHIMA, Kimie KITAGAWA, Sumie MATSUOKA

Outlines

Xenobiotic extruding pumps have recently been known to be widely distributed in living organisms from mammalian to bacteria as a host-defense mechanism in cellular level. These pumps not only confer multidrug resistance of cancer cells and pathogenic bacteria but also cause hereditary diseases through the mutation. The purposes of our laboratory are to elucidate the molecular structures and the molecular mechanisms of these xenobiotic exporters and the roles of these exporters in cell functions.

We determined the crystal structure of bacterial major xenobiotic exporter AcrB and elucidated the molecular mechanism of xenobiotic export and the structural basis of multidrug recognition by determining the crystal structure of the drug-binding form of AcrB. In 2012, we solved the first inhibitor-bound structures of AcrB and MexB successfully at last. The pyridopyrimidine derivative tightly binds to a narrow pit composed of a phenylalanine cluster located in the distal pocket and sterically hinders the functional rotation. The structure of the hydrophobic trap will contribute to the development of universal inhibitors of MexB and MexY. In addition, studies on the exporters for lipophilic signal transducers in mammalian cells have also been advanced as described below.

Current Research Projects

The Inhibitor Specificity is Determined by the Small Difference in the Amount of Space in the Hydrophobic Narrow Pit

This pit is a hydrophobic trap that branches off of the substrate-translocation channel. F178 is located at the edge of this trap in AcrB/MexB and contributes to the tight binding of the inhibitor (ABI-PP) molecule through a π - π interaction with the pyridopyrimidine ring. The voluminous side chain of W177 located at the corresponding position in MexY prevents inhibitor binding, which may be the reason why ABI-PP does not inhibit MexY. To confirm this hypothesis, we constructed the mutants, MexY W177F, MexB F178W and AcrB F178W. The inhibitory effect of ABI-PP on efflux transporters was measured by examining its effect on cell growth and its ability to prevent the accumulation of doxorubicin in *E. coli* cells. The results were indicating that the AcrB F178W mutant is no longer inhibited by ABI-PP, and in contrast, the MexY W177F mutant is inhibited by ABI-PP. These clearly indicate that

the presence of a voluminous side chain at the edge of the hydrophobic trap in MexY reduces the inhibitory activity of ABI-PP.

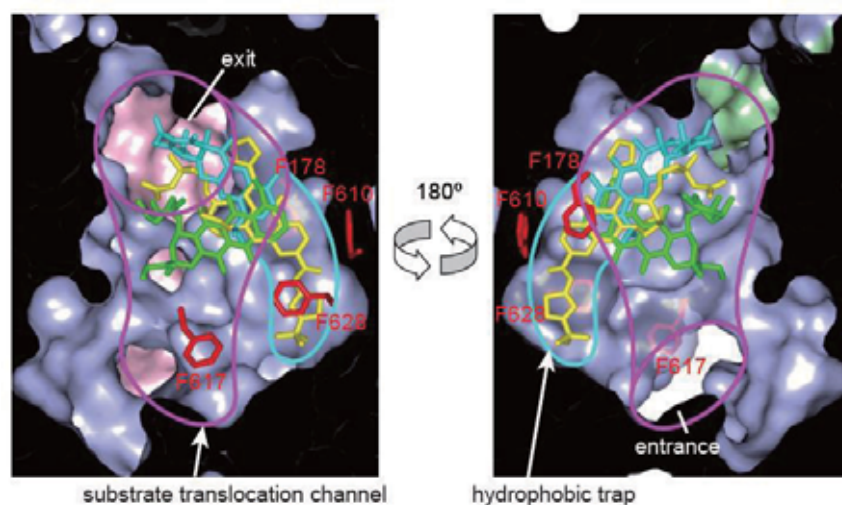


Fig. 1. Cutaway view of the distal drug-binding pocket toward the exit and the entrance. Bound minocycline (blue) and doxorubicin (green) are superimposed on inhibitor (yellow) binding structure.

Physiological Role of the Sphingosine 1-phosphate Transporter, SPNS2 in Mice

Sphingosine 1-phosphate (S1P) is one of the most important lipid mediators and essential for cell migration such as lymphocyte, preosteoclast cells and endothelial cells in mammalian. We have been trying to identify the physiologically functional S1P transporter(s) that supply S1P into blood plasma in mammals. Recently, we identify the zebrafish *Spns2* is a physiologically functional S1P transporter and essential for myocardial precursors migration to form normal heart in zebrafish. Human and mouse *Spns2* orthologues have S1P transport activity as similar extent to zebrafish *Spns2*.

To elucidate a physiological role of SPNS2 in mammals, we analyzed SPNS2-deficient mice. SPNS2-deficient mice were born in the expected Mendelian ratios and showed no abnormalities in the cardiovascular system or other organs, suggesting that there are functional differences between zebrafish and mammals in cardiogenesis.

Spns2 transcripts were detected in vascular endothelial cells and S1P secretion were abolished in the vascular endothelial cells prepared from SPNS2-deficient mice. Consequently, blood plasma S1P concentration of SPNS2-deficient mice was reduced to approximately 60% of that of wild type. Although about a half of S1P remaining in blood plasma, the blood of SPNS2-deficient mice contained significantly fewer lymphocytes. However, lymphocytes in SPNS2-deficient mice thymus express more S1p1 and show a high migration activity at a lower S1P concentration.

These results suggested that S1P at microenvironments around the thymus endothelial cells is rather important for the lymphocytes egress from the thymus than overall S1P concentration in plasma.

Department of Biomolecular Science and Engineering

Professor: Takeharu NAGAI
Associate Professor: Yoh WADA
Assistant Professor: Tomoki MATSUDA, Yoshiyuki ARAI
Specially Appointed Associate Professor: Kenta SAITO (-2012.6.30)
Specially Appointed Assistant Professor: Masahiro NAKANO
Post Doctoral Fellows: PEREZ Koldenkova Vadim, TIWARI Dhermendra Kumar
Kunito YOSHIDA (2012.11.16-)
Graduate Students: Kazushi SUZUKI, Kousui HORIUCHI
Under Graduate Students: Shigenori INAGAKI, Syoji KAWAKAMI
Research Student: Yu-Fen CHANG, Noritaka FUKUDA
Supporting Staff: Kazuyo SAKAI

Outlines

The “cooperative” functioning of a nanosystem composed of a small number of elemental molecules can be considered as a vital phenomenon in living system. However, no previous study has analyzed the elementary process of cooperation among small groups of molecules (minority molecules) in live cells. In our laboratory, we will approach how the minority molecules in live systems emerge robustness and adaptability of cellular functions by developing super-resolution molecular counting methods and techniques for physiological imaging and manipulation at molecular level.

Current Research Projects

Photoactivatable Ca^{2+} Indicator PA-TNXL.

Calcium ion (Ca^{2+}) is a universal second messenger involved in cellular signal transduction and plays crucial role in a number of physiological processes such as neural transmission and cardiac contraction. Genetically encoded fluorescent Ca^{2+} indicators for bioimaging are powerful tools for visualizing Ca^{2+} dynamics related to biological phenomena. However, available gene promoters or localization sequences are not applicable for visualizing all expression events. Furthermore, a visualization technique focusing on single cells or cellular compartments is required for characterizing specific cellular properties including individuality of cells in the cell population. To address these limitations, we developed a genetically encoded caged Ca^{2+} indicator for which expression timing and location could be controlled. This indicator, PA-TNXL, comprises a Ca^{2+} -binding protein and troponin between a photoactivatable FRET donor

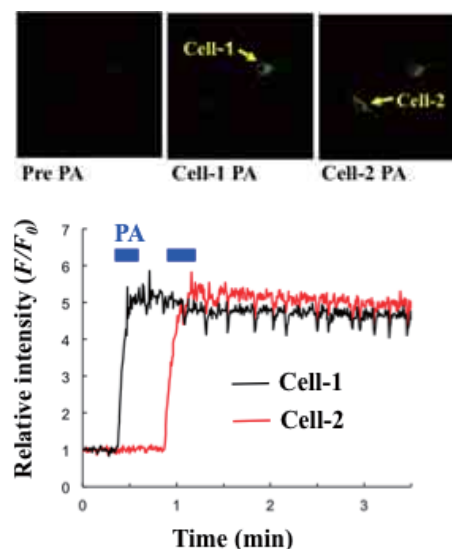


Fig.1 Photoactivation and imaging of spontaneous Ca^{2+} oscillation in rat hippocampal neuron dissociation culture by PA-TNXL

(PA-GFP) and a FRET quencher (dim variant of YFP). Ultraviolet irradiation activates the FRET Ca^{2+} indicator. Using this indicator, we successfully imaged Ca^{2+} dynamics in a given set of HeLa cells and cultured hippocampal neurons. This technology can be applied for developing other photoactivatable indicators, thereby opening a new area of biological research. Imaging studies conducted using photoactivatable indicators will allow imaging of specific cells; imaging studies will no longer be limited to the small repertoire of available gene promoters. In addition, examining single cells will allow for more precise quantitation, a quality that is lost when examining bulk cells. These indicators can be used to determine how individual cells cooperate to contribute to the systematic behavior in the tissue or entire body. [Original Paper 11]

Super-duper Bright Chemiluminescent Protein Nano-lantern.

Recent live cell imaging technologies enable us to visualize cells, organs and animals in living conditions with use of fluorescent proteins. However, because of the requirement of external excitation light, so far several problems are pointed out such as phototoxicity, decrease of signal-to-ratio caused by autofluorescence from samples and in case of compatible use of optogenetic tools which also recommend excitation light. Therefore, use of chemiluminescent proteins which emit photons by catalyzing substrates are desired. However, due to the low signals of chemiluminescent proteins, real time imaging has not been available so far. Here, we developed Nano-lantern, a fusion of *Renilla* luciferase Rluc and fluorescent protein Venus, which has 10 times higher luminescent signals than previous chemiluminescent proteins by using Förster resonance energy transfer phenomenon. We successfully observed live cell imaging with Nano-lantern as well as conventional fluorescent proteins. We could also observe Nano-lantern transplanted mouse with hair and freely locomoting conditions at video rate. Next, we developed Nano-lantern based second messenger indicators, Nano-lantern (Ca^{2+}), Nano-lantern (ATP) and Nano-lantern (cAMP). Compatible use of Nano-lantern (Ca^{2+}) and optogenetic tool Channelrhodopsin2 enabled us internal Ca^{2+} increase upon light stimulation in neuronal cells. In plant cell which has large autofluorescence, we observed biphasic ATP increase by Nano-lantern (ATP) upon light synthesis. Finally, we could observe cAMP relay under aggregation stage of *Dictyostelium discoideum* which is known as sensitive for phototoxicity. [Original Paper 7]

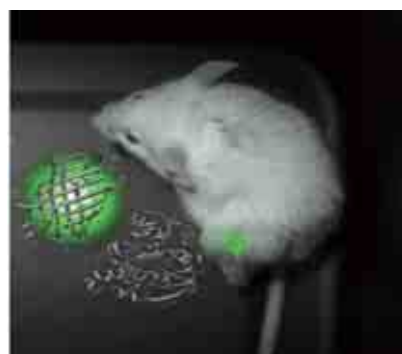


Fig.2 Model structure of Nano-Lantern and Nano-Lantern expressing cancer cell transplanted mouse

Division of Next Industry Generation

Outlines

Three new research departments have been established. The goal of each department is to provide advances in science and technology via close relationships with industry, which will lead to create a novel industry in the 21st century.

The departments are:

-Department of New Industrial Projection

Perform research on new projects that can lead to industrial-structure innovations in the next generation.

-Department of New Industry Generation System(s)

Investigate and develop novel business systems that enable transfer of academic research outcomes to a new industry effectively and promptly, and that intend to improve productivity through responding to social demands.

-Department of Intellectual Property Research

Perform the strategic world-leading study of intellectual property linked with potential needs of the society, where the academia is required to create intellectual properties efficiently from the wide-ranging knowledge accumulated from academic research of the new interdisciplinary fields of material, information, and biology.

Department of New Industry Generation System

Specially Appointed Professor: Mototsugu OGURA

Outlines

Based upon "Collaboration Framework Agreement" between imec and ISIR, 1st imec Handai International Symposium was held on June 4&5, 2012. JSPS Brain Circulation Program and JSPS Core to Core Program were accepted. The academic exchange agreement between imec and ISIR was extended into imec and Osaka University in cooperation with Graduate School of Information and Technology. The concept of imec Japan + ISIR cooperation ambition was considered, then proposed to METI and MEXT.

Current Research Projects

1st imec Handai International Symposium

Total 143 participants were joined for 2 days(June 4 and 5).,

Invited speakers (13 members) were of especially Jo de Boeck CTO, Paul Heremans director, Iryna Yakimets manager, Naoto Horiguchi managers, Piest de Moor, Pol Van Dorpe, Cedric Huyghebaert of imec. to discuss our collaboration topics. General participants were from METI, Panasonic, Tokyo Tech, Fujitsu, IDEC, HOYA executives.



Fig.1 Photo of 1st imec Handai International Symposium

JSPS Brain Circulation Program (coordinator: Junichi Takeya professor)

"Intensive Education Program to Foster Young International Researchers in Collaboration with an International Research Consortium of Advanced Electronics Nanodevices" was accepted, then started last October for coming 2.5 years to establish mutually friendship relations and to do human resource cultivation. Araki PhD student and Uemura assistant professor were as the resident of Holst Centre and imec Leuven to develop new stretchable conductor by printing and new burned technologies and to develop solution-crystallized high-mobility organic transistors and its application to CMOS circuits, respectively.

JSPS Core to Core Program (coordinator: Kazuhiko Matsumoto vice director)

"International Research Collaboration Network for Developing Highly Functional

Sensing Devices for Health, Safety and Security" was accepted. ISIR is as main hub, and composed of 6 overseas hub (Max Planck, imec, Purdue univ., univ Oxford, NTNU, Paris Sud univ.) to do academic exchange and to have 17 seminars for coming 5 years.

Academic exchange with imec was extended into whole Osaka University

This academic exchange agreement was extended last October in cooperation with Graduate School of Information and Technology.

2nd imec Executives Special Conference

This conferences was held last November, Jo de Boeck gave the topic of imec executive overview, especially imec latest results of advanced semiconductor, body area network, life science, solar cells), Paul Heremans the topic of organic devices and flexible electronics(OLED lighting&display, OPV, organic REID, and organic MPU).



Fig.2 Poster used in ISIR



Fig.3 Jo CTO presentation

Proposal of (imec Japan + ISIR) Cooperation Ambition Concept

Holst Centre like R&D cooperation ambition of imec Japan and ISIR was proposed to MET and MEXT together with imec executives(Gilbert Declerck former CEO& president and Jo de Boeck CTO last December, and basically was accepted.. Three key points for success are the support of local committee (ISOR), leading company (Panasonic) and government budget (MEXT, METI).

Department of Intellectual Property Research

Specially Appointed Professor: Hirokazu SHIMIZU
Invited Professor: Akio KOBAYASHI
Specially Appointed Associate Professor: Shigeki KAWAKAMI
Invited Associate Professor: Takahiro MURATA
Specially Appointed Assistant Professor: Yoshihiro KIMURA

Outlines

The object of this department is to perform the strategic world-leading study of intellectual property linked with potential needs of the society, where the academia is required to create intellectual properties efficiently from the wide-ranging knowledge accumulated from academic researches of the new interdisciplinary fields of material, information, and biology.

We gained three external grants, the Wakasa Wan Energy Research Center industry-university cooperation joint research, the Japanese Society of Eucommia / 8th research grant, and the 160th committee on plant biotechnology "industry-university cooperation activity strengthening program, respectively. These empirical studies were carried out.

Current Research Projects

Research on Methods of Searching Academia Industry Collaboration Partners by Patent Survey

To promote the use of intellectual property held by the University, we developed new methods to explore the possible partners of joint research in the industry by patent-related information survey. We applied the specific case study of the new methods for searching the companies with high professional and specialized properties, and demonstrated that this method is effective in finding companies with the potential for application deployment and matched with the university research.

Investigation of New Business Fields of Academia Industry Collaboration

We have investigated the R&D problems and university-industry collaboration projects of the following new business fields.

- New element technologies to enable the value adding of natural materials
- Development of manufacturing technology for tableting mold with low sticking characteristics
- Development of Laser lighting technology (number of patent applications: 3)

New Element Technologies to Enable the Value Adding of Natural Materials

We demonstrated a simple method to preserve physiologically homogenous plant flowers and mushroom tissues using Cobalt-60 radiation in the Wakasa Wan Energy Research Center industry-university cooperation joint research.

To develop systems to create intellectual properties from plant biology, we inspected Eucommia farms and research laboratories in China.

We held on a public symposium to promote public relations and public engagement in plant biotechnology.

Specially Appointed Laboratory: Kawai FIRST Project

Specially Appointed Professor:	Tomoji KAWAI
Specially Appointed Assis. Professors:	Takahito OHSHIRO, Masayuki FURUHASHI, Sou RYUZAKI, Kazumichi YOKOTA, Mingsheng XU
Specially Appointed Technical Expert:	Hiroe KOWADA
Specially Appointed Researchers:	He YUHUI, Sakon RAHONG, Kazumi KONDA, Chie HOTEHAMA, Tomoyo KAWASE, Sanae MURAYAMA, Rie YAMADA
Support Staff:	Yayoi KATAYAMA

Outlines

Our research group was launched in 2010 as one of the FIRST Projects: “Research and Development of Innovative Nanobiodevices Based on Single-Molecule Analysis”, and directs toward developing innovative technologies and devices that enable single-molecular separation, detection, and analysis of biological substances of varied sizes such as DNA/RNA molecules, proteins, virus, and pollen allergens. Main subjects are (1) Sequence of RNA/DNA using tunneling current, (2) Development of Gating Nano/Micropore Device for Single-molecule Analysis, (3) Control of Translocational Velocity for a DNA Passing through a nanopore, (4) Denaturation of DNA in an integrated microchannel with an embedded microheater.

Current Research Projects

Sequence of RNA/DNA Using Tunneling Current

A “transverse” electrical conductivity detection of a DNA/RNA sequence has been proposed as a promising methodology that can be potentially used for a high-speed electrical discrimination of the individual nucleotides without chemical probes and PCR amplifications. This method is based on sequentially reading the transverse electron transport across individual single-nucleotides in the sequence. In this fiscal year, we report on a read of DNA / RNA sequence by the transverse electron transport. We measured the single-molecule electrical conductance for let7 family oligonucleotides at the single-nucleotide level, by using gap-tunable gold nanoelectrode. Based on this determined electrical conductivity for single-nucleotides, we electrically identify the base-type in their oligonucleotides, and read the fragment of sample nucleotide passing through the sensing electrode. On the basis of a reconstruction of the read fragment sequences, we performed a resequencing and determined a sample RNA sequence.

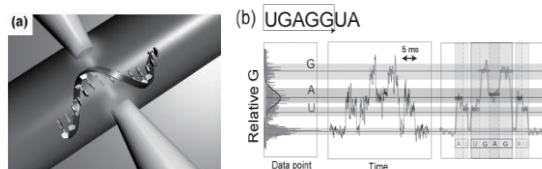


Fig.1 (a) Schematics of Tunnel-Current based Single-Molecule Electrical Sequencing. (b) A typical molecular Signal for let7 common region sequence.

Development of Gating Nano/Micropore Device for Single-molecule Analysis

For a rapid and low-cost DNA sequence, it is essential to perform high sensitive electrical measurements on solid state nanopore devices integrated on-chip. We have

fabricated in-plane nanopore devices (Fig. 2a) and vertical nanopore devices (Fig. 2b) and have developed a high speed and high sensitive electrical measurement system for these devices. The in-plane nanopore device, in which microfluids, microheater, electrophoresis electrodes, and nanogap electrodes embedded in a nanopore are integrated, enabled the increasing of detection rate by applying an electrophoresis voltage. Also, it was found that the transverse time of molecules can be controlled by using the vertical nanopore devices which possess a micro/nanopore surrounded by a gate electrode.

Control of Translocational Velocity for a DNA Passing through a Nanopore

One of the most important issues which should be solved is controlling the DNA translocation speed at a nanopore in order to achieve the practical use of the nanopore DNA sequencer as the velocity of DNA is too fast to sequence. We work on the control the DNA translocation speed by means of reverse electroosmotic flow to the DNA translocation, which is caused by a charged surface of the surround gating nanopore (Fig. 3). The surround gating nanopores are fabricated by coating SiN nanopores with Au electrode, and the diameter of the nanopores is less than 20 nm. In this study, the DNA translocation speed was found to be reduced to one-tenth by the gate voltage ($V_g = -500$ mV) when compared to $V_g = 0$ V. In addition, the speed reduction is controllable by adjusting V_g , ion density of the solution, etc. It was found that the surround gating nanopores are effective devices for the controlling the DNA translocation speed.

DNA Separation and Elongation in a Nanostructure-integrated Microchannel

Denaturation of double-stranded DNA (dsDNA) is indispensable for sequence of DNA bases by tunneling current. A microheater has a good controllability for temperature and is easily integrated on a microfluidic device. In this year, we fabricated a Pt microheater on a glass substrate (Fig. 4a), and investigated property of rise of temperature and locality of its temperature. After addition of voltage on the heater for 1s, the temperature nearly reached to that of steady state. The comparison of experimental data with simulation shows that the spread of heat on the substrate is suppressed within 100 μ m. In addition, we demonstrated denaturation of dsDNA with flurophore using the microheater. We found that the denaturation occurred within 60 ms from the heating.

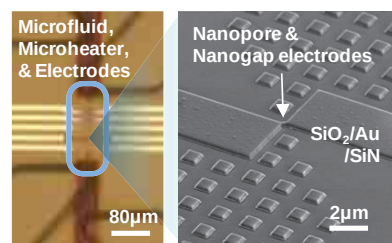


Fig. 2(a) An optical microscope image and a SEM image for the in-plane nanopore device.

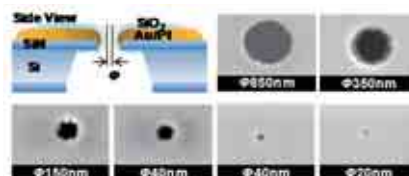


Fig. 2(b) A side view illustration for the vertical nanopore devices and SEM images for the surrounding gated micro/nanopores.

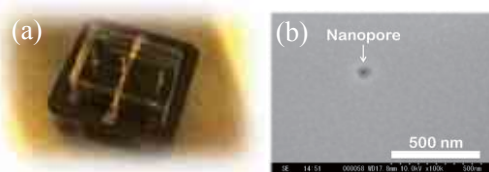


Fig. 3 (a) Surround gating nanopore device. (b) SEM image of 20 nm-diameter surround gating nanopore.

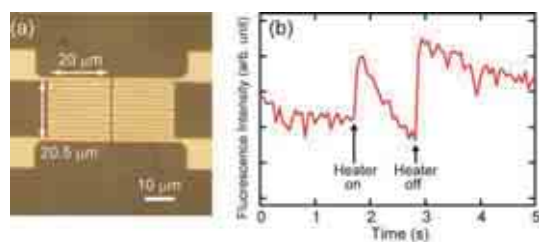


Fig. 4 (a) Photograph of the fabricated microheaters. One of them is used as a thermometer. (b) Variation of fluorescence in intensity from the labeled DNA solution during heating.

Laboratory of Microbiology and Infectious Diseases

Associate Professor:	Kunihiko NISHINO
Specially Appointed Assistant Professor:	Mitsuko NISHINO
Specially Appointed Researcher:	Yoshimi MATSUMOTO (Visiting Professor)
Graduate Students:	Katsuhiko HAYASHI, Suguru YAMASAKI, Seiji YAMASAKI,
Supporting Staff:	Aiko Fukushima

Outlines

Multidrug-resistant bacteria are now encountered frequently and the rates of multidrug resistance have increased considerably in recent years. Genome annotation produces a considerable number of drug efflux pumps in bacteria. We previously identified efflux pumps related with bacterial multidrug resistance and virulence. Our discoveries support the notion that drug efflux pumps have specific physiological substrates because these pumps have been shown to have roles in bacterial virulence. We are trying to identify natural substrates of drug efflux pumps in order to understand physiological functions of pumps. This knowledge should promote the development of novel inhibitors or strategies that could counteract the contribution of efflux pumps to drug resistance and virulence.

Current Research Projects

Effects of Indole on Drug Resistance and Virulence of *Salmonella enterica* Serovar Typhimurium Revealed by Genome-Wide Analyses

Bacteria communicate using small molecules by a process termed quorum sensing. Accumulation of quorum-sensing signals in growth medium indicates cell density. The use of chemical signals for bacterial communication is a widespread phenomenon.

The intestinal tract is colonized by approximately 10^{12} commensal bacteria including those belonging to the genus *Escherichia*. Among *Enterobacteriaceae*, indole is produced by *E. coli* and certain *Proteaeae* such as *Proteus vulgaris*, *Providencia* spp., and *Morganella* spp.. Indole production is commonly used for *Escherichia coli* identification. Indole is generated from tryptophan by the enzyme tryptophanase, encoded by *tnaA*. Extracellular indole is found at high concentrations

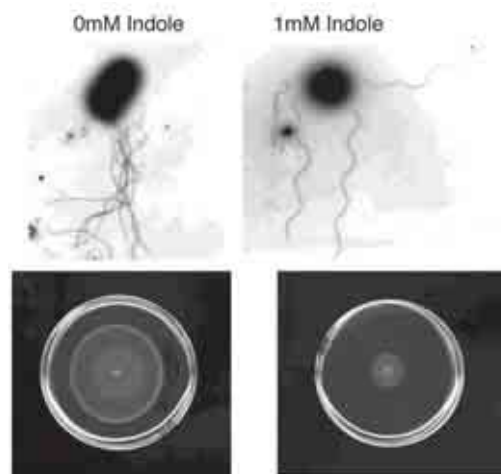


Figure 1. Indole represses flagella production and motility of *Salmonella*. Transmission electron microscopy was used to detect flagella on the wild-type strain (ATCC14028s) grown in the presence or absence of 1 mM indole. Indole represses motility of *Salmonella*. After incubation of the wild-type ATCC14028s strain in the presence or absence of 1 mM indole, motility was assayed on a semi-solid agar plate. Result is representative of one of the three experiments.

(over 600 μM) when *E. coli* is grown in enriched medium. Furthermore, indole has also been found in human feces at comparable concentrations (~250–1100 μM). Recent studies have also revealed that indole is an extracellular signal in *E. coli*.

Salmonella enterica is a bacterial pathogen that causes various diseases in humans including gastroenteritis, bacteremia, and typhoid fever. In contrast to *E. coli*, *S. enterica* does not harbor *tnaA*; therefore,

this organism does not produce indole. Our previous study suggests that indole is used as a cell-signaling molecule in both intra- and inter-species communication. However, the global effect of indole on *Salmonella* remains to be elucidated.

To understand the complete picture of genes regulated by indole, we performed DNA microarray analysis of genes in the *S. enterica* serovar Typhimurium strain ATCC 14028s affected by indole. Predicted *Salmonella* phenotypes affected by indole based on the microarray data were also examined in this study. Indole induced expression of genes related to efflux-mediated multidrug resistance, including *ramA* and *acrAB*, and repressed those related to host cell invasion encoded in the *Salmonella* pathogenicity island 1, and flagella production. Reduction of invasive activity and motility of *Salmonella* by indole was also observed phenotypically. Our results suggest that indole is an important signaling molecule for inter-species communication to control drug resistance and virulence of *S. enterica*.

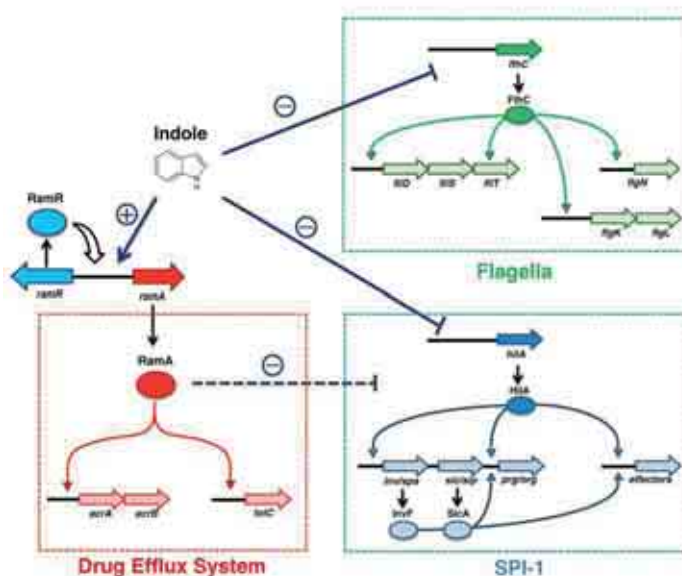


Figure 2. Proposed regulatory network controlled by indole. Indole induces the multidrug efflux system genes *acrAB* and *tolC* through the increased expression of *ramA*. Indole represses flagellar and SPI-1 genes in a *ram* locus-independent manner. However, the indole-mediated upregulation of *ramA* may be partially involved in decreased expression of SPI-1 genes.

Quick Tests for MDRP and Drug Efflux Activity of Bacteria

Resistant bacteria, which antibiotics cannot destroy, have posed a problem in the medical arena in many countries. We have developed a method utilizing microfabrication technologies to detect multidrug resistant bacteria in a very short period time. Our method allows judgment to be made in just 15 minutes to measure the bacterial drug efflux activity.

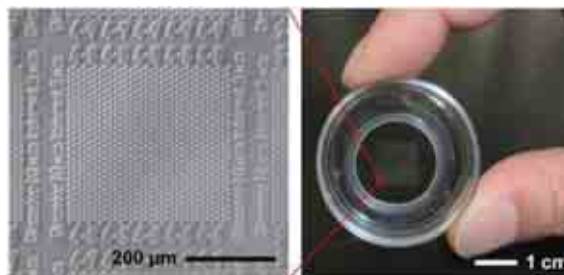


Figure 3. A single-cell drug efflux assay device.

Laboratory of Atomic Scale Materials Processing

Associate Professor:	Takeshi YANAGIDA
Specially Appointed Assistant Professor:	Kazuki NAGASHIMA
Specially Appointed Researcher:	Fuwei ZHUGE
Specially Appointed Researcher:	Yong HE
Specially Appointed Researcher:	Gang MENG (2012.4.1-)

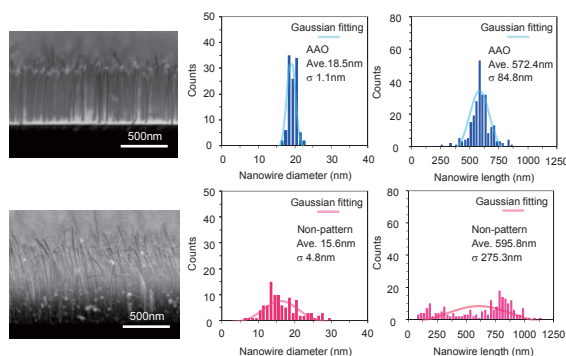
Outlines

This research group investigates the atomic scale materials processing by taking over the principle of nature, in which their 3D hierarchical structures are naturally formed by utilizing extremely small energy and reacting in limited environments. We try to explore the mechanism of such atomic scale materials processing, and to create the original hierarchical nanostructures, the functional properties and the unique nanodevices. Main subjects are (1) Creation and design of one-dimensional functional nanowires via identifying fundamental principles of the atomic scale materials processing, (2) Search for nanoscale physical properties in a spatially confined single nanowire, (3) Developments of green-electronics devices (nonvolatile memory and energy conversion, etc.) and biomolecular analysis devices.

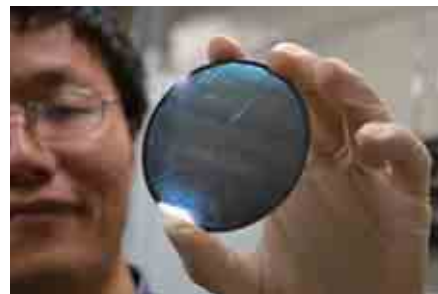
Current Research Projects

Development of Large Scale Uniform Nanowire Growth Technique

Creating uniform nanowires with small morphological distribution is strongly demanded in bottom-up nanostructures for practical nanodevice applications. However, none of nanowire fabrication techniques with scalability and uniformity has existed. Here we demonstrated a novel nanowire patterning technique using ultra thin anodic aluminum oxide (AAO) membrane mask. In conventional vapor-liquid-solid (VLS) nanowire growth technique, preparing the metal catalysts with uniform size and uniform adjacent spacing is crucial for uniform nanowire growth. In this study, AAO membrane technique successfully validated the improvement of structural distribution of nanowires by 3-5 folds and could be applicable up to 3 inch wafer scale. These results provide a platform to investigate the nanodevices using bottom-up nanowires.



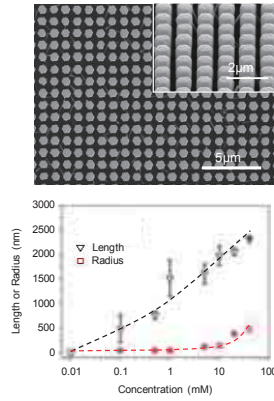
Nanowire structural distributions of AAO membrane technique (upper) and of conventional technique (lower).



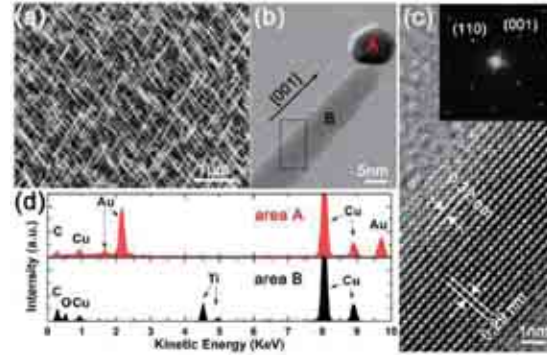
Transferred AAO membrane onto 3 inch wafer.

Critical Crystal Nucleation Mechanism on Nanowire Growth

Although an anisotropic crystal growth is essential for creating one-dimensional nanowire structures, the knowledge as to the crystal nucleation, which initiates the nanowire growth, is scarce due to the complexity of nanowire growth system. Here we demonstrated the impact of critical material supply rate (partial pressure for vapor phase and concentration for solution phase) on both vapor and solution nanowire growth systems, which crucially determines the anisotropic crystal growth. Furthermore, TiO₂ nanowires were successfully fabricated with precise control of material supply flux, which had been difficult to be fabricated in vapor system. These results encourage synthesizing the various novel nanowires via controlling material flux.



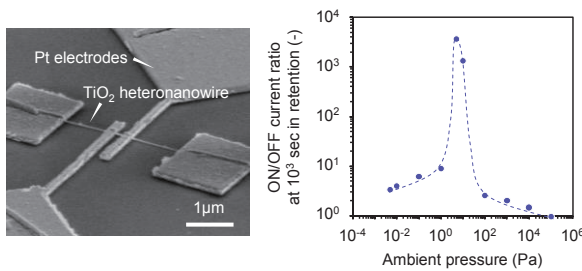
Nanowire growth in solution system and the crystal plane dependent critical nucleation.



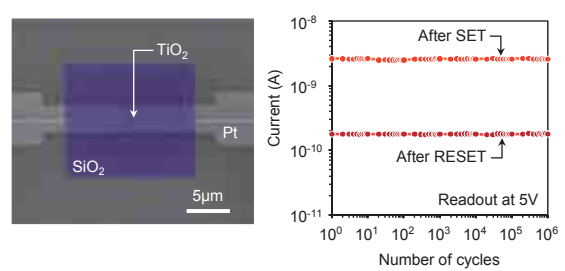
TiO₂ nanowires grown via precise material supply flux control.

Revealed Thermodynamical Stability of Nanoscale ReRAM via Nanowire Device

Switching of electrical resistance in metal/oxide/metal structure has attracted much attention as next-generation high-density nonvolatile memory, so-called ReRAM or memristor due to its excellent memory performance. Despite its ability, the switching mechanism in nanoscale, especially the thermodynamical stability of nanoscale switching, is lacking, which had been big hurdle to design nanoscale ReRAM. Here we demonstrated the open-top planar-type nanowire ReRAM device to investigate the thermodynamical interaction of switching event with surroundings. The results showed the material dependent thermodynamical stability of switching and provided the direction to design the stability of switching event at nanoscale. We also drastically improved the stability of switching event in TiO₂, which was quite unstable in atmospheric condition, by introducing a precise passivation layer. These results offer the novel design rule of nanoscale ReRAM and the importance of passivation layer for future high-density nonvolatile memory applications.



Open-top planar-type nanowire ReRAM device and ambient pressure dependent switching characteristics.



Passivated nanowire ReRAM device and its switching property

Department of Cellulose Nanofiber Materials

Associate Professor: Masaya NOGI

Specially Appointed Assistant Professor: Hirotaka KOGA

Postdoctoral Fellow: Thi Thi Nge

Supporting Staff: Ming-chun HSIEH, Miki NAKAMURA(2012.11.16-), Hitomi YAGYU(2013.3.4-)

Outlines

Cellulose is the most common and abundant bioresources, mainly originating from higher plants. We have successfully extracted cellulose nanofibers with widths of 4-15 nm from wood pulps, and have developed cellulose nanofiber-based materials, such as transparent paper, especially for electronic applications.

Current Research Projects

Optically Transparent Paper with High Thermal Resistance

Highly transparent paper with a total transmittance of ca. 90% was successfully prepared from wood-derived cellulose nanofibers (Fig. 1). The transparent paper has high thermal durability, and thus is a green alternative for plastic films.



Fig. 1 Transparent paper.

Paper Solar Cell

Organic solar cells were successfully fabricated on a transparent paper by collaboration with Assis. Prof. Makoto Karakawa, Department of Soft Nanomaterials. The paper solar cell having conversion efficiency of ca. 3% is expected as next-generation energy devices with lightweight and foldable properties (Fig. 2).



Fig. 2 Paper solar cell.

Origami Electronics

Conductive Origami was prepared by using silver nanowires and cellulose nanofibers. As shown in Fig. 3, the conductive paper can light up LED even after folding. This technique can be applied for the preparation of foldable nanopaper antenna.



Fig. 3 Conductive paper crane.

Printable Conductive Nanoink

We found that cellulose nanofibers act as dispersing agent for carbon nanotubes (CNT). As shown in Fig. 4, the aqueous dispersion can be used as printable nanoink to provide conductive properties for various substrates including PET films.

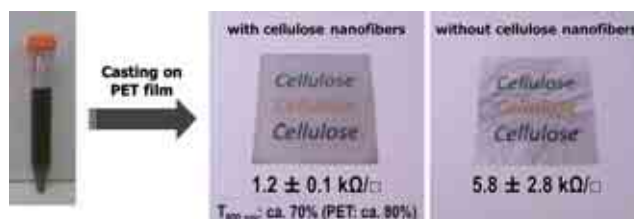


Fig. 4 Conductive nanoink based on CNT and cellulose nanofibers.

Department of Beam Application Frontier

Specially Appointed Professor:	Seiichi TAGAWA
Specially Appointed Professor:	Masayuki ENDO
Specially Appointed Associate Professor	Akihiro OSHIMA (2012.6.1-2013.3.31)
Specially Appointed Researcher:	Dinh CONG QUE
Specially Appointed Researcher:	Dang NGUYEN TUAN (-2013.2.28)
Assigned Researcher:	Satoshi ENOMOTO
Supporting Staff:	Kaoru KOJIMA

Outlines

In department of Beam Application Frontier, we pursue the application of device systems which contribute to the forthcoming information society based on basic researches on materials and processes by applying quantum beam technologies to nano-scale measuring and nanofabrication. The most important mission in our studies is the establishment of global science infrastructure. Therefore, we construct knowledge infrastructure and attempt to make new processes and high performance resist materials.

In this year, we have studied the prediction of resist sensitivity in extreme ultra-violet (EUV) region using absorbed dose, and linear energy transfer (LET) effects for resist sensitivity.

Current Research Projects

1. Prediction of Resist Sensitivity in Extreme Ultra-violet (EUV) Region

Recently, potential extension of 13.5 nm extreme ultraviolet lithography (EUVL) to the soft X-ray region in the 6.x nm region (6.6 nm – 6.8 nm) has been discussed in academia and the semiconductor industry in terms of the light source, optics, and resist performance. In this year, we investigated the precise sensitivities of several resists (both non-chemically amplified (non-CA) and chemically amplified (CA) resists) using highly monochromated soft X-rays (3.1 nm – 6.7 nm) from synchrotron radiation with accurate dosimetry at BL27SU of the SPring-8 (seen in Fig. 1). The selected wavelengths included 6.7 nm, which is one of the candidates for 6.x nm EUVL. Each obtained dose/sensitivity (mJ cm^{-2}) was converted into the absorbed doses (Gray; $\text{Gy} = \text{J kg}^{-1}$) in terms of radiation chemistry. Although the absorbed dose in a resist film depends on the resist thickness, the required absorbed doses (D_0 or D_{50}) corresponding to the dose/sensitivities (E_0 or E_{50}) were almost constant for each resist, regardless of the exposure wavelength from 3.1 nm to 6.7 nm. This would be applicable in the EUV/soft X-ray region, where almost the same chemical reactions are induced. According to the our obtained results, the resist sensitivities at any exposure wavelength in the EUV/soft X-ray region can be predicted easily using the obtained sensitivity at a certain wavelength, resist thickness, and linear absorption coefficients calculated using the chemical composition and density of a resist materials. The resist sensitivity at 6.x nm can be predicted by evaluating the sensitivity using a conventional 13.5 nm EUV exposure tool. Moreover, this prediction method can be used for dose calibration of a

simplified EUV exposure tool by using a resist sensitivity obtained for a calibrated exposure source.

2. LET Effects for Resist Sensitivity

The different exposure sources have been carried out a different energy deposition in resist materials. Linear energy transfer (LET) effects for resist sensitivity are very important problem in the viewpoints of radiation induced chemical reaction for high-volume nanofabrication. The sensitivities of positive tone non-CA (ZEP) and CA (UV-III) resist materials are evaluated using various ionized radiation such as EUV, soft X-rays, EB and various ion beams. Since the notation of sensitivity of resist different from exposure sources, in order to evaluate systematically, the resist sensitivity were estimated with absorbed dose in resist materials. Highly-monochromated

EUV and soft X-rays (6.7 nm – 3.1 nm) from the BL27SU of the SPring-8, high energy ion beams (C^{6+} , Si^{14+} and Ar^{18+}) with 6 MeV/u from MEXP of HIMAC, EB from low energy EB accelerator (Hamamatsu Photonics, EB-engine, 100 kV) and EB lithography system (30 kV and 75kV) were used for the exposure. For non-CA and CA resist materials, it was found that LET effects for sensitivity would be correlated with normalized absorbed dose. Especially, in the case of the high energy ion beam less than Si^{14+}/Ar^{18+} with 6 MeV/u, it is suggested that the radiation induced chemical reaction would be equivalent to EUV, soft X-ray and EB exposure. Hence, for the notation of sensitivity of resist different from exposure sources, it indicates that the resist sensitivity could be systematically evaluated by absorbed dose in resist materials.

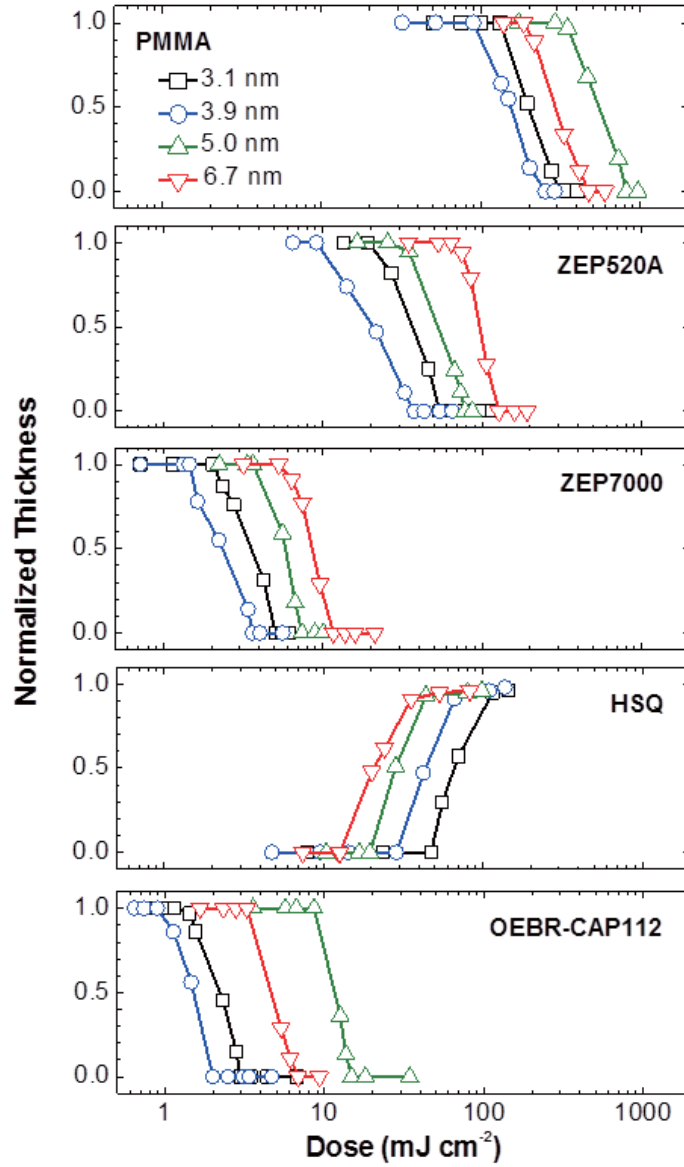


Figure 1. (Color online) Obtained sensitivity curves of PMMA, ZEP520A, ZEP7000, HSQ, and OEBC-CAP112 at 3.1, 3.9, 5.0, and 6.7 nm exposure wavelengths

Department of Chemical Biology, Glycomics Team, Systems Glycobiology Research Group (RIKEN-ISIR, Osaka University Alliance Lab)

Guest Professor:	Naoyuki TANIGUCHI
Guest Associate Professor:	Kazuaki OHTSUBO
Visiting Academic Staff:	Congxiao GAO, Hiroaki KOREKANE
Technical Assistant:	Junko IJIMA, Emmanuel Siota PALACPAC
Supporting Staff:	Izumi SUGASE

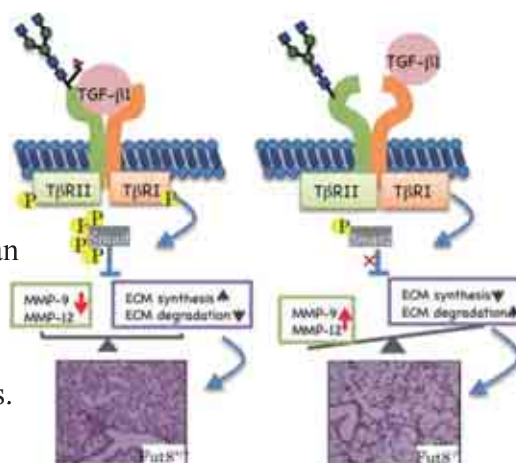
Outlines

Higher organisms use “carbohydrate” as the energy source, as well as the transmitter “Sugar Chain” encoding enormous bio-information by constructing particular glycan structures. The bio-information encoded in glycan structure has been gradually decoded along with the development of glycobiology, and it is well known that sugar chain is essential for maintaining biological functions. Indeed, glycosylation defect evokes various intractable diseases and life-style-related diseases. This laboratory is engaged in biochemical and molecular genetic approach to elucidate the disease process associated with dysglycosylation, to develop diagnostic marker of disease manifestation, and to develop novel strategies for therapy.

Current Research Projects

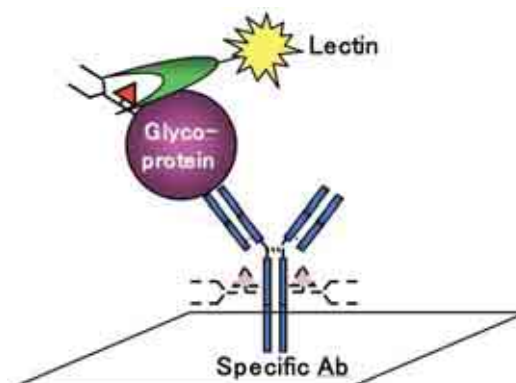
The Role of Glycosylation in Pathology of Pulmonary Emphysema

In Fut8 deficient mice, TGF- β receptor can not be fucosylated and diminishes the TGF- β signaling, that results in the MMP activation and lead to emphysematous changes.



Development of the Highly-Sensitive and -Specific Tumor Diagnostic Marker

We are developing a novel diagnostic technology for cancer by detecting altered protein-glycosylations associated with tumor progression using lectin which preferentially binds to glycan.

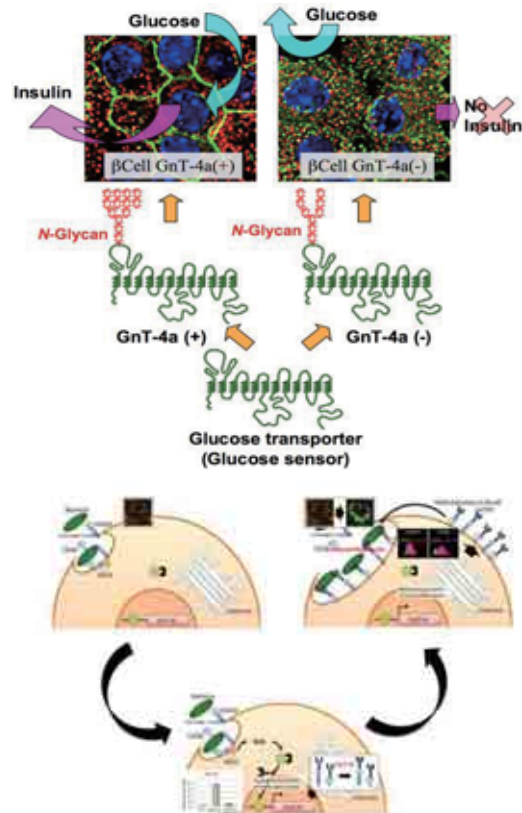


Functional Analyses of Protein Glycosylation in Pathogenesis of Diabetes Mellitus

The proper *N*-glycosylation of glucose sensor is required for the cell surface residency in pancreatic β cells that contributes to maintain insulin secretion. The failure of this mechanism evokes type 2 diabetes.

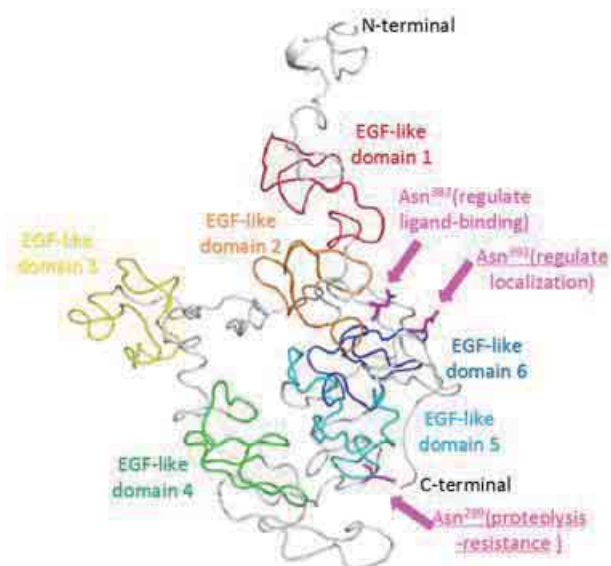
Physiological Control of Scavenger Receptor Glycosylation in the Process of Phagocytosis

We have elucidated GnT-III expression is controlled by production of reactive oxygen species that is coincident with *N*-glycosylation of scavenger receptors and the facilitation of phagocytosis. These results illuminate the biological significance of GnT-III in the positive feedback mechanism in phagocytosis.



Functional Relevance of N-glycans of SREC-I in Pathogenesis of Atherosclerosis

SREC-I is an endocytic receptor for chemically modified LDL such as acetylated and oxidized LDLs and has been implicated in pathogenesis of atherosclerosis. Structure-function relationship analyses revealed that *N*-glycans of Asn289, Asn382 and Asn393 have distinct functions in regulating proteolytic resistance, ligand-binding affinity, and subcellular localization, all of which could be involved in the development of atherosclerosis.



Activities of Centers

Nanoscience and Nanotechnology Center

Director, Professor: Yoichi YOSHIDA
Supporting Staff: Masayo HAYASHI

Outlines

The Nanoscience and Nanotechnology Center was founded in ISIR in April 2002 as the first nanotechnology center in Japan for developing Bottom-up Nanotechnology, Top-down Nanotechnology, and their collaborated applications in industrial field. Following the reorganization in ISIR in 2009, the Center was strengthened to a new structure led by 6 full-time departments.

In the new Nanoscience and Nanotechnology Center, there are 18 research departments composed of 6 full-time departments, 3 departments on concurrently serving in ISIR, 6 departments on concurrently serving in Osaka Univ. 3 departments of domestic and foreign visiting professors. And the Advanced Nanotechnology Instrument Laboratory is newly opened in order to develop cutting edge researches on nanoscience and nanotechnology. The specified period of time set initially has been cancelled; now the Center focuses on nano-system creation in a wide variety of hard, soft, and bio-materials through the combination of top-down and bottom-up nanoprocess; and the new development generated by the interdisciplinary researches on theory and evaluation. Through these new innovations, nanotechnology research is expected to contribute to the interdisciplinary new science development. Furthermore, through constructing variety networks between Japan and overseas countries, the Center aims to become the hub in nanotechnology research.



Department of Functional Nanomaterials and Nanodevices

Professor: Hidekazu TANAKA
Associate Professor: Teruo KANKI
Assistant Professors: Azusa HATTORI, Kohei FUJIWARA
Specially Appointed Researcher: Koichi OKADA
Graduate Students: Hidefumi TAKAMI, Nguyen Thi Van ANH, Atsushi ONO,
Kenichi KAWATANI, Takayoshi KUSHIZAKI,
Yasushi FUJIWARA, Takashi ICHIMURA
Under Graduate Students: Hiroki UEDA, Shouta YAMASAKI, Tatsuya HORI
Research Student: Wei TINGTING
Technical Supporting Staff: Aya IWAKI (2012.9.1-)
Supporting Staff: Tomoko OKUMOTO

Outlines

This research group focuses on functional oxide materials showing huge response against external fields, and establishes nano-fabrication techniques by fusing two processes of “Bottom-up nanotechnology”, which is a film fabrication technique using a pulsed laser deposition (PLD) method, and “Top-down nanotechnology” for nanoimprint (NIL). Our fruition in the near future will lead creation of novel multi-function-harmonized nano-materials/devices with sensing, information processing and memories. The main subjects in this year are outlined below:

Current Research Projects

Construction of functional metal oxide 3D nanostructures

Transition metal oxides possess unique functionalities, and these three-dimensional (3D) nanostructures are indispensable factor to achieve the nanoscale electronic devices. We have been developed a novel nanofabrication technique by combining inclined PLD with NIL, namely “3D nanotemplate PLD” [Original Paper 1, 6, 12, 13] and “3D nano-seeding assembly” [Original Paper 3, 4, 14, 15] techniques. Figure 1(a) shows the epitaxial $(\text{Fe,Zn})_3\text{O}_4$ (FZO) nanowall wire fabricated by 3D nanotemplate PLD [Original Paper 6], and Fig. 1(b) shows the FZO nanoconstriction with a bottleneck width of 65 nm and a length of 53 nm, fabricated by utilizing a nanoscale shadowing effect [Original Paper 1]. FZO is a ferromagnetic semiconductor at RT and one of the candidate materials for spintronics applications, and a nanoconstriction of FZO would produce the enhancement of magnetic resistant effect due to the domain wall pinning effect. Figure 1(c) shows the epitaxial nano-scale FET structure of ferromagnetic FZO and ferroelectric BiFeO_3 fabricated by 3D nano-seeding assembly technique [Original Paper 3, 14].

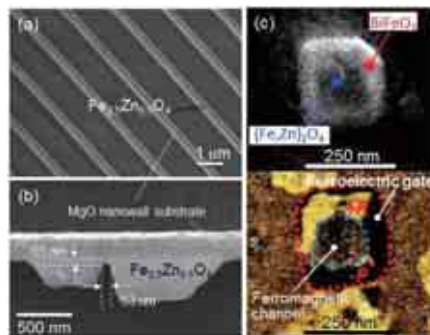


Fig. 1 Typical SEM images for ferromagnetic semiconductor $(\text{Fe}_{2.5}\text{Zn}_{0.5})\text{O}_4$ (a) nanowall wire and (b) nanoconstriction structures. (c) SEM (upper panel) and PFM (lower panel) images of epitaxial nano-scale FET structure obtained by thin film growth based on nano-phase separation and subsequent self-organization

Demonstration of unique electrical properties on VO₂ nano wire

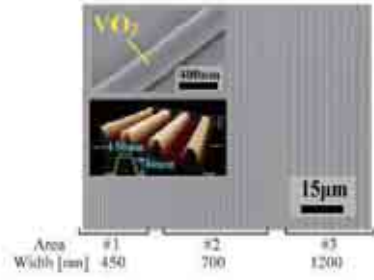


Fig. 2. Top-down SEM image of VO₂ nanowires fabricated by using the nanoimprint lithography method in a wide area. Upper inset shows a tilted and magnified SEM image of a nanowire. Lower inset shows an AFM image.

Vanadium dioxide (VO₂) shows orders-of-magnitude changes in resistance around 340 K, showing a metallic state at high temperature and an insulating state at low temperature. In terms of nano-spatial characteristic in VO₂, their mixed electronic phases are present in nature. These domains work on an important element in their physical properties. In this year, we established a VO₂ nano-fabrication process using a nano-imprint lithography method to evaluate nano-physical properties and successfully obtained VO₂ nano-wires in a wide area (Fig. 2) [Original Paper 8]. Also, we investigated the dependence of spatial dimensionality on wire width for disordered configurations of metal and insulator domains in VO₂ wires on TiO₂ (001) substrates. Domains with 1D alignment were realized in wires. Moreover, variation of dimensionality in the domain configuration caused drastic modification of the electronic properties (Fig. 3) [Original Paper 9, 10]. The concept of dimensional control of domain configuration through precise size control of thin films will provide strategies for creation of unique electronic functionalities in materials with coexisting different electronic phases.

Exploration of electronic phase change phenomena induced by an electric field in layered ferrites

Strongly correlated electrons in transition-metal oxides produce a rich variety of electronic phases, including solid and liquid states of charges, spins, and orbitals, just like interacting atoms and molecules. Devices utilizing the phase changes and associated gigantic responses have been envisaged as a key ingredient for the next-generation electronics. In order to achieve such phase change phenomena at room temperature, we have been exploring electric-field effects on the high-temperature charge ordered states of a mixed-valence layered ferrite, LuFe₂O₄. In this work, we have fabricated *c*-axis oriented films of LuFe₂O₄ by pulsed-laser deposition, and investigated the effect of a high electric-field stress on the transport properties. In the three-dimensional charge-ordered state where ordering develops over the layered structure, we observed a drastic current switching effect with a high current on/off ratio of ~8000% (Fig. 4) [Original Paper 2]. The breakdown of charge ordering and resulting phase switching may be responsible for the observed switching effect.

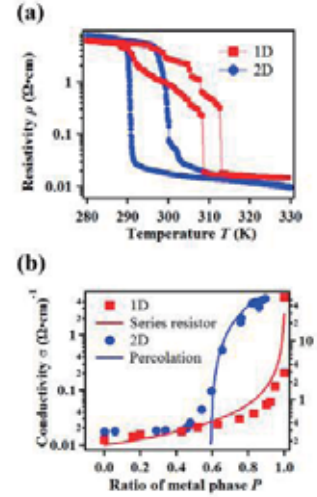


Fig. 3. (a) Temperature dependence of resistivity for both 1D (red square) and 2D (blue circle) domain configurations. (b) Conductivity vs ratio of metal phase (P)

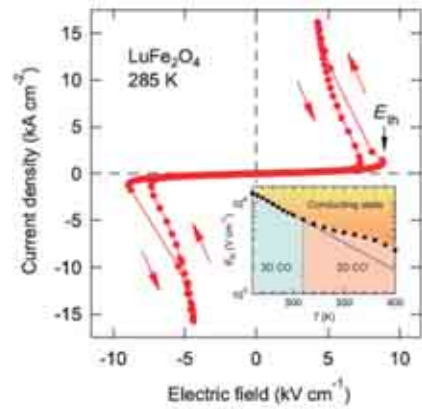


Fig. 4 Current-voltage characteristics of a LuFe₂O₄ thin film in the 3D charge-ordered insulating state.

Department of Advanced Nanofabrication

Professor:	Yoichi YOSHIDA
Associate Professor:	Jinfeng YANG
Assistant Professors:	Takafumi KONDOH, Koichi KAN
Guest Professors:	Atsushi OGATA, Hitoshi KOBAYASHI
Specially Appointed Researcher:	Masao GOHDO (2013.3.1-)
Graduate Student:	Tomohiro TOIGAWA
Under Graduate Students:	Takumi NAKANISHI, Taiki IGAHARA, Itta NOZAWA
Research Student:	Liang LI
Supporting Staff:	Anna CHIYO

Outlines

The basic and primary processes in materials are studied for the development of advanced nanofabrication by using quantum beam by means of the time-space reaction analysis method. In order to reveal the reaction mechanism in nano-space, a femtosecond/attosecond pulse radiolysis and femtosecond time-resolved electron microscopy are being developed using an advanced photocathode electron gun.

Current Research Projects

Research of formation process of solvated electrons in polar solvents by femtosecond pulse radiolysis

Radiation chemistry of water is very important on radiation therapy and cooling water of a nuclear power plant. It is well known that excess electrons produced by irradiation are stabilized by solvating polar solvent molecules and then the solvated electron react some solute. It is important for developing applications that formation process of the solvated electron will be revealed. We developed successfully an observation of time-resolved spectral change on the solvation process of excess electrons, by expanding measurable wavelength on the femtosecond pulse radiolysis system from ultra-violet to near infrared. Large spectral jump from NIR to VIS region and small continuous spectral shift were observed. Solvation model was proposed that the solvation progresses by the relaxation caused by electronic transition and the relaxation by re-orientation of solvent-molecule on same time, and it can explain the experimental results. Important information about the solvated electron production mechanism were obtained.

Research of G-value of initial ionization of dodecane by femtosecond pulse radiolysis

The quantitative estimation and control of the reaction product yield of n-dodecane which is used as a solvent of extraction agent in nuclear fuel reprocessing, it is necessary to determine the initial ionization G-value of dodecane, but had not been successful. Results of the femtosecond pulse radiolysis study of biphenyl-dodecane solution were compared with the results of simulation which considered excited radical

cation. By comparing with the reported simulation, we succeeded in obtaining the molar extinction coefficient, the intrinsic G value of generation and initial ionization G-value of dodecane radical cation

Research of fundamental process on radiation chemistry in polymer-resist by femtosecond pulse radiolysis

In order to disclose the primary process of radiation chemistry of resist in the semiconductor nano-fabrication, polystyrene, poly α -methyl styrene and ZEP which is a high-sensitivity and high-resolution resist were studied by the femtosecond pulse radiolysis system. As a result, the time dependent behaviors of phenyl-dimer radical cation and phenyl- halogen CT complex were measured. Further, the reaction in the polymer solution is complicated, we have developed the technique called Freeze and Erase (FE) method which can measure the intra-molecular reaction more than inter-molecular charge transfer. Reaction model is necessary for analyzing the results in detail. Knowledge of primary processes of radiation chemistry in the polymer resist was obtained.

Temperature dependence of formation process of solvated electron in alcohol at low temperature

Pulse radiolysis study of alcohols at low temperature (140K~RT) was carried out to clarify the primary process of pre-solvated and solvated electron in lower alcohols. The very slow decay of pre-solvated electron and the very slow formation of solvated electron were observed at nanosecond region because of very high viscosity of alcohols near melting and glass transition temperature. The activation energy of solvated electron formation was estimated to be 0.17 eV, and this suggests that the formation process of solvated electron depends on a break of hydrogen bond due to reorientation of OH-groups.

Generation of ultrashort electron beam for attosecond pulse radiolysis

Generation of an ultrashort electron beam was realized by several schemes, e.g., femtosecond photocathode RF gun, magnetic bunch compression with higher-order compensation and usage of a slit. At the same time, infrared electro-magnetic (EM) -wave emitted by the electron beam was measured by a Michelson interferometer with a combination of a bolometer and MCT (HgCdTe) detector, which enabled dual-band detection of the EM-wave. The generation schemes realized ultrashort electron beam with an rms bunch length of ~ 3 fs at a bunch charge of ~ 2 pC according to the measurement using the interferometer.

Development of femtosecond time-resolved electron microscopy

A prototype of femtosecond time-resolved MeV electron microscopy has been constructed at the first time in the world to reveal the ultrafast hidden dynamics of intricate molecular and atomic processes in materials. A high-quality MeV electron beam with bunch length of 100 fs was generated by a photocathode radio-frequency (RF) gun in the prototype. Using the femtosecond electron beam, the demonstrations of MeV electron diffraction and microscopy were carried out. Both the single-shot electron diffraction measurement and the MeV electron imaging with resolution of 30 nm were succeeded in the prototype using the RF gun.

Department of Nanocharacterization for Nanostructures and Functions

Professor: Seiji TAKEDA
Associate Professor: Manabu ISHIMARU
Assistant Professors: Hideto YOSHIDA
Tadahiro YOKOSAWA(2012.7.16-2013.2.28)
Specially Appointed Researcher: Keju SUN
Graduate Students: Yusuke ISOZAKI, Shuki NAKAMURA, Kentaro SOMA,
Satoru MAENOU
Supporting Staff: Noriko TAKASE

Outlines

Our group is aiming to characterize nanomaterials and nanodevices at the atomic scale when they actually exhibit their functions. We have developed high-resolution environmental transmission electron microscopy (ETEM) that allows us to observe solid-gas reactions in situ at atomic scale. Using the ETEM, we have studied the morphology and surface structure of gold and platinum nanoparticle catalysts supported on oxides under reaction conditions and the nucleation and growth of carbon nanotubes from nanoparticle catalysts.

Current Research Projects

Intrinsic Structure of Au/TiO₂ Catalysts under Reaction Conditions

It is well known that gold nanoparticles supported on TiO₂ (Au/TiO₂) act as catalysts for the oxidation of CO, even below room temperature. To elucidate the microscopic mechanism of Au/TiO₂ catalysts, in situ observations under reaction conditions are necessary. Transmission electron microscopy (TEM) has been used to determine the structures of Au/TiO₂ catalysts in vacuum and gases. However, the fragility of TiO₂ under electron irradiation has caused conflicting results of in situ studies in the structure of Au/TiO₂. We studied structural reorganization of Au/TiO₂ caused by electron irradiation systematically and then deduced intrinsic catalytic structure of Au/TiO₂ without electron irradiation. Figure 1 summarizes the structures observed in Au/TiO₂ catalysts using ETEM, in different environments

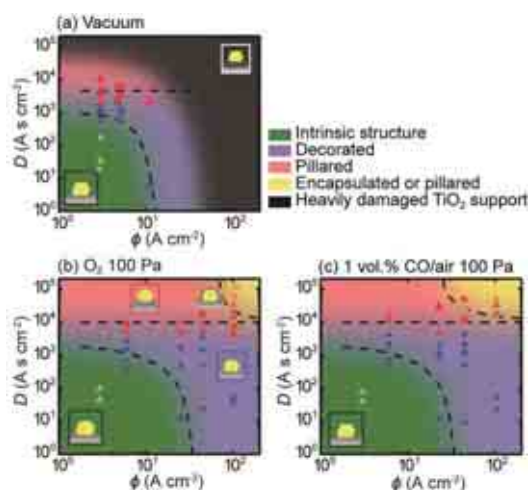


Fig. 1 Structure evolution diagrams for Au/TiO₂ catalysts under electron irradiation, as a function of dose, D and electron current density ϕ , in (a) vacuum, (b) O₂ at 100 Pa and (c) 1 vol.% CO in air at 100 Pa, at room temperature

produced as a function of the electron current density ϕ and the electron dose D . As shown in this structural evolution diagram, the electron-irradiation-induced structural reorganizations of Au/TiO₂ catalysts were categorized into "decoration", "pillar", "encapsulation", and "damage". In the green regions of low ϕ and low D , structural reorganizations were not detected. By extrapolating the structure at $\phi = 0$ and $D = 0$ using the structure evolution diagram, the intrinsic structure in the absence of electron irradiation can be deduced for different environments, including reaction environments. Under reaction conditions, the major {111} and {100} facets of gold nanoparticles were exposed, and the particles displayed a polygonal interface with the TiO₂ support that was bounded by sharp edges parallel to the <110> directions (Fig. 2). Similar diagrams may be helpful in deducing intrinsic structures and/or intrinsic phenomena in various chemical reactions that can be produced in TEMs and ETEMs.

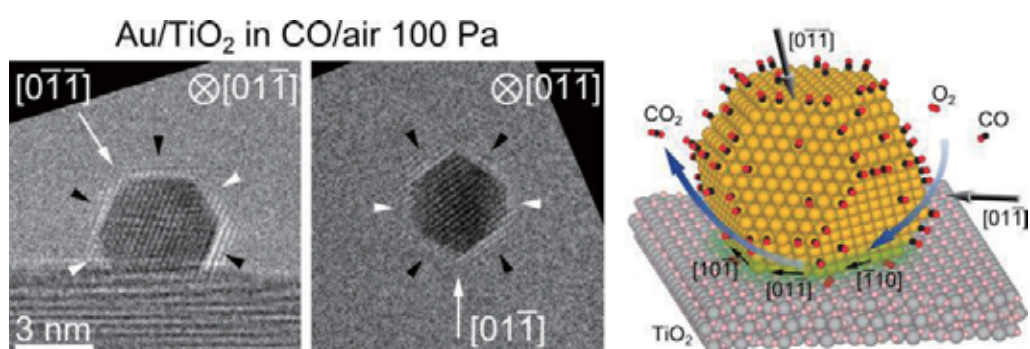


Fig. 2 ETEM images and the instantaneous view of Au/TiO₂ under reaction conditions (in 1 vol% CO in air at 100 Pa).

In Situ Structural Analysis of Nanoparticle Catalysts during the Growth of Carbon Nanotubes

In situ TEM observations of various reactions at the atomic scale are becoming more important. To improve the precision of the structure analysis of in situ processes, in situ structural analysis combined with image simulations is significant. Experimental ETEM images of a crystalline nanoparticle catalyst during the growth of carbon nanotubes were compared with simulated images of the Fe₂₁Mo₂C₆ structure that was observed along various directions (Fig. 3). Lattice images that appear in the nanoparticle at different times can be accounted for by considering only the Fe₂₁Mo₂C₆ structure. By combining the image simulation given here, ETEM becomes a more acceptable method to investigate various dynamic reactions at the atomic scale.

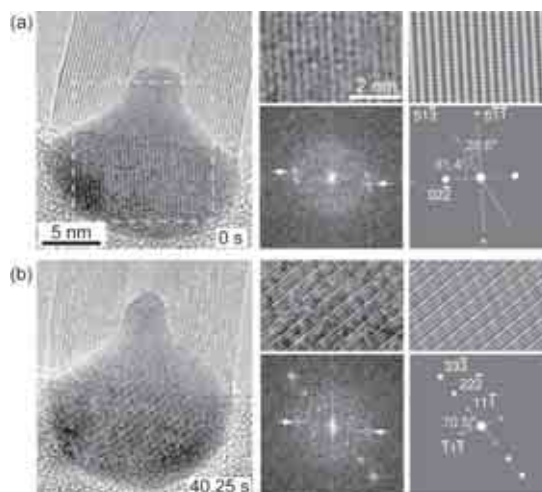


Fig. 3 In situ ETEM images of a (Fe,Mo)₂₃C₆ nanoparticle during the growth of a carbon nanotube recorded at the different times. An enlarged image, a simulated image, a simulated Fourier transform and the observed Fourier transform in clockwise order.

Department of Theoretical Nanotechnology

Professor:	Tamio OGUCHI
Associate Professor:	Koun SHIRAI
Assistant Professors:	Kunihiko YAMAUCHI, Hiroyoshi MOMIDA (2012.4.1-)
Guest Professors:	Akira YANASE, Mitsuhiro MOTOKAWA, Takeo JO (2012.8.1-)
Visiting Professors:	Hubert EBERT (2012.4.6-2012.5.31), Jaejun YU (2012.6.25-2012.8.24)
Specially Appointed Researcher:	Masayuki TOYODA (2012.4.1-),
Research Fellow:	Hongbin HUANG (2012.4.1-2013.3.31)
Graduate Students:	Mohammad SHAHJAHAN, Keisuke ISOYAMA, Naoki UEMURA, Takayoshi FUJIMURA, Shouhei KOMORI, Takuya UEDA, Taufik Adi NUGRAHA, Kyouhei SAKUMA, Eriko TAKASAKI, Masataka DEGUCHI, Akihiro FUJII
Under Graduate Student:	Hiroaki SAIJO
Supporting Staff:	Minako KAKIUCHI

Outlines

We currently study the electronic structure of various kinds of solid and surface systems on the basis of first-principles calculation for the prediction of materials properties. Clarifying the underlying electronic mechanisms, we endeavor to design new materials with desired properties. The development of related theory and first-principles calculation methods is also carried out.

Current Research Projects

Electronic Structure of Transition Metals and Their Compounds

Transition-metal elements form alloys and compounds with other elements and reveal a wide variety of physical properties. One of such examples is transition-metal hydride. We studied the structural stability and magnetism of FeH, CoH, and NiH on the basis of first-principles calculations. By hydrogenation, electronic structure with 3d bands filled by approximately one more electrons is realized. Because of this, the stable structure and magnetism are found to be the same as those seen for its right neighbor in the periodic table [Original Paper 1]. Pressure effects in the transition-metal hydrides are also investigated and the relation between the electronic structure and magnetism under pressures is obtained by comparison with x-ray absorption experiments [Original Paper 4]. In collaboration with photoemission experiment groups, the detailed electronic structure of Pd metal [Original Paper 6] and Fe pnictides [Original Paper 7] is studied.

Materials Design utilizing Atom Dynamics

Integrated study of the ground-state properties and atom dynamics is one of the main research subjects in our group. In this year, progresses have been achieved in the following issues.

Why are boron crystals insulators? For a long time, researchers of boron physics have suffered from this question. Band calculations give an answer of metal to many of boron crystals, while in experiment it should be metal. The deviation from stoichiometry is the most important factor in determining the electronic structures. A combination of the deviation and the recently proposed idea of frustrate system give most satisfactory account for this discrepancy.

The thermoelectric power factor of SrTiO_3 is unusually high with respect to its mobility and band gap. We have determined the mechanism behind the high power factor. The key issue is that different effective masses contribute to different transport phenomena. Light electrons were responsible for the high conductivity, whereas heavy electrons were responsible for the high thermoelectric power. Our findings provide a new direction for the band engineering of thermoelectric materials.

Multiferroics and Magnetoelectrics

Multiferroics are the systems that show both magnetism and ferroelectricity. In half-doped manganites, it has been expected that non-centrosymmetric charge ordering of Mn ions may induces ferroelectricity, as accompanying CE-type charge-, orbital-, and antiferromagnetic orders. In fact, newly synthesized $\text{Pr}(\text{Ca}_{0.9}\text{Sr}_{0.1})_2\text{Mn}_2\text{O}_7$ shows lack of the inversion center in the particular bilayer crystal structure. We performed DFT calculations to evaluate stability of the polar structure and clarify the cross-coupling between different electronic orders with the ferroelectricity. Moreover, we performed a similar investigation on A-site ordered perovskite, $\text{SmBaMn}_2\text{O}_6$, and predicted its polar crystal structure and the ferroelectric polarization [Original Paper 12].

Electronic Structures of Electron and Spin Device Materials

We performed first-principles calculations of future electronic and spin device materials to clarify electronic structures and magnetic properties. We have investigated bulk and surface band structures of topological insulators, Bi-Se and Sb-Te systems, and discussed electronic structures near the Fermi levels. We have studied magnetic properties of ferromagnetic full Heusler alloys. We calculated the hyperfine fields at Sn nuclear positions in $X_2\text{MnSn}$ ($X=\text{Co}, \text{Ni}, \text{Cu}$) Heusler alloys, and compared with experimental results. Calculated results of Co_2MnSn with and without antisite defects show that the presence of antisite defects reduces the hyperfine fields at neighboring Sn sites compared with the bulk value. This result can account for the experimental hyperfine field distributions of Co_2MnSn . Our study of aluminum oxides including oxygen vacancies contributes to give an atomistic resistance-switching mechanism in a non-volatile resistance-switching memory device. Optical responses of metallic materials are investigated in collaboration with experimental groups [Original Paper 15].

Department of Soft Nanomaterials

Professor: Yoshio ASO
Associate Professor: Yutaka IE
Assistant Professors: Makoto KARAKAWA, Masashi NITANI
Graduate Students: Jianming HUANG, Seihou JINNAI, Kazunari TANAKA, Chihiro SATO, Saori TONE, Yi WANG
Supporting Staffs: Keiko YAMASAKI, Misayo UMEDA(-2013.7.31), Yuka UMEMOTO (2012.8.20-2013.3.31)
Technical Assistant Staff: Takeo MAKINO

Outlines

The main subject in the Department of Soft Nanomaterials is the development of novel molecular-based materials with promising electronic and photoelectric properties for organic electronics. The research is based on the design and synthesis of nano-scale p-conjugated molecular materials for organic electronics as well as molecular electronics and the elucidation of the relationship between molecular structures and physical properties to control and improve the functions. We have been focusing our research on the development and evaluation of (1) chemically modified pi-conjugated systems as organic semiconductors with high electron mobility, and (2) functionalized molecular wires and metal-electrode-anchoring units applicable to molecular electronic devices.

Current Research Projects

Organic electronics materials

We have developed organic materials for n-type field-effect transistors (FETs). It has been known that the introduction of electron-withdrawing groups into pi-conjugated systems increases their n-type character. Previously, we reported on carbonyl-bridged bithiazole (**1**) as a

new electronegative unit, in which the combination of an electron-withdrawing thiazole ring with carbonyl-bridging contributes to enhancing both the electron-accepting characteristics and intermolecular interactions. On the basis of these findings, we anticipated that expansion of the pi-conjugation to a pentacyclic dione system could

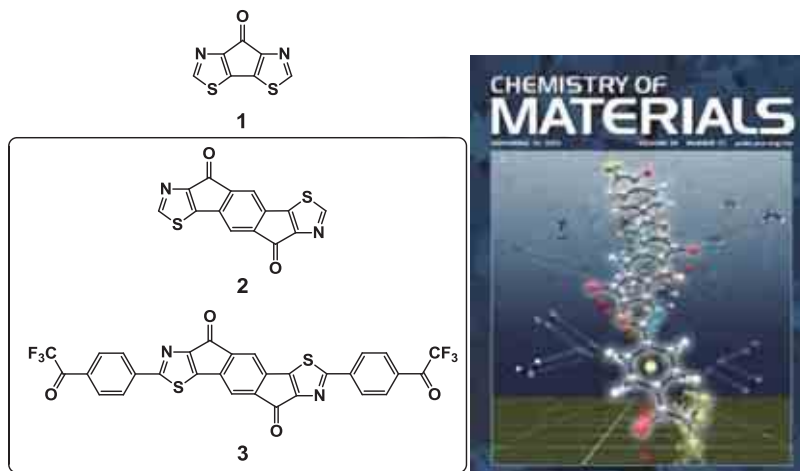


Fig. 1. Electronegative oligomers based on carbonyl-bridged bithiazole.

further enhance both the electron-accepting characteristics and the intermolecular overlapping of the pi-systems, resulting in higher electron mobility as well as air stability for the OFETs. Therefore, we designed 4,9-dihydro-s-indaceno[1,2-*b*:5,6-*b'*]dithiazole-4,9-dione (**2**) as a new electronegative unit and developed electronegative pi-conjugated compounds (**3**) as a candidate material for n-type OFET transistors. [Original Paper 3] (Fig. 1). Their cyclic voltammetry measurements indicate fairly low LUMO levels, and their FET devices showed high n-type FET performance and air-stable operation as our expectations.

Bulk-heterojunction organic photovoltaics (OPV) based on conjugated polymers and soluble fullerene derivatives have attracted a great deal of attention owing to their solution processability and mechanical flexibility. A well-known soluble fullerene derivative, [6,6]-phenyl C₆₁ butyric acid methyl ester (PC₆₁BM), is the most promising acceptor material in OPVs, while we have almost no choice of other acceptors in testing new donor polymers for the device fabrication. This lack of the acceptor materials leads to insufficient fundamental understanding and limits the further improvement of the OPV performances. We have synthesized novel soluble fullerene derivatives, followed by their detailed light absorbance, electrochemical, and photovoltaic properties. We have fabricated OPV devices using a low-bandgap polymer as a donor material with the fulleropyrrolidine derivatives. The devices showed the highest class performance of OPVs using C₆₀ derivatives as an acceptor material.

Molecular electronics materials

In the field of molecular electronics, it is important to develop new molecular wires. Although the energetic alignment between the work function of metal electrodes and the energy level of molecular wire has been considered to influence charge injection, the modification of electronic states in molecular wires is still behind. Especially, molecular wires for electron transport through the lowest unoccupied molecular orbital (LUMO) level orbital have been limited. We previously reported that the difluorodioxocyclopenta[*c*]thiophene contributed to increasing electron affinity without interrupting the effective conjugation. Based on this result, we developed new insulated electron-accepting unit (**C_b**) and its containing insulated oligothiophenes ((**TC_bT**)_{*n*}) (Fig.2). UV-vis absorption spectra of oligomers indicated that effective conjugation is maintained in these oligomers. These molecules showed reversible reduction waves in cyclic voltammetry measurements. The appearance of reduction process indicates that the presence of **C_b** unit apparently leads to increasing the electron affinity of oligothiophenes. UV-vis-NIR measurements of oxidized species revealed the absence of intermolecular interactions between the conjugated backbones.

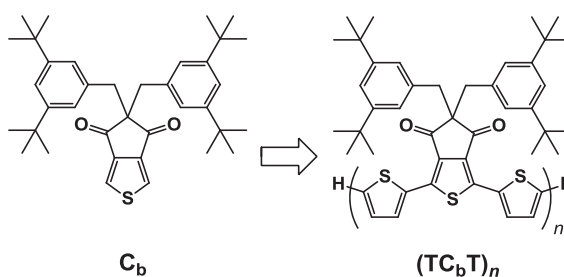


Fig 2. Chemical structures of electron-accepting unit and its-containing insulated oligothiophene molecular wire.

Department of Bio-Nanotechnology

Professor: Masateru TANIGUCHI
Assistant Professors: Hiroyuki TANAKA, Makusu TSUTSUI
Graduate Student: Sadato HONGO
Supporting Staff: Noriko FUJIBAYASHI

Outlines

This research group aims to develop a new biosensing platform based on biomimetic nano-architecture for future medical diagnosis. Our strategy is based on electrical detection of single molecules or particles using a pair of sensor electrodes with a nanometer separation. We have developed nano-fabrication processes to form several-nanometer-sized electrode gap in nano-fluidic channels, the structure of which mimics ionic channels in biological systems. This solid-state device can be used as a useful tool to characterize the electrode-molecule link chemistry, local heating, chemical reactions, and translocation dynamics of single-molecules passing through the nano-channel. We have also been working on single-molecule observations and manipulations of DNA and other biologically important molecules using a scanning electron tunneling microscopy. To bring the single-molecule science in industries, we are creating new single molecule technologies for future development of Single-Molecule Total Analysis System (SM-TAS). Current research topics include: Development of electrode-embedded nanochannel single-molecule detectors; Scanning probe microscopy observations of single-biomolecules; Electrical DNA sequencing using solid-state nanopores; Development of single-molecule energy harvesting devices.

Current Research Projects

Combining resistive pulse technique with fluorescent imaging for single-particle tracking

Nanopores and nanochannels are considered as useful platform for sensing various bio- molecules and particles such as red blood cells, white blood cells, and viruses. In this sensor device, ionic current through a nanoscale conduit is monitored. When an individual analyte translocate through the channel, it causes a temporal drop in the ionic current that enables identification of single-molecules and -particles. An important issue in the nanopore sensors has been that they lack a way to ensure the presence of analytes at the moment when a resistive pulse is observed. In the present work, therefore, we combined

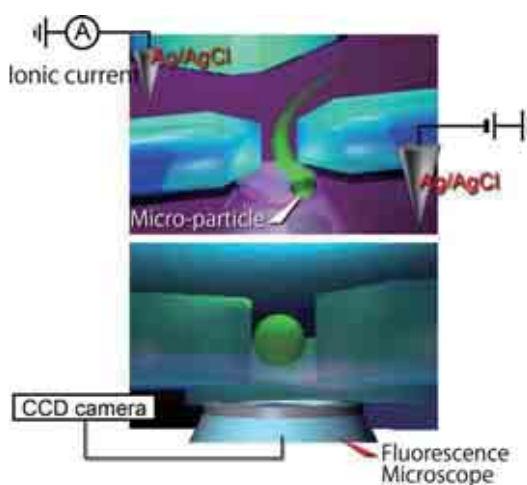


Figure 1. Single-particle tracking via ionic current measurements and fluorescent imaging.

the resistive pulse technique with a fluorescence microscopy technology (Fig. 1). We found ionic current spikes synchronous to the fluorescent images that clearly showed translocation of dyed single-particles through a microfluidic channel, thereby proving the capability of the combined technique for unambiguous detections of analytes with a high spatiotemporal resolution.

Stability of single-molecule junctions in a liquid environment

Single-molecule electronics devices consist of an individual molecule connected to two electron reservoirs. Fabrications of electrode-molecule-electrode bridges are usually carried out by immersing an electrode gap in a dispersion solution of a target molecule for molecular chemisorption on the electrodes. Here, as the electron tunneling transport in single-molecule junctions is affected largely by the electrode-molecule configurations, it is important to keep the gap distance between the electrodes unchanged during the junction formation processes. As a first step toward development of optimal formation processes for single-molecule bridges, we evaluated the stability of a nanoelectrode system in a liquid media. We find that the holding time of gold single-atom contacts degrades by an order of magnitude in 1,2,4-trichlorobenzene compared to that in a vacuum, suggesting non-negligible effects of collisions of solvent molecules on the stability of junction electrodes. This infers the importance of employing low-molecular-weight solvent for fabrications of single-molecule junctions.

Easy Fabrication of Graphene Substrate for DNA Sequencing

Efficient DNA sequencing of real long DNA by scanning tunneling microscope (STM) requires millimeter wide and atomically flat conductive substrate. Recently, graphene is considered to be good substrate for observing adsorbed molecule's electronic state. One of well-known easy methods, such as the cleavage of graphite will produce several micrometers wide graphene. Graphene film growth by chemical vapor deposition needs supported substrate such as nickel. Unfortunately, wide and atomically clean Ni(111) is not easy to prepare. Moreover nickel deposition needs an expensive electron beam evaporator system. Here the author describes an easy graphene preparation method by using a home-made nickel evaporator.

Department of Nanotechnology for Environmental and Energy Applications

Professor: Yoichi ANDO

Outlines

To address the urgent issues of environment and energy, we are studying basic properties of novel spintronics materials and unconventional superconductors by utilizing the facilities for micro/nano-fabrications available at the Nanoscience and Nanotechnology Center. This year, we focused on recently discovered compound $\text{Bi}_{2-x}\text{Sb}_x\text{Te}_{3-y}\text{Se}_y$ which has the lowest residual bulk conductivity among known topological insulators.

Current Research Projects

Basic research of topological insulators for spintronics applications

This project explores new avenues of the spintronics to utilize the “helically spin-polarized” metallic state that naturally exists on the surface of a *topological insulator* (TI), which is a new state of matter discovered just a few years ago. In the helically spin-polarized surface state, the current direction and the spin polarization is directly coupled; namely, right- and left-moving electrons carry up and down spins, respectively (spin-momentum locked surface state). This allows a completely new way to generate and control spins with minimal energy dissipation.

The helically spin-polarized surface states of topological insulators have been observed by photoemission experiments, but practical utilization of the spin transport properties remains a challenge. It is therefore important to develop suitable device designs for electrically detecting the surface spin currents. Known TI materials such as Bi_2Se_3 and Bi_2Te_3 have a relatively large bulk conductivity, which prevents reliable detection of the surface transport. Recently, we developed a highly bulk-insulating TI material $\text{Bi}_{2-x}\text{Sb}_x\text{Te}_{3-y}\text{Se}_y$, in which the surface-dominant transport has been achieved for the first time in a bulk single crystal. Using this material, we pursue the idea of detecting spin currents on the surface of a TI by fabricating a spin-injection device (Fig. 1) using a small exfoliated piece of $\text{Bi}_{2-x}\text{Sb}_x\text{Te}_{3-y}\text{Se}_y$, where spin-polarized electrons injected from ferromagnetic contacts will be filtered by the surface state depending on the matching of the spin polarization with that of the electrons in the surface state.

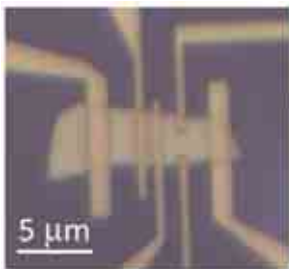


Fig. 1 Optical microscope picture of a spin-injection device made of exfoliated $\text{Bi}_{2-x}\text{Sb}_x\text{Te}_{3-y}\text{Se}_y$ single crystal and FeCo electrodes fabricated with e-beam lithography.

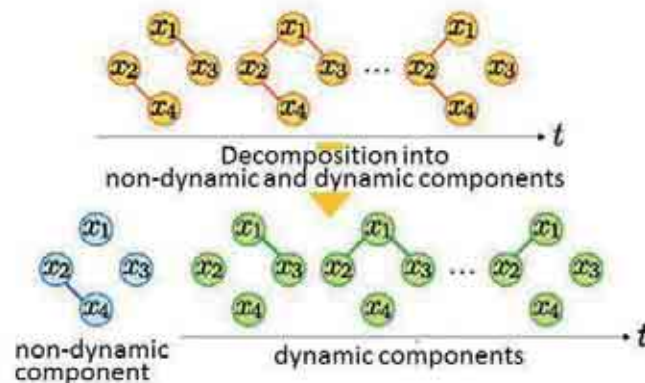
Department of Nano-Intelligent Systems

Professor: Takashi WASHIO

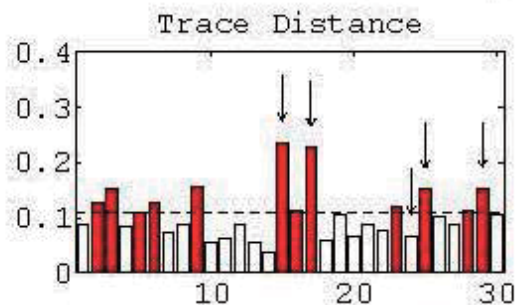
Outlines

Massive data are being accumulated in nano-technology study along the development of experiment and measurement techniques. However, the fast extraction of meaningful knowledge from the massive data is difficult due to the limitation of human analyst's ability. To address this issue, we develop methods to efficiently extract or estimate meaningful knowledge from the massive data by applying various reasoning and searching mechanisms. In this year, we worked on the development of a new method based on our latest research outcome in collaboration with Department of Quantum Information Photonics (Alliance Laboratory of ISIR, Osaka Univ. and RIES, Hokkaido Univ.). During a quantum information experiment over a long period, various outer disturbance and performance degradation of facilities change the experimental conditions and can reduce the reliability of the experiment. We developed a new mathematical method to decompose state density matrices into their steady components and unsteady components and derive accurate estimation results. Moreover, we applied it to real experiments and confirmed its efficacy.

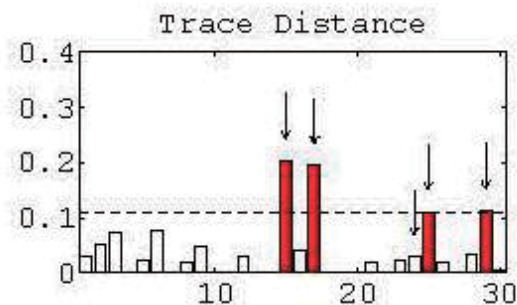
Current Research Projects



Components decomposition of state density matrices.



Error detection by a conventional method



Error detection by our method

Our method detects erroneous parts (indicated by arrows) more accurately (indicated by red bars).

Department of Nanodevices for Medical Applications

Professor: Kazuhiko NAKATANI

Outlines

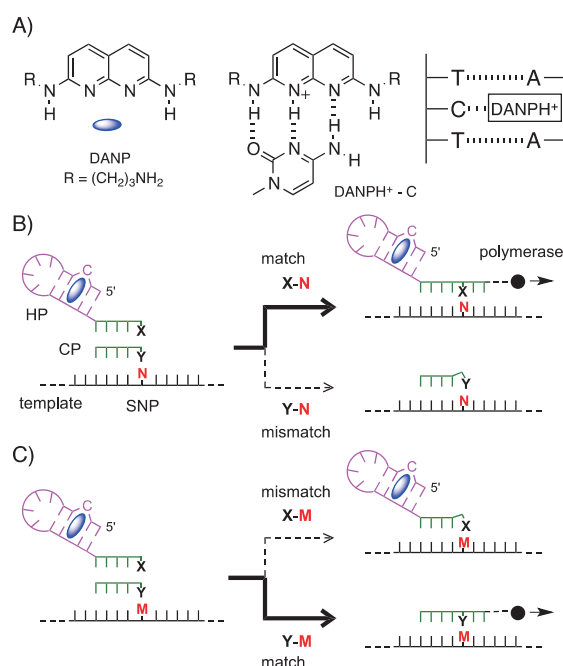
We are developing novel method and devices for rapid, simple, and cost-effective detection of genetic mutations on the basis of a proposal of new concept.

Current Research Projects

Development of Technology for Single Nucleotide Polymorphisms (SNP)

The technique for promptly detecting the genetic mutation is expected as a basic technology that supports the personalized medicine. We have reported a new SNP typing method based on DNA secondary structure-inducible ligand fluorescence. In this SNP typing method, the hairpin tag is unfolded by a PCR and is transformed into a duplex. As a result, the primer losses of the DANP binding sites, and the fluorescence intensity decreases. This time, we have focused on the method to improve the allele specificity of the PCR using hairpin primers with competitor primers, and the SNP alleles are discriminated by fluorescence. The allele-specific hairpin primer PCR (AS-HP-PCR) method is the simple method to increase the allele specificity without optimized a PCR conditions. The allele specificity is dramatically increased by this method.

This research is collaborative research with assistant professor Dr. Fumie Takei in department of regulatory bioorganic chemistry.



Department of Nanosystem Design

Geust Professor :

Yuden TERAOKA (2012.9.1-11.30)

Outlines

Thin film formation of various kinds of semiconductors, metals, and insulators, and following fine structure fabrication are necessary for manufacturing of electronic and optical devices. In recent years, the thin film thickness and the special size are reducing to nanometer scales. Therefore, the needs of nano technologies are increasing also in the research of electronic and optical devices. As to the thin film formation, deep understanding on the surface reactions needs atomic level control of reactions between a substrate and impinging molecules, and real-time in-situ observation of the surface, to achieve uniformity of the film with nanometer-scale. Thus, the developments of atomic level control and the real-time in-situ observation of surfaces and interfaces were discussed from a view point of surface reaction dynamics and photoemission analysis with institute staffs and students through five times seminars in the period of three months as an invited professor.

Achievements

Supersonic molecular beam (SSMB) techniques are used to control thin film formation in Japan Atomic Energy Agency (JAEA). The maximum translational energy is 2.3 eV for oxygen molecules. X-ray photoemission spectroscopy (PES) with soft x-ray synchrotron radiation (SR) is also used as a technique for observation of chemical bonding states. An ultra-high vacuum apparatus with experimental equipment of low energy electron diffraction and thermal desorption gas analysis as well as the SSMB and the SR-PES had been installed in a JAEA beamline of SPring-8. The studies on oxidation reaction dynamics of Si, Ge, which are important for fabrication of field-effect transistors, and of various kinds of metals, for instance, Ni as a major component of catalysts, were overviewed.

As an application of vacuum is indispensable in research and development of materials, thin film formation on semiconductors and metals, and their fine processing have been conducted using high vacuum apparatuses. However, residual gases often affect unexpected influence to property of products. Thus, ultra-high vacuum apparatuses (electron beam, ion beam, accelerators, fusion reactors), their application for surface analysis, SR-PES et al. were explained and discussed on the necessity of ultra-high vacuum for surface chemical reaction studies in the 2nd seminar

Light interacts with materials to occur scattering, diffraction, and absorption. Application of such phenomena enables us to study atomic and electronic structures of materials. The SR involves wide band electromagnetic waves from x-rays to infrared. Especially, x-rays are used for material science. In the 3rd seminar, configuration of accelerators and beamlines, light sources and nature of SR, monochromators, and interlock systems et al. were explained to make experiments easy in the beamlines.

The PES is spread as a major surface analytical technique. Application of SR as a

light source makes very high quality data comparing to conventional x-ray sources. In the 4th seminar, structures of conventional x-ray sources, mechanisms of photoemission, characteristics of photoemission spectra, treatment of background signals et al. were explained to introduce soft and hard x-ray SR-PES, photoelectron diffraction, and x-ray absorption spectroscopy.

Recent studies of surface chemical reaction dynamics conducted using the SR-PES and the SSMB were introduced in the 5th seminar. Improvement of ultra-thin oxide film formation using effects of translational energy of incident oxygen molecules and real-time in-situ observation of the oxide formation processes was discussed through the five seminars.

Department of Nanodevice Characterization

Visiting Professor: Hubert EBERT (2012.4.6-2012.5.31)

Outlines

Electron theories of x-ray spectroscopy of transition-metal alloys and compounds have been investigated based on the electronic structure calculations.

Achievements

X-ray Spectroscopy of Transition-Metal Alloys and Compounds

Transition-metal alloys and transition-metal compounds show a wide variety of magnetic orders even if they are in bulk phases. A more intriguing possibility is that some materials may possibly have novel magnetic structures by controlling their nanostructures, such as surfaces and clusters. Thus the transition-metal alloys and compounds have been attracted great interest for technological and industrial applications to device materials especially in the field of spintronics.

In this research, focusing our attention on the transition-metal alloys and compounds, we have developed new theoretical techniques based on the electron theories in order to describe electronic structure and magnetic properties in an accurate way. We have discussed microscopic relations between the optical responses in x-ray energy regions and the electronic and magnetic properties. We have also discussed fundamentals of dichroism in the spectroscopy for materials without the inversion symmetry, for example, polar crystals, surfaces, and artificial multilayer systems. Spin-transport phenomena such as spin-Hall effect have been recently attracted great interest in both scientific and technological viewpoints, and we have developed theoretical techniques using the electronic structure theories with aiming to understand experimental results.

We organized three open seminar series entitled "Ab-initio studies on spin-orbit induced properties of magnetic solids" on the 25th of April, 2012, "Influence of spin-orbit coupling on the transport properties of magnetic and non-magnetic transition metal alloys" on the 10th of May, 2012, and "Calculation of angle-resolved photo emission spectra within the one-step model of photo emission - recent developments" on the 23rd of May, 2012 presented by Prof. Ebert, giving us detailed explanations of fundamentals and advanced research topics.

Department of Nanodevice Characterization

Visiting Professor: Jaejun YU (2012.6.25-2012.8.24)

Outlines

Electronic structures of transition-metal oxides have been investigated from electron theories.

Achievements

Electronic Structures of Transition-Metal Oxides

Transition-metal oxides show various interesting properties, which are originated from competitions between itinerant and localized characters of d electrons of transition-metal elements. Many theoretical discussions have been given in order to describe their electronic structure in terms of both electron band theory and Mott physics. The 3d transition-metal oxides have been major interested subjects in solid-state physics, as typically known for Cu-oxides high-temperature superconductors, which are recognized as the doped Mott insulators. The 4d and 5d transition-metal oxides with large spin-orbit interaction have been recently attracting much interest because of their peculiar electronic structure and novel material properties. In this research, focusing our attention on the transition-metal oxides, we have developed advanced theoretical methods based on the electron theories in order to precisely describe the electronic structure. We have studied electronic mechanisms of their novel material properties associated with the peculiar electronic structure. Especially we have discussed uniqueness of the electronic structure originating from effects of the spin-orbit coupling. We organized an open seminar entitled “Spin-orbit coupled ground state of Ir-oxides: From $J_{\text{eff}}=1/2$ state to topological insulator to quantum magnets” on the 23rd of July, 2012 by Prof. Yu, stimulating valuable discussion for the perspectives on this research subject.

Department of Nanodevice Characterization

Guest Associate Professor : Mohamed Almokhtar ABDEL-MOLA (2012.9.3-10.2)

Outlines

Rare-earth-doped III-Nitride diluted magnetic semiconductors (DMSs) exhibit photo-emission and ferromagnetic characteristics at room temperature and are promising materials for semiconductor spintronics. Especially, Gd-doped InGa_N, InGaGdN, shows photo-emission in the visible wavelength region as well as ferromagnetics. On the other hand, single photon emission from the semiconductor quantum dot is gathering great interest from the viewpoint of future information processing technology. In this work, the single photon emission from the InGaGdN/AlGa_N single quantum disc (SQDisc) structure in the visible wavelength region is studied.

Achievements

InGaGdN/AlGa_N/Ga_N SQDisc structures were grown by radio-frequency plasma-assisted MBE on Si (001) substrate with thin SiO₂ layer. Cross-sectional transmission electron microscopy measurement showed that SQDisc structures were formed. Photoluminescence (PL) emission was observed from this SQDisc structures. We have already established the method for the separation of nano-rod structures from the Si substrate and it is possible to measure the PL emission from the separated SQDisc sample. The observed PL wavelength range in this study was too short to measure the single photon emission, but it will be possible by the growth of more In-rich InGaGdN/AlGa_N/Ga_N SQDisc structures.

Department of Nanodevice Characterization

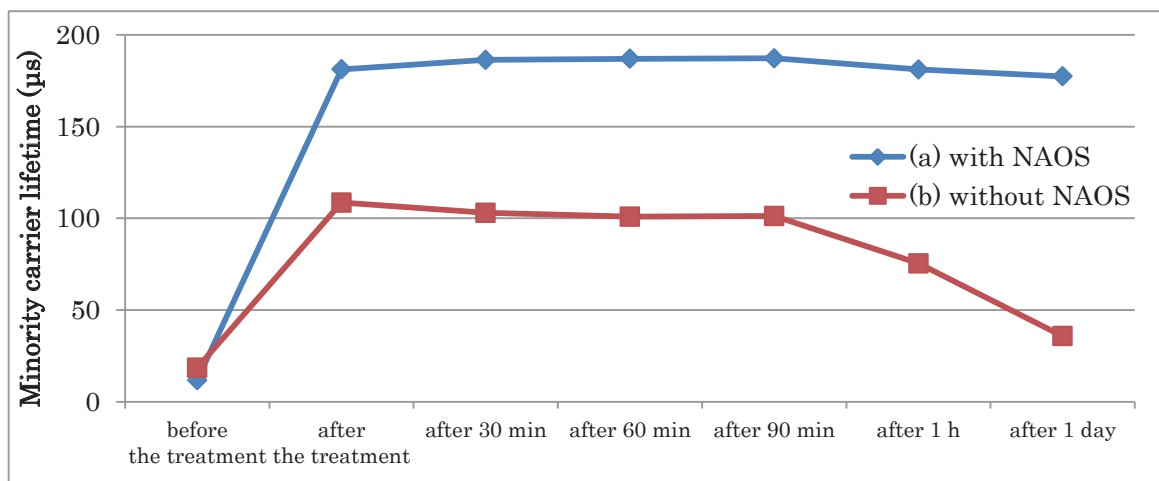
Guest Professor: Asuha(CHANG SHAN) (2012.12.14-2013.2.25)

Outlines

In our previous studies, we have fabricated a gate SiO_2 layer of thin-film transistors (TFTs) for liquid-crystal displays by use of the nitric acid oxidation of Si (NAOS) method at low temperature. The NAOS SiO_2 layer with a high atomic density effectively blocks the leakage current, and therefore, the gate SiO_2 layer thickness in TFTs is greatly decreased, resulting in a vast decrease in power consumption. The purpose of this research is to apply the NAOS method to the passivation of ultra-low reflectivity Si solar cells formed by the surface structure chemical transfer (SSCT) method and to improve the energy conversion efficiency of the cells.

Achievements

To evaluate the surface passivation effect, we measured the minority carrier lifetime using the microwave photoconductance decay (μPCD) method. The below figure shows the minority carrier lifetime of single crystalline Si specimens with (a) and without (b) a the NAOS method. It is obvious from this result that the passivation layer formed by the treatment including the NAOS method can effectively suppress electron-hole recombination on the ultra-low reflectivity Si surface. Moreover, in the case of the treatment with the NAOS method, the enhanced lifetime remains unchanged with time. By use of this treatment, a vast increase of the energy conversion efficiency of the ultra-low reflectivity Si solar cells is expected.



Department of Nanodevice Characterization

Guest Professor: Emil Pinčík (2013.2.18-3.29)

Outlines

For achievement of high efficiency solar cells, we have developed the surface structure chemical transfer (SSCT) method by use of the catalytic activity of platinum (Pt), which method can produce ultra-low reflectivity silicon (Si) surfaces. Physical properties of ultra-low reflectivity Si surfaces have been investigated using Transmission Electron Micrograph (TEM) observation and measurements of photoluminescence spectra, surface reflectivity, minority carrier lifetime, etc. The fine structure of the Si surfaces and the band-gap widening for the nanocrystalline Si are concluded to result in the ultra-low reflectivity in the wide wavelength region (300 ~ 1000 nm) and the increase in the minority carrier lifetime.

Achievements

A method of fabricating low reflectivity Si surfaces has been developed using the SSCT method. A nanocrystalline Si layer can be produced on the Si surface simply by contact of a Pt mesh with Si in an HF-H₂O₂ solution, resulting in the ultra-low reflectivity below 5% in the 300~1000 nm wavelength region. The TEM observation reveals the followings: (1) The size of nanocrystalline Si is 2~5 nm and (2) the density of nanocrystalline Si in the layer increases with the depth, i.e., the porosity in the layer gradually decreases with the depth. By the gradient porosity structure, the refractive index of the nanocrystalline layer varies from 1.0 (air) to 3.8~4.5 (Si). We concluded that this continuous change in the refractive index yields the ultra-low reflectivity in the wide wavelength region.

Minority carrier lifetime increased from 1 μ s to 5 μ s by the SSCT method. The photoluminescence was observed for Si wafers with the SSCT method as shown in Fig. 1 (broad peak at about 670 nm, i.e., ~1.8 eV). The quantum size effect widens the band-gap of the nanocrystalline Si to ~1.8 eV (cf. the band-gap of Si; 1.1 eV). We concluded that this band-gap widening results in formation of the energy barrier at the nanocrystalline Si/Si interface, and thus energy barrier prevents recombination of electrons and holes, leading to an increase in the minority carrier lifetime increases.

Using the SSCT method, we have fabricated single crystalline p-Si-based solar cells, having no anti-reflection coating, no back-surface field, and no surface passivation, and achieved a high short-circuit photocurrent density of 36.5 mA/cm² under AM 1.5 100 mW/cm² irradiation.

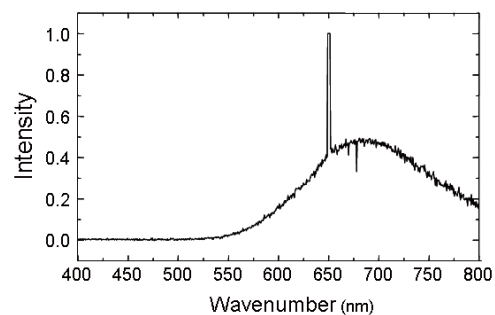


Fig. 1 Photoluminescence spectrum of a Si sample with the SSCT method.

Department of Nanotechnology for Industrial Applications

Guest Associate Professor:

Md. Altab HOSSAIN (2012.7.2-9.28)

Outlines

The studies in this laboratory focus on computer vision and media processing. In particular, score-level fusion for biometric person authentication is a central topic of this department.

Achievements

Density-based Score-level Fusion by Adaptive Smoothness Control

Score-level fusion by multi-modal biometrics or multiple classifiers, is one of central topics in biometric person authentication. We employ an approach of posterior distribution estimation within a density-based score-level fusion framework. The density-based score-level fusion in general guarantees the optimality in terms of receiver operating characteristics in verification scenarios, as long as the estimated distribution is complete. On the other hand, when the posterior distribution accuracy is degraded due to small sample size problems, the accuracy of the score-level fusion is also degraded due to the generalization errors. We therefore introduce a prior distribution based on the generalization error-free sum-rule and adaptively control the weight on the sum-rule prior based on the number of the training samples (Fig. 1). We confirmed the effectiveness of the proposed method using simulation data as well as real and publicly available biometric score databases.

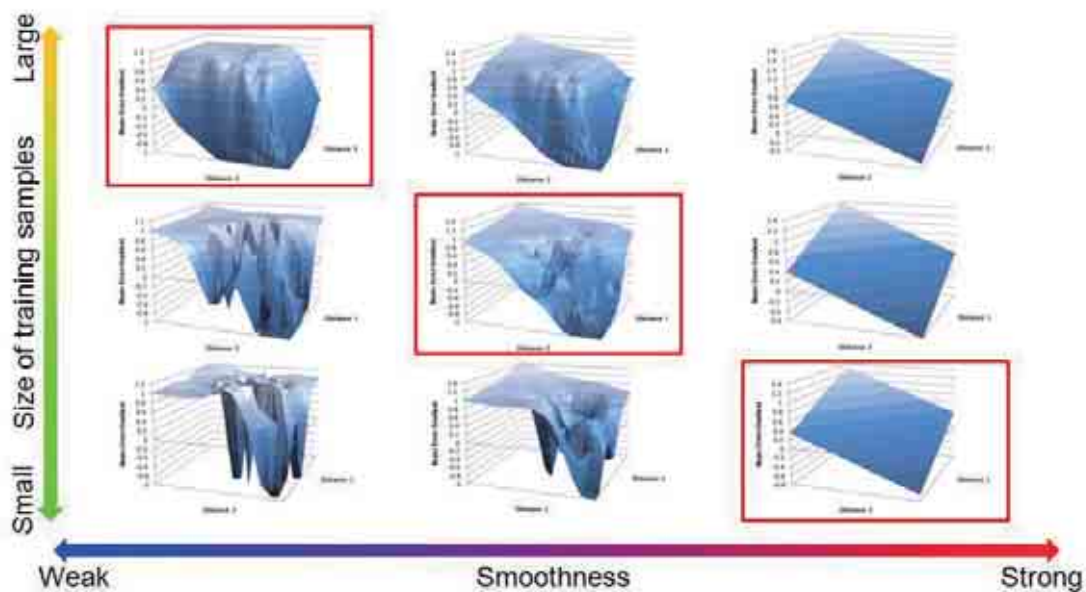


Fig. 1. Posterior distribution estimation by adaptive smoothness control

Department of Nanotechnology for Industrial Applications

Guest Associate Professor: Gan Bahadur Bajracharya (2012.11.1-2012.12.31)

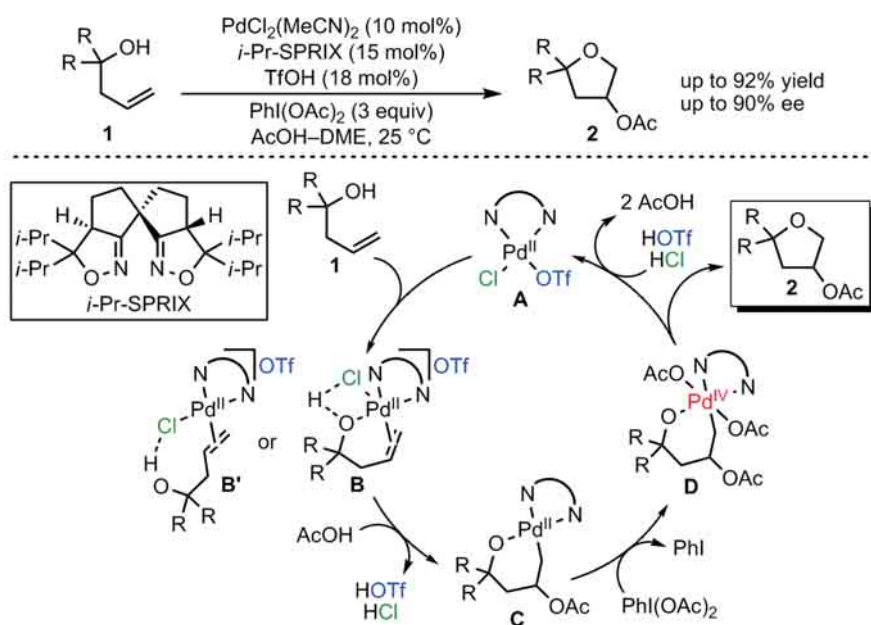
Outlines

Asymmetric catalysis has been generally recognized as the most environmentally benign methodology for the preparation of optically active compounds. Recently, catalytic reactions involving Pd(IV) intermediates that are generated in situ by the oxidation of a Pd(II) precursor have attracted tremendous interest in synthetic chemistry. The Pd(II)/Pd(IV) catalysis can realize unprecedented transformations complementary to the conventional Pd(0)/Pd(II) catalysis because of the unique reactivity of Pd(IV) complexes. Enantioselective Pd(II)/Pd(IV) catalytic reactions are therefore expected to be an efficient synthetic method of optically active functional materials.

Achievements

Development of new asymmetric Pd(II)/Pd(IV) catalysis utilizing SPRIX ligand

A chiral 3-oxy-tetrahydrofuran skeleton is found in a variety of biologically active compounds such as amprenavir. Hence, its enantioselective construction promises to be a versatile synthetic transformation. We have successfully developed asymmetric cyclative acetoxylation of homoallyl alcohols **1**, which provides 3-acetoxytated tetrahydrofuran derivatives **2** in excellent yields with high enantioselectivities. Several control experiments indicated that SPRIX ligand developed in Prof. Sasai's group, chloride anion, and triflate anion were essential for promoting this enantioselective Pd(II)/Pd(IV) catalysis efficiently (Scheme 1).



Scheme 1. Enantioselective Synthesis of 3-Oxy-tetrahydrofurans **2** via Pd(II)/Pd(IV) Catalysis by Utilizing SPRIX Ligand

Department of Nanotechnology for Industrial Applications

Guest Professor: Sung Sik KIM (2013.1.9-2013.2.27)

Outlines

Radical ions are important reactive intermediates applicable to various reactions, and can be generated by radiation chemical or photoinduced processes. Our research groups have investigated excited state properties of radical ions because of their higher reactivities. From these multi-laser chemical studies, we have revealed higher redox reactivity of excited radical ions as well as their site- and time-selectivities. In the present study, we have investigated inter- and intra-molecular electron transfer processes of the excited radical anions.

Achievements

In the present study, properties of excited naphthalendiimide (NDI) radical anions have been investigated. Since radical anion of NDI exhibits a strong absorption band in the visible region, NDI seems to be suitable molecule for the investigation of the excited radical anion using laser flash photolysis. On the other hand, pyromellitic imide (PI) was used as an electron acceptor of excited NDI radical anion. Intermolecular electron transfer process between excited NDI radical anion and PI was investigated by means of pulse radiolysis – laser flash photolysis of NDI-PI mixture solution. Intermolecular electron transfer was confirmed by observing the generation of PI radical anion upon excitation of NDI radical ion. It was revealed that the bimolecular rate constant of the electron transfer was faster than the diffusion-limited rate. On the other hand, intramolecular electron transfer process was investigated using NDI-PI linked molecules. Upon excitation of NDI radical anion, which was generated by chemical reduction, excited NDI radical anion was confirmed. With the decay of excited NDI radical anion, generation of PI radical anion was confirmed, indicating the intramolecular electron transfer. From the linker dependence of the electron transfer rate, the damping factor for the electron transfer was evaluated.

Activities of Facilities

Nanofabrication Shop

Director, Professor: Hidekazu TANAKA
Technical Staff: Shouichi SAKAKIHARA, Kimiaki TANIHATA

Outlines

Nanofabrication Shop was established in order to promote nanotechnology-related research by use of equipments and special skills for nanotechnology researchers and students belonging to ISIR. In addition, this shop fabricates nano-devices for the ISIR researchers and develops devices for researchers who want to apply those devices for their own experiments.

Current Research Projects

On demand fabrication requests

The nanofabrication shop performs the development of a new device from beginning, or does a part of the device-fabrication process such as etching and the film formation. Though we received 137 fabrication requests from 9 laboratories in 2012, the increase of requests depended on the number of processing only requests such as etching and surface treatment (fig.1).

As new development, we developed micro tweezers in 2012. We tried to transfer a thinned silicon film (thickness of a few hundred nano-meters) which showed interference light color to another substrate by use of the glass micro pipette. Because static electric force was weak in the glass itself, we tried the pipette covered with resin (fig. 2). We also utilized the water flow and surface tension to transfer the silicon film.

Cooperation to the manufacturing class

We cooperated with holding of the manufacturing class which held in summer by the technical division (fig. 3). The primary and secondary student participated in four people per a day, three days. We let them experience photolithography, dry etching, reduction photography. They observed diffraction and the hologram of the light with their devices.

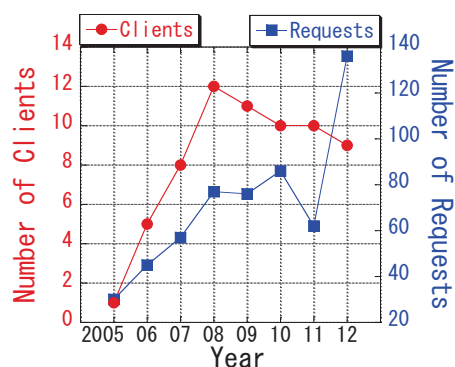


Fig.1 The transit of requests since 2005.

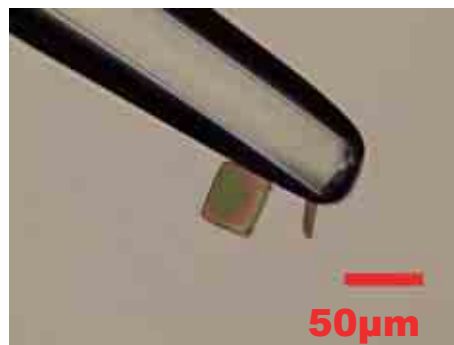


Fig.2 The picked up silicon film.



Fig.3 The manufacturing class.

Advanced Nanotechnology Instrument Laboratory

Director, Professor: Hidekazu TANAKA
Graduate Technical Staff: Michiko SAKUMA

Outlines

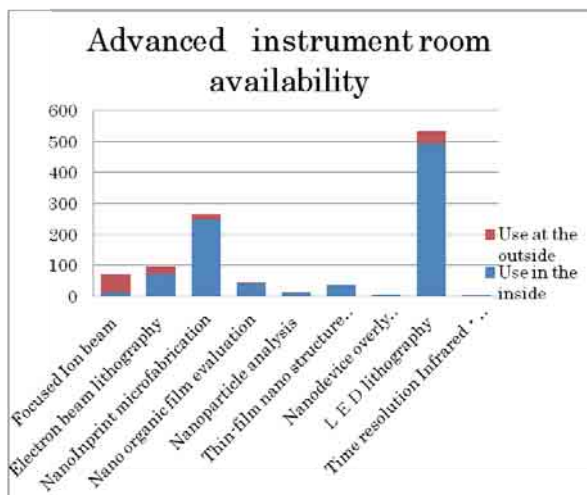
Advanced Nanotechnology Instrument Laboratory has founded in the new Nanoscience and Nanotechnology center since 2009 in order to develop cutting edge researches on the nanoscience and nanotechnology. The fine nano-fabrication system based on electron beam lithography is installed at present to construct fine nano-structures. Within this fiscal year, the nano-device fabrication system and nano-device characterization systems on structure and electrical properties of nano device will be installed, and enable us to study various nano-materials and nano-devices composed of inorganic/ soft organic /bio materials. This laboratory will continuously develop and work to promote advanced Nanotechnology.

Current Research Projects

I show the use situation according to the equipment in the Advanced Instrument Laboratory availability in the right figure.

The total number using a device is 934 cases as similar to last year. The number of the use of nanofabrication device such as nanoinprint or LED lithography greatly increases.

In addition, the use from the outside of Industrial Science Laboratory increases little by little because the equipment are shared with Nanotechnology Open Facility from July this fiscal year.



Nanotechnology Open Facilities

Director, Professor:	Yoichi YOSHIDA (2012.7.2-)
Professor:	Hidekazu TANAKA (2012.7.2-) Masateru TANIGUCHI (2012.7.2-) Hidehiro YASUDA (2012.7.2-)
Specially Appointed Professor:	Hirotarou MORI (2012.7.2-)
Specially Appointed Assistant Professor:	Akira KITAJIMA (2012.8.16-) Toshitaka OKA (2012.8.16-2013.2.28)
Specially Appointed Researcher:	Miki KASHIWAKURA (2012.8.1-) Kouji HIGUCHI (2012.8.1-) Nguyen Tuan DANG (2013.3.1-) Takashi TANIGUCHI (2013.3.16-)
Supporting Staff:	Kyoko SHIMOMITSU (2012.11.1-) Rieko UEMURA (2012.11.1-)

Outlines

Nanotechnology Open Facilities (NOF) was founded in mission of Nanotechnology Platform Project, supported by Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan. The purpose to start up is to establish a platform supporting nanotechnology research and development, especially, for researchers outside of Osaka University. NOF started from July 2012, and our efforts resulted in supporting 110 research themes in 2012.

The mission of Nanotechnology Platform Project was organized to respond to the requests that researchers belonging to public / private universities or companies hope to realize and to respond to researchers finding opportunity to use special facilities and equipments for their nanotechnology research and development program.

Institute of Scientific and Industrial Research (ISIR), Osaka University has played an important role in nanotechnology fields by providing individual technologies and information. NOF supported lots of researchers inside / outside of Osaka University through three platforms, "Nanofabrication", "Molecule & Material Synthesis" and "Advanced Characterization".

Focuses of NOF are shown below.

- (1) Innovation by integrated and speedy nanotechnology support consisting of "Fabrication (top-down and bottom-up)" and "Observation and Measurement".
- (2) Creation of advanced interdisciplinary nanotechnology through integrated research and development of inorganic and organic materials, metals, semiconductor materials, and biomaterials.
- (3) Fostering of scientists in the field of advanced interdisciplinary nanotechnology.

Current Research Projects

Bring-up Nanotechnology Open Facilities

The 110 research themes (except for technical consulting and non-publish the fruits) have been supported in this project in 2012. Considering they have been applied for by researchers in the universities, companies, and national institutes, we are able to see that NOF activates clearly nanotechnology field. NOF has been founded to support nanotechnology researchers through nanofabrication, molecule & material synthesis, advanced characterization. These supports are divided into following five ways, (a) Technical consulting, (b) Equipments utilization without assistance, (c) Technical substitution, (d) Collaborative research with NOF staff and (e) Using equipments with NOF operators.

Break-through toward Multi-platform Nanotechnology R&D

NOF supports advanced nanotechnology research and development as well as fundamental study. The research on functional integration and system building based on nano scale materials is acceptable in NOF.

Fusion between Top-down and Bottom-up Nanotechnologies

For top-down and bottom-up nanotechnologies, lots of useful equipment such as EB lithography system, FIB-CVD and PLD, and so on, are in operation. The fusion between top-down and bottom-up nanotechnologies will bring much important progress on nanotechnology in the near future.

Comprehensive Analysis Center

Professor Director: Katsuaki SUGANUMA
Associate Professor: Takeyuki SUZUKI
Assistant Professor: Da-Yang ZHOU, Kaori ASANO
Specially Appointed Assistant Professor: Mitsuko NISHINO
Technical Staff: Takanori TANAKA,
Tsuyoshi MATSUZAKI, Hitoshi HANEOKA
Technical assistant Staff: Takeshi ISHIBASHI, Tsunayoshi TAKEHARA
Support Staff: Etsuko TANI

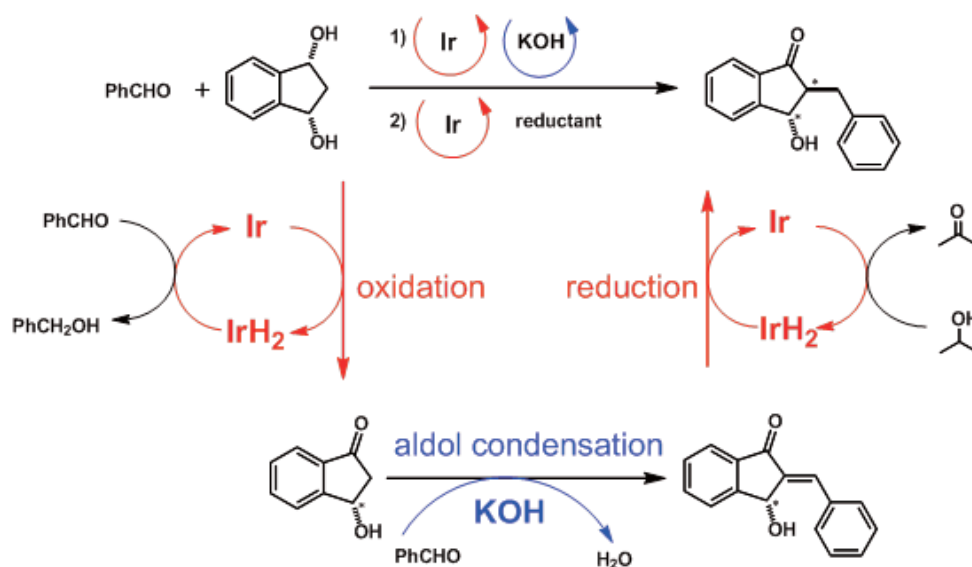
Outlines

The Comprehensive Analysis Center was founded in 2009, whose project includes (1) analysis of samples provided from other research sections in ISIR and (2) original research for developing novel synthetic methods using a molecular catalyst.

Current Research Projects

Iridium-catalyzed oxidation: development and applications

Development of catalytic reaction using clean oxidant is one of the most important themes in modern organic synthesis. In addition, desymmetrization of *meso* diols is the efficient methods for the synthesis of chiral building blocks. This time we have developed the catalytic tandem asymmetric reaction based on desymmetrization of *meso* diols (Scheme 1). Furthermore, we found the asymmetric hydrogen autotransfer process proceeds in high selectivities.



Scheme 1. catalytic tandem asymmetric reaction using chiral Ir complex

Research Laboratory for Quantum Beam Science

Professor, Director: Goro ISOYAMA
Associate Professors: Yoshihide HONDA
Assistant Professors: Sachiko TOJO
Technical Staff: Kazuya FURUKAWA
Supporting Staff: Tamotsu YAMAMOTO, Akira TOKUCHI,
Kumiko KUBO, Shoji SUEMINE

(Concurrent members)

Professors: Tetsuro MAJIMA, Yoichi YOSHIDA, Takahiro KOZAWA
Specially Appointed Professor: Seiichi TAGAWA, Masataka ENDO
Associate Professors: Ryuko KATO, Mamoru FUJITSUKA, Kiyohiko KAWAI,
Jinfeng YANG, Yusa MUROYA(2013.1-),
Specially Appointed Associate Professors: Yusa MUROYA(2012.8-2013.12), Akihiro
OSHIMA (2012.8-2013.3)
Assistant Professors: Kazuo KOBAYASHI, Keigo KAWASE, Takafumi KONDO,
Takashi TACHIKAWA, Nobuyasu NARUSE, Akinori IRIZAWA,
Hiroki YAMAMOTO
Specially Appointed Assistant Professors: Koichi KAN, Jungkweon CHOI

Outlines

The Research Laboratory for Quantum Beam Science (RLQBS) has 3 electron linacs, i.e. an L-band linac, a 150 MeV S-band linac, an RF-Gun S-band linac, and 3 ^{60}Co γ -ray sources as the representative facilities. These are opened to the users in Osaka University. Based on quantum beam science, frontier beam science relating to environmental material science, new energy sources and advanced medical technology as well as fundamental beam science are promoted with the above concurrent members. The management including operation, maintenance and the safety control of radiation related facilities are also conducted with the aid of concurrent members.

Current Research Projects

Facilities (L-band linac, S-band linac, RF-Gun S-band linac, ^{60}Co γ -ray sources)

The results of operation for all of the linacs are shown in Fig. 1.

L-band linac : the linac was operated for 230 days, 2,767 hours in this fiscal year. The leakage of cooling water for acceleration tube, which was initially observed 4 years ago, was increased because of the overpressure caused by the new water-controlling system, forcing to stop operation in October. After the careful inspection, the leakage was found at the brazed interface between water jacket and output resonator. Repairing of this part and the additional improvements for the water cooling system such as well, regulated of water flow, regulation of cooling fan with inverter were also made. Furthermore,

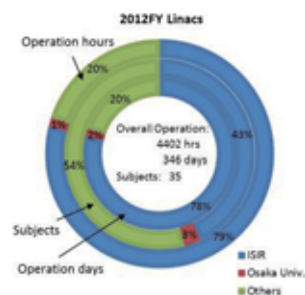


Fig.1 The results of the overall operation of the linacs

the improvements of stabilizing circuit of charging voltage and injection circuit of electron gun, and the operation test of SI thyristor in the modulator were also carried out.

150 MeV S-band linac: The monitoring of the scattered X-ray due to the linac operation was carried out and a new shielding was discussed.

RF-gun S-band linac: the operation of the linac including electron diffraction experiments was made in 116 days, 1,635 hours, for the research subjects. There arose no serious problem in this year.

Cobalt-60 facility

Cobalt-60 facility was used in 99 days, 1613 hours, for 18 subjects, which were proposed not only by ISIRI staffs but also by the member of other faculties, as shown in Fig.2.

Management (Joint use & Radiation safety management)

Accepted subjects relating to the joint-use facilities were 45 in total (Fig.3). Specially programmed academic meetings were held two times and the annual briefing session was held on March 10 in 2013. More than 340 guests visited our laboratory. About radiation safety management, the educational and training courses were opened to the new users in May. 117 researchers including students were registered as the occupationally exposed person. Special self-inspection was made twice a year for radiation facilities according to an ordinance.

Evaluation of dynamical property using positron

Macrocyclic polyether, so called crown ether, is known as a trapping material of cation whose size is equivalent to that of cavity of crown ether. The trapping efficiency is sensitive to the size of the cavity as well as on the electronic state influenced by surrounding solvent. The structural analysis for crown ethers was made by positron annihilation spectroscopy. The results showed that the cavity size was increased with increase of temperature by almost one ether bond, whereas it was not influenced significantly by relative humidity or water molecules.

Radiation Chemistry of polyphenylethanes

Polyphenylethane radical anions ($\text{Ph}_n\text{E}^{\bullet-}$) formed during the radiolysis was investigated by spectroscopic and theoretical methods. The charge resonance band of $\text{Ph}_n\text{E}^{\bullet-}$ was observed in the near-infrared region to be attributed to the intramolecular dimer radical anion. $\text{Ph}_n\text{E}^{\bullet-}$ undergoes C-C bond cleavage (mesolysis) to form anion and radical. The mesolysis of $\text{Ph}_n\text{E}^{\bullet-}$ is discussed in terms of charge delocalization in the intramolecular dimer radical anions.

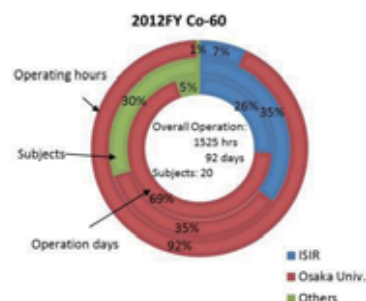


Fig.2 The results of operation of the cobalt-60 facility.



Fig.3 Accepted subjects. JRN means the joint research network.

Center for Collaborative Research Education and Training

Director:	Professor Yoichi YOSHIDA
Head of Educational Affairs Board:	Professor Tamio OGUCHI
Board Members:	Professor Junichi TAKEYA
	Associate Professor Ryuko KATO
	Associate Professor Tsuyoshi NISHI
Head of International Affairs Board:	Professor Katsumi TANIMURA
Board Members:	Professor Kazuhiko NAKATANI
	Associate Professor Jinfeng YANG
	Assistant Professor Ikuhisa MITSUGAMI

Outlines

One of the unique features of ISIR is that students from the six graduated schools in Osaka Univ. gathered together to carry out their research studies in the institute. To provide multidisciplinary education programs for them, the Center for Research Education and Training was founded in April 2009.

The Center will promote various kind of educational programs for the students, such as teaching interdisciplinary sciences by integrating our multidisciplinary research fields, giving internship opportunities with companies, exchanging students with foreign universities/research institutes and giving opportunities to acquire technical skills beyond their own research discipline.

International Collaboration Center

Outlines

ISIR has promoted international collaboration with various universities and institutions all over the world based on the agreements on the academic exchange programs with the institutions and universities and by establishing the ISIR Branches in the foreign countries and so on. To further promote and to continuously support such international exchange and collaborations, International Collaboration Center was founded in April 2009. The center consists of several collaborative laboratories, which are established between ISIR and the universities / institutions in the foreign countries. Currently seven collaborative laboratories are working. Researchers and students who belong to the collaborative research projects stay at a collaborative laboratory on each side and perform the collaborative research.

PU-ICT lab.

The School of Electronics Engineering and Computer Science, Peking University, and the Institute of Scientific and Industrial Research, Osaka University, have established a cooperative research laboratory on information and communication technology (ICT) between both institutions. The studies in ICT collaborative laboratory focus on computer vision and media processing including basic technologies and applications.

1. Range sensing and 3D reconstruction
2. Image segmentation and object detection
3. Human motion analysis and human recognition

KU-AMR lab.

College of Science and Technology (CST), Korea University (KU), Korea, and the Institute of Scientific and Industrial Research (ISIR), Osaka University, Japan, based on the agreement on academic exchange between CST and ISIR, established a collaborative laboratory on each side on advance materials research between both institutions.

1. Fast energy and electron transfer of photoresponsible materials
2. Redox reactions of substituted carboranes
3. Solar light conversion materials

POSTECH-PMR lab.

School of Environmental Science and Engineering/Department of Chemical Engineering (SES/DCE), Pohang University of Science and Technology (POSTECH), Korea, and the Institute of Scientific and Industrial Research (ISIR), Osaka University, Japan, based on the agreement on academic exchange between SES/DCE and ISIR, established a collaborative laboratory on each side on photoresponsible materials

research between both institutions.

1. TiO₂ photocatalysts
2. Visible-light responsible photocatalysts
3. Artificial photosynthesis by photocatalysts

UCL-ESS lab.

In order to stimulate collaboration on the photo-induced structural changes of solid surfaces from both theoretical and experimental approaches, ISIR has had one post-doctoral researcher, who stayed at UCL to perform theoretical investigation on the following topics:

1. Photoinduced structural phase transitions of Graphite and gold
2. The first principle calculation of electronic structures of Si surfaces
3. Theoretical methodology of the first-principle excited-state molecular dynamics

DLSU-ICT lab.

College of Computer Studies (CCS), De La Salle University-Manila (DLSU), and ISIR have established a cooperative research laboratory on information and communication technology (ICT) between both institutions. Its studies focus on empathic computing.

1. Several aspects of empathy in computing
2. User modeling based on physiological and other sensors
3. Adaptive user interfaces and machine learning

AU-SOC lab.

Institute of Organic Chemistry, RWTH Aachen University-Germany (AU), and ISIR have established a cooperative research laboratory on synthetic organic chemistry (SOC) between both institutions. Its studies focus on efficient transformation of organic molecules.

1. Organocatalytic enantioselective catalysis
2. Transition metal catalyzed reactions
3. Development of domino reactions

BU-SOC lab.

Faculty of Chemistry, Bielefeld University-Germany (BU), and ISIR have established a cooperative research laboratory on synthetic organic chemistry (SOC) between both institutions. Its studies focus on combination of biocatalysis and molecular catalysis.

1. Hybridization of biocatalysis and enantioselective organocatalysis
2. Immobilization of enantioselective catalysis
3. Exploring a novel C-C bond-forming reactions

Nano-Macro Materials, Devices and System Research Alliance

Outlines

The aim of "Nano-Macro Materials, Devices and System Research Alliance" is to endeavor strategic development of "Materials, Devices, and System" as a cooperative research project with Research Institute for Electronic Science (Hokkaido University), Institute of Multidisciplinary Research for Advanced Materials (Tohoku University), Chemical Resources Laboratory (Tokyo Institute of Technology), the Institute of Scientific and Industrial Research (Osaka University), and Institute for Materials Chemistry and Engineering (Kyushu University). This Alliance consists of four research groups for (1) next-generation electronics, (2) energy materials and devices, (3) medical materials, devices, and system, and (4) environmentally benign materials and devices. The collaborative research alliance through interuniversity research institutes aims to develop innovative materials and devices by linking nanoscopic and macroscopic worlds, toward the realization of safety and secure society.

The Nano-Macro Materials, Devices and System Research Alliance was being run under the Steering Committee of 5 member Institutes. The Committee members of FY2012 from ISIR were Prof. H. Tanaka (Vice Chair), Prof. Y. Yagi, and Prof. T. Oguchi. Our members of this Alliance were as follows.

- (1) Next-generation electronics research group
Prof. K. Matsumoto (Group Leader), Prof. H. Tanaka, Prof. J. Takeya, Prof. T. Washio, Prof. Y. Ando, Prof. Y. Aso, Prof. T. Oguchi
- (2) Energy materials and devices research group
Prof. H. Kobayashi (Group Leader), Prof. M. Numao, Prof. K. Tanimura, Prof. K. Suganuma, Prof. S. Takeda, Assoc. Prof. Y. Honda, Assoc. Prof. T. Suzuki
- (3) Medical materials, devices, and system research group
Prof. K. Nakatani (Group Leader), Prof. Y. Yagi, Prof. R. Mizoguchi, Prof. N. Kato, Prof. K. Tanizawa, Prof. A. Yamaguchi, Prof. M. Taniguchi, Prof. T. Nagai
- (4) Environmentally benign materials and devices research group
Prof. Y. Yoshida (Group Leader), Prof. T. Majima, Prof. H. Sasai, Prof. G. Isoyama, Prof. T. Kozawa

Next Generation Electronics Research Group

Professors: Kazuhiko MATSUMOTO (Group Leader),
Hajime ASAH, Yoshio ASO, Hidekazu TANAKA, Yoichi
ANDO, Jun TAKEYA, Tamio OGUCHI, Takashi WASHIO

Outlines

New functional nano-electronics mainly based on the semiconductor materials are targeted and their material characteristics, physical evaluation, device performance, etc. are analysed in details as follows:

The Synthesis and development of III-nitride semiconductor-based room temperature transparent ferromagnetic semiconductors with strong photoemission properties and their application to novel semiconductor spintronics device fabrications were conducted. (Asahi)

Using the carbon nanotube as a treating material, the quantum functional device, field effect transistor, new nanomemory, FET type bio sensor, electrochemical biosensor are developed. Also, the fundamental growth process, such as a chirality control, growth direction control are investigated. The antigen/antibody reaction using graphene FET was successfully developed. (Matsumoto).

On the basis of our strategy of designing and synthesizing novel π -conjugated molecular materials, we have focused our research on the development and evaluation of functionalized molecular wires and anchoring units applicable to molecular electronic devices. (Aso)

Functional oxides show unusually giant physical properties including ferromagnetism, giant metal–insulator transition, superconductivity, and others. To control their functionalities by external field, nano-structuring is quite effective toward construction of power saving devices and sensor devices. We have construct nano-heterostructured correlated oxides to effectively control their electron correlation. (Tanaka)

To develop innovative device principles to utilize novel quantum functionalities, we are studying topological insulators and topological superconductors using high-quality single crystals and top-notch measurements of basic physical properties. This year, we have succeeded in achieving the surface-dominated transport for the first time in a bulk topological-insulator crystal. (Ando)

A new technology is developed to fabricate high-performance transistor arrays of crystalline organic semiconductors. Typically one order of magnitude higher mobility is achieved so that the result offers fundamental breakthrough for low-cost and fast operating active-matrix panels. We actually demonstrate that liquid-crystal displays are driven by the matrices successfully. (Takeya)

First-principles studies to clarify the electronic mechanism for various materials properties are performed. Magnetic crystalline anisotropy of transition-metal multilayers and magneto-electric effects of multiferroics are investigated. (Oguchi)

A new estimation method to more accurately separate quantum states into invariant and variant components under condition changes in quantum experiments is developed. (Washio)

Current Research Projects

Fabrication of Diluted Magnetic Semiconductor Nano-Structures

In the GaGdN nano-rod structures the enhancement of magnetization perpendicular to the sample plane was realized by the structural magnetic anisotropy. InGaGdN/GaN multi-quantum disc structures were successfully fabricated. GaDyN/GaN tunnel magneto-resistance device structures were also fabricated.

Carbon Nanotube Nano Memory

Owing to the small diameter of the carbon nanotube (CNT), the electric field concentration was induced around the nanotube. Therefore, we could get the higher electric field even at the lower applied voltage. Using this phenomenon, CNT was surrounded by two dielectric layers of $\text{Si}_3\text{N}_4/\text{SiO}_2$ for the memory structure. In this carbon nanotube nanomemory, only 2V is necessary for the write in and read out process. This is 10 times smaller value than the conventional planar type memory. By reducing the gate length down to 10nm, and all rounded structure was formed. In this device, one by one memory effect was observed even at room temperature. Using the smaller size of the device, single charge memory effect could be detected even at room temperature.

Graphene Bio Sensor

Using the graphene as a channel of the FET, the bio sensor was first fabricated. In the solution, the electrical double layer works as an infinitesimally thin gate dielectric of $\sim 2\text{nm}$, the FET showed 34times higher transconductance than measured from the backgate electrode. By modulating the surface of the graphene by the fragment antibody, antigen/antibody reaction was successfully detected electrically for the first time.

Molecular Electronic Materials

We have designed and synthesized a pyridine-based tripodal anchor unit to construct a single-molecule junction with a gold electrode. X-ray photoelectron spectroscopy measurements indicated a π -type physical adsorption of the anchor unit to the gold surface. The conductance of a single-molecule junction that consists of the tripodal anchor and a molecular wire was measured by modified STM techniques. By theoretical analyses of the transport mechanism, the participation of the π orbital of the anchor moieties and n-channel electric transport were predicted. We have also developed a series of oligothiophenes having homogeneously substituted encapsulating units that maintain the efficient conjugation of the π systems. Owing to the absence of intermolecular interactions between π -conjugated backbones, the electrical conductance of the single molecule determines the real decay constant of the oligothiophenes.

Construction of Transition Metal Oxide Nano Structured Devices

We discovered micro-scale phase separation in VO_2 thin films on $\text{TiO}_2(001)$

substrates and the abrupt resistive changes against temperature. Furthermore, we have constructed two-terminal multistate memory elements based on VO_2/TiO_2 thin film microcantilevers. Volatile and non-volatile multiple resistance states are programmed by current pulses at temperatures within the hysteretic region of the metal-insulator transition of VO_2 . The memory mechanism is based on current-induced creation of metallic clusters by self-heating of micrometric suspended regions and resistive reading via percolation.

Basic Research of Topological Insulators and Superconductors

We discovered a highly bulk-insulating topological insulator compound $\text{Bi}_{2-x}\text{Sb}_x\text{Te}_{3-x}\text{Se}_x$, and by optimizing this material, we have succeeded in achieving the surface-dominated transport for the first time in a bulk topological-insulator crystal. Also, we discovered that the $\text{Cu}_x\text{Bi}_2\text{Se}_3$ superconductor, which is an electron-doped topological insulator, is the first concrete example of a time-reversal-invariant topological superconductor that hosts Majorana fermions on the surface.

Active Matrix-panel using Solution-crystallized High-mobility Organic Transistors

High-performance active matrix panels are developed using transistor arrays of crystalline organic semiconductors fabricated through a novel solution-crystallization method. Their one order of magnitude higher mobility opens the way towards high-end flexible and printed electronics industry, so that the achievement is highly evaluated in the industrial community, being awarded as the Nanotech best project in 2012.

First-principles Studies on Materials Properties

We have investigated the spin-orbit driven magnetic crystalline anisotropy of transition-metal multilayers such as FePt and CoPt on the basis of first-principles calculations. The origin of the shape anisotropy is also studied. We have elucidated the microscopic mechanism for the ferroelectric polarization originating from spin-orbit coupling in multiferroic $\text{Ba}_2\text{CoGe}_2\text{O}_7$.

An Estimation Method of Quantum States for Quantum Experiments

Devices for quantum information processing have potential power enabling revolutionary information processing. Quantum states satisfy a mathematical property named positive semidefinite. This study aims to develop an estimation method to separate quantum states into invariant and variant components under condition changes in quantum experiments. We obtained its world's first theoretical framework. Results of quantum experiments are known to satisfy a mathematical property named positive semi-definiteness due to their background physical nature. This study worked on the development of a method and its algorithm to derive the accurate estimation from the large scale and complex experimental results based on the mathematical property. As a consequence, the feasibility of the accurate estimation by using projection of the large-scale experimental results to high dimensional data space has been clarified.

New Energy Material • Devices Research Group

Professors: Hikaru KOBAYASHI (Group Leader), Katsuaki SUGANUMA, Katsumi TANIMURA, Seiji TAKEDA, Masayuki NUMAO, Tateyuki SUZUKI, Yoshihide HONDA

Outlines

Silver nanowire transparent electrodes were fabricated by mechanical press at room temperature. In addition, the surface roughness of the pressed electrodes was decreased because the junctions between silver nanowires were mechanically compressed. (Suganuma).

We study the dynamics of photogenerated carriers on semiconductor surfaces and interfaces by means of time-resolved two-photon photoemission spectroscopy with fs temporal resolution. We aim to reveal dynamical aspects of hot-carrier relaxation in the processes of light-to-energy conversion of semiconductor devices. (Tanimura)

In order to elucidate the catalytic mechanism of Au nanoparticles supported on CeO₂, we have studied the morphology and surface structure of Au nanoparticles under reaction conditions using environmental transmission electron microscopy. (Takeda)

Towards constructing a fundamental technology for clarification of physical degradation and/or monitoring system of fuel cells, we develop the intelligent damage evaluation methodology based on data mining technique. (Numao)

The energy saving and environmentally benign process using transition metal catalysis is one of the most fundamental technologies. We have studied the novel tandem asymmetric reactions based on the oxidative desymmetrization. (Suzuki)

Radical-induced reactions in polymer electrolyte membrane for fuel cell, has been studied with the aids of several techniques such as gamma-ray, electron beam, laser and positron along with pulse radiolysis system. (Honda)

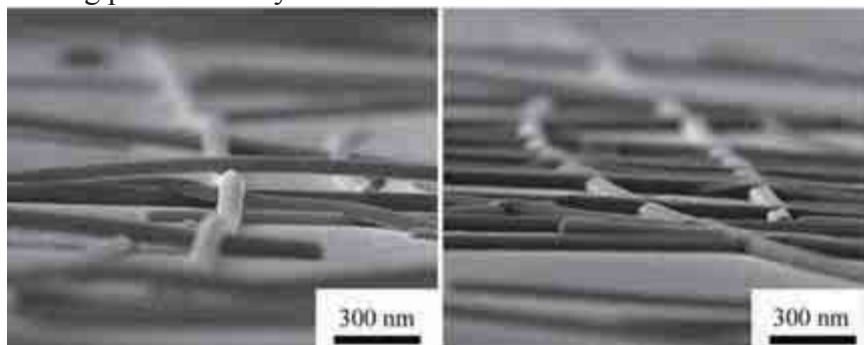
A method to effectively produce Si nanoparticles has been developed by use of the photochemical etching method. The characteristics of the *pn*-junction solar cells with the fabricated Si nanoparticles were improved by the nitric acid oxidation method. (Kobayashi)

Current Research Projects

Non heating fabrication of transparent conductive electrodes for solar cell

Silver nanowire electrodes have attracted attention as flexible transparent electrodes. However, when electrical devices are fabricated on silver nanowire electrodes, there is a issue that electrical leakage occur due to coarse surface roughness (left picture). In this study, silver nanowire electrodes were fabricated by mechanical press at room temperature. The pressed electrodes have low surface roughness (right picture). This

finding paves the way for fabrication of electrical devices on silver nanowire electrodes.



Ultrafast Carrier Dynamics on Semiconductor Surfaces Studied by Time-Resolved Two-photon Photoemission Spectroscopy

The dynamics of photoinjected hot electrons in Si and GaAs bulk conduction band has been studied using 6-eV probe pulse of 90 fs temporal width. The photogenerated electrons with a high excess energy are transferred (captured) to surface defect levels with significantly high rates before forming quasi-equilibrated distribution within a few ps after excitation. The surface recombination processes are induced in later temporal domains till 100 ps.

Morphology and surface structure of supported Au nanoparticle catalysts under reaction conditions

Operand environmental transmission electron microscopy observations show that the morphology of Au nanoparticles supported on CeO₂ depends on the partial pressures of CO and O₂. Adsorption of CO molecules stabilizes the gold nanoparticles with faceted shape. On the other hand, Au nanoparticles become rounded in O₂. In addition, we have found that adsorbed CO molecules caused the {100} facets of gold nanoparticles to reconstruct during CO oxidation.

Inference of mechanical effects among structural members on fuel cells

In order to infer mechanical effects of structural members on Solid Oxide Fuel Cell (SOFC), we validated the proposed algorithm that extracts frequently occurring damage patterns from a sequence of Acoustic Emission events of damage observation. We revealed mechanical effect among structural members of SOFC, such as initial small cracks and contraction of the glass seal significantly affect to the total fracture process. Also, we have started to apply our method to Li-ion battery.

Asymmetric tandem reactions using iridium-catalysis

Development of catalytic reaction using clean oxidant is one of the most important themes in modern organic synthesis. Ir-catalyzed oxidative desymmetrization of *meso* diols is the efficient methods for the synthesis of chiral building blocks. This time we

have developed the catalytic tandem asymmetric reaction based on desymmetrization of *meso* diols. Furthermore, we found the asymmetric hydrogen autotransfer process proceeds in high selectivities.

Study of radical reactions in polymer electrolyte membrane(PEM) with pulse radiolysis

Degradation process of PEM has been studied with electron pulse radiolysis technique. The samples were prepared by loading substrate(S) into Nafion. Decreasing water content in Nafion reduced generation of $\text{OH}^\bullet$ adduct of S, whereas the amount of products due to one-electron oxidation was not changed, suggesting that $\text{OH}^\bullet$ was mostly generated from the water- SO_3^- ionic clusters.

Solar cells using Si nanoparticles

Si nanoparticles were fabricated from Si swarf by use of the photochemical method. The fabricated Si nanoparticles possessed a strong photoluminescence peak around 400 nm, indicating that the band-gap was broaden due to the quantum size effect. The p-type Si nanoparticle/n-type crystalline Si structure showed a good rectifying behavior and the photo-response of this structure was improved by the nitric acid oxidation of Si (NAOS) method due to improvement of the contacts between nanoparticles.

Medical Treatment Materials, Devices, and System Research Group

Professors: Kazuhiko NAKATANI (Group Leader),
Yasuhi YAGI, Riichiro MIZOGUCHI, Nobuo KATO,
Katsuyuki TANIZAWA, Akihito YAMAGUCHI,
Masateru TANIGUCHI, Takeharu NAGAI

Outlines

This research group focused attention on development of gene/drug delivery system, modulation of protein functions by organic small molecules, an imaging device with polyhedral mirror, gene detection method and system, bioactive substances transporter, single-molecule electrical analysis system, high-sensitive Ca^{2+} sensor, and a tool for describing human activity.

The bionanocapsule that can deliver drugs and genes to a specific organ or tissue has been developed and applied to gene/drug delivery systems. (Tanizawa)

An organic molecule that stabilizes a binary complex of 14-3-3 protein and its mode 3 client peptide has been synthesized from a natural diterpene glucoside. (Kato)

A shape estimation method by analyzing brightness of single scatterings has been developed. (Yagi)

A tool for describing human activity was developed. On the basis of positive reactions of its informal evaluation, we made an experimental plan for its evaluation of the tool by applying it to description of the guideline for emergency patients at Miki City Hospital. (Mizoguchi)

Analysis of the sphingosine 1-phosphate (S1P) transporter, SPNS2, knockout mice revealed that the secretion of S1P from vesicular endothelial cells is essential for T-lymphocyte egress into blood. Crystal structure of the inhibitor-bound multidrug transporter reveals the inhibitor-specific binding pit. (Yamaguchi)

By optimizing the length and sequence of competitor primers, we have achieved the exceptionally high allele specificity with hairpin primer PCR method. (Nakatani)

We find that transverse electric field of 10 mV/nm in an electrode-embedded silicon dioxide nanochannel slows down the biopolymer translocation velocity by about three orders of magnitude. (Taniguchi)

By construction of circularly permuted fluorescent proteins with Ca^{2+} sensor domain and development of high-efficient screening system, we made blue, green and red Ca^{2+} sensors with tremendous big dynamic range. (Nagai)

Current Research Projects

Development of a New Method of Pinpoint Gene and Drug Delivery Systems Using Bionanocapsule Derived from Hepatitis B Virus Surface Antigen L Protein (Tanizawa)

Bio-nanocapsule (BNC) is a virus-like empty nanoparticle made of phospholipids and envelope proteins derived from hepatitis B virus. Since it does not contain viral genome, BNC is nontoxic to cells *in vitro* and safe *in vivo* especially to humans when used as vaccines. BNC is now being developed as a novel drug delivery vector capable of specific delivery of genes, proteins, and pharmaceutical drugs to human hepatocytes with high efficacy. BNC potentially alters its target specificity when the PreS1 region is replaced with an appropriate bio-recognition molecule such as homing peptides, cytokines, and antibodies specific to cell surface proteins. Next-generation BNC has also been developed in this year by displaying antibody-binding modules derived from protein G and L on the BNC surface, which can bind various immunoglobulins from a number of animal species.

Client selective modulation of 14-3-3 protein functions by fusicoccin derivatives (Kato)

14-3-3 proteins play a crucial role in regulation of Ser/Thr kinase-dependent signalling pathways through protein-protein interactions. We have rationally designed and synthesized a fusicoccin derivative (FC-THF) that stabilizes a binary complex of 14-3-3 protein and its mode 3 client protein selectively. FC-THF stabilized 14-3-3/TASK-3 interaction and increases potassium currents in *Xenopus laevis* oocytes.

Shape from Single Scattering for Translucent Objects (Yagi)

A shape estimation method by analysing brightness of single scatterings has been developed. The single scattering is a one-bounce collision of light to a particle in the medium, hence the optical path and the attenuation can be analysed. Based on this analysis, we confirmed that the surface shape of translucent objects such as plastic can be roughly estimated.

Development of a tool for describing human task-performing behaviors (Mizoguchi)

We developed a tool called CHARM-Pad for describing human behaviors on tablet computers. Its major features include computer-interpretable semantics, explicit representation of the purposes of actions and easy comparison among action-execution ways with explicit reasons of the way selection. It is now under on-site evaluation in the Osaka Kouseinenkin Hospital for ICU tasks.

Analysis of Sphingosine 1-Phosphate Transporter (SPNS2)-Knockout Mice and the Determination of the Inhibitor-binding Structure of Multidrug Transporter (Yamaguchi)

Analysis of the SPNS2-KO mice revealed that SPNS2 is a S1P efflux transporter in vesicular endothelial cells. The lack of the S1P from vesicular endothelial cells results

in the disappearance of T-cells in blood, indicating that secretion of S1P by SPNS2 is essential for the T-lymph egress into blood. Crystal structure of the inhibitor-bound multidrug efflux transporter revealed the specific inhibitor binding pit branched from the drug translocation route. By using the site-directed mutagenesis, we proved that the amino acid side chain at the edge of the entrance of the pit determines the inhibitor specificity.

Development of Improved Hairpin Primer PCR Method (Nakatani)

We have reported a new PCR technology using hairpin primer containing cytosine bulge named hairpin primer PCR as convenient and simple method for SNP typing. The current hairpin primer PCR detects the decrease of fluorescent intensity as the PCR proceeds. In order to increase the sensitivity of hairpin primer PCR method, fluorescent indicator DANP was attempted to covalently immobilize to the hairpin primer at the vicinity of the C-bulge. We found the site of covalent attachment of DANP showing the increase of fluorescent intensity. This method is applied for the detection of virus infection.

Method to Control the Translocation Speed of Single DNA (Taniguchi)

Transverse electric field effects on DNA translocation kinetics in a 50 nm fluidic channel was investigated by simultaneous measurements of the trans-channel and transverse current using an electrode-embedded nanochannel sensor. Transverse field of 10 mV/nm slows DNA translocation speed in the channel by three orders of magnitude. Field-retarded translocation significantly improves the single-molecule topographic reading capability and enables identification of local conformation of an individual unlabeled DNA strand.

Development of high-sensitive Ca^{2+} sensor with blue, green and red color variants (Nagai)

We developed novel Ca^{2+} sensor, GECO series, by introducing Ca^{2+} sensor domain composed of CaM and M13 into circularly permuted fluorescent protein. To seek high- Ca^{2+} sensitive sensor effectively, we invented high-effective screening system by expressing the proteins in periplasmic region of *E. Coli* so that the constructed sensors in *E. Coli* show the high sensitivity for external Ca^{2+} . Finally, we yielded high dynamic range (2,600%) green Ca^{2+} sensor, G-GECO. Furthermore, we succeeded to develop color variants of GECO such as B-GECO, R-GECO and GEM-GECO which enables one wavelength excitation and two wavelength emissions (i.e., ratiometric) measurement.

Environmental Harmonized Materials and Devices Research Group

Professors: Yoichi Yoshida (Group Leader),
Hideo NAKAJIMA, Tetsuro MAJIMA, Goro ISOYAMA,
Hiroaki SASAI, Takahiro KOZAWA

Study of Environmental harmonized chemical reaction process by using quantum beam technology (YOSHIDA)

Redox reactions by active species induced by quantum beam without using harmful oxidants or reductants are environmental friendly chemical reaction process. In order to study the reaction process of active species which are very fast, the femtosecond pulse radiolysis system was developed in ISIR. By the way, room temperature ionic liquids which have common characters of non-flammable and ultra-low vapor pressure are safety and low environmental emission as environmental conscious reaction solvent. In this year, it was studied that the solvated electron was generated by the electron beam in ionic liquids, and the electron transferred to the aromatic compound (reduction). Electron beam induced redox reaction using ionic liquid is a new environment-friendly reaction processes.

Collaboration research projects: For the collaboration study, started the consideration with the chemistry of molecular assembly group in IMECE for the study of intra-molecular electron transfer. And for the environment-friendly reaction process in ionic liquids, started the consideration with the micro process control group and the nano scale evaluation group in IMECE .

Fabrication, Properties and Applications of Macro and Nano Porous Metals (NAKAJIMA)

Mechanical properties of lotus-type porous metals with directional pores were investigated, which revealed that lotus carbon steels exhibits superior impact energy absorption originating from the unidirectional pores. Furthermore, the fabrication process of nonporous oxide was investigated, which clarified that oriented anisotropic nano pores in amorphous oxides can be evolved through the structural relaxation in the amorphous thin films at high temperature. It was also revealed that inhomogeneous density distribution in the amorphous film gives rise to the formation of nano pores.

Collaboration research projects: Lotus Fe-12mass% alloys were fabricated by the continuous zone melting technique under hydrogen pressure of 2.5 MPa, using the high-purity (99.997%) raw materials prepared in Issiki group (Institute of Multidisciplinary Research for Advanced Materials, Tohoku University). It was found that large pores are formed in the high-purity Fe-Cr alloy, because the number of nucleation sites for the pore formation is small.

Beam-induced Chemistry of Nanomaterials (MAJIMA)

"Beam-induced Chemistry of Nanomaterials" based on photo- and radiation-induced chemistry of nanomaterials such as supramolecules, oligomers, polymers, DNA,

proteins, metal oxides, semiconductors, and metals has been investigated from both basic and beam-functional points of view. We carried out the research projects such as charge transfer in DNA, TiO₂ photocatalyst, energy and charge transfer in supramolecules, and dynamics of proteins and DNA.

Collaboration research projects: We carried out the collaboration with the research group of Prof. Shinmyozu in Kyushu University where cyclophane compounds are synthesized. The γ -radiolysis in the rigid matrix at 77 K and pulse radiolysis at room temperature were studied to discuss the intramolecular charge delocalization. We also carried out the collaboration with the research group of Prof. Maruyama in Kyushu University. We successfully measured the charge-recombination dynamics in DNA at the single-molecule level from fluorescence correlation spectroscopy of fluorescent dye-modified DNA.

Upgrade of a high intensity THz radiation source and its applications to research on environment-conscious materials (ISOYAMA)

As a part of study to upgrade the high intensity THz radiation source based on free electron laser (FEL), we measured the FEL gain, which has a significant influence on FEL operation, using the method developed last year to measure the FEL energy in the macropulse as a function of the number of amplifications. The maximum gain is derived to be 58 % at a 105 μ m wavelength and its dependency on the optical cavity length is in good agreement with predictions of the super-mode theory. Wavelength spectra of FEL are measured with development of the FEL power at two cavity lengths and contour maps in time and wavelength ordinates are derived, showing quite different features. We conducted experiment to generate circularly-polarized light from the linearly-polarized FEL light in order to apply it to studies on the magnetic materials with spin polarization and optical isomers with chirality.

Collaboration research projects: In order to find research groups for collaboration, we continue introducing our research activities at plenary meetings of the alliance and section meetings, and continue our deliberations on possibility of collaboration studies in the next year by studying research activities of other groups.

Development of Environmentally Benign Catalytic Process for the Enantioselective Synthesis of α -Acyloxycarbonyl Compounds (SASAI)

α -Acyloxycarbonyl group is widely seen in nature and is known as a useful substructure for pharmaceutical products and synthetic intermediates. For its construction, a stoichiometric or an excess amount of a highly toxic oxidant such as manganese or lead compounds is generally necessary. We have successfully developed an environmentally benign synthetic approach to the α -acyloxycarbonyl functionality, where Pd-SPRIX complex and O₂ serve as an effective catalyst and a green oxidant, respectively.

Collaboration research projects: We have performed the collaboration with the research group of Prof. Nagatsugi at Institute of Multidisciplinary Research for Advanced Materials in Tohoku University about the biological activity of novel chiral spiro compounds we prepared.

Study of Primary Processes of Radiation Chemistry in Condensed Matter

(KOZAWA)

The enhancement of reaction efficiency induced in materials used for high volume production is important for saving energy and resources. For the enhancement of reaction efficiency, the catalytic chain reaction induced in resist materials used for extreme ultraviolet lithography was investigated. Also, the reaction mechanisms of environmentally-responsive biomolecules were investigated using radiation-chemical method for the development of environmentally-responsive sensors.

Collaboration research projects: The response mechanism of oxygen biosensor to oxygen concentration in the environment was investigated in collaboration with Bioreaction Design group in IMRAM.

Workshop

Director Professor: Katsumi TANIMURA

Technical Staff:

Machine Shop: Masayoshi OHNISHI, Yuki MATSUSHITA

Glassworks: Hiroaki MATSUKAWA, Noriyuki OGAWA

Outlines

A machine shop and a glass factory were set up at the same time when the Institute of Scientific and Industrial Research was founded.

Since research fields studied in the institute covers a wide range, many of experimental apparatuses requested to the Workshop are various and novel. The Workshop, which consists of the Machine Shop and the Glassworks, plays an important role in activities of the institute and contributes to them by making and providing such experimental apparatuses.

The Machine Shop performs design and trial manufacture of experimental apparatuses for science and engineering as well as production of experimental tools made of various metals. Requests of experimental apparatuses for ultra high vacuum or ultra low temperature are increasing recently and accordingly we work in closer cooperation with researchers asking such apparatuses from the design phase to respond to the requests and make apparatuses best fit to experimental purposes. A gate-type machining center was introduced in 2002, and a CNC lathe was introduced in 2009, so that we can answer to advanced and difficult requests from researchers.

The Glassworks performs design and trial manufacture of experimental tools and apparatuses made of various kinds of glass. We develop apparatuses necessary and suitable for experiments and we also devote ourselves to our studies and establishment of technique for improving functions of conventional apparatuses and for providing safer and easier-to-use apparatuses. Since we are recently asked to work with ceramics, we are trying to obtain machines for it. A CNC plain grinding machine was introduced in 2009, so that we can answer to advanced and difficult requests from researchers.

Activities

Although one employee decreased in number, we were able to keep reduction of the work request number to the minimum, as a result of doing our best in order to maintain the work request number.

We participated in the event of the technical Division, and achieved the local contribution in cooperation with the ISIR.

The members of the Workshop organized and participated in the national technical meeting and the symposium on glass works for all the engineers and technicians of universities and national laboratories in Japan.

Number of jobs

Machine Shop: 193 jobs (265 jobs in the previous year).

Glassworks: 132 jobs (148 jobs).

Laboratory for Radio-isotope Experiments

Professor: Goro Isoyama

Outlines

This laboratory is specially designed for biochemical and molecular biological experiments using the radioactive compounds labeled with ^3H , ^{14}C , ^{32}P , ^{33}P or ^{35}S . The main equipments are liquid scintillation counters and a bioimaging analyzer (FLA3000). Radioactive compounds are convenient tool for the research in the field of biochemistry, molecular biology, and cell biology. The use of radioisotopes is regulated with the national law for the prevention of radiation hazard. The facilities are inspected regularly with authorities and pass the required standard. Radioisotope users must attend the mandatory education program every year to get the knowledge for the safe use of radioisotopes.

In this year, three continued projects were applied for use of this laboratory. Contributions of the facilities to the research projects are described in the section of each department.

Electronic Processing Laboratory

Professor: Kazuhiko MATSUMOTO
Associate Professor: Shigehiko HASEGAWA
Associate Professor: Takuya MATSUMOTO
Associate Professor: Koichi SUDOH
Associate Professor: Kenzo MAEHASHI
Assistant Professor: Yi-Kai ZHOU

Outlines

Electronic Processing Laboratory was established as a sort of device fabrication workshop in 1991. The aim of this laboratory is to contribute to the development of nanotechnology and related researches by setting up the equipment and systems for fabrication, required commonly for the researches related to the areas such as photonic and electronic materials, molecular device materials and organic device materials and by improving process technology for various device materials.

The equipment and systems are a small-size clean room, a double crystal X-ray diffractometer, an atomic force microscope, a digital optical microscope, a photolithography system, a sputter deposition system, a high vacuum evaporation system, an electron beam evaporation system, a reactive ion etching system, a focused ion beam system, a crystal cleaving system, a wire bonding system and personal computers for data analysis

This laboratory is utilized for experimental researches of surface structure analysis and electrode formation, for the measurements of electronic and other properties of various materials and also for the fabrication of photonic, electronic and molecular devices. Guidance to the users to the equipments and systems as well as the daily maintenance and repair of them were conducted. In the year of 2012, the equipment and systems were used about 50 times from 4 laboratories and facilities.

Library

Professor: Kazuhiko MATSUMOTO
Commissioned Staff: Yasuko ONO
Supporting Staff: Kuniko HAMANAKA

Outlines

The ISIR Library houses technical books and journals for researchers. Most materials are on open shelves directly available to faculty and students. The library has a reading room with photocopiers on the second floor of the administration building.

The library office offers the following services; orders for books, survey and inquiry of literature, Interlibrary Loan services, photocopy request and so on.

Guide to the Library could be found on its home page
(<http://www.sanken.osaka-u.ac.jp/labs/lib-web/>).

(As of March 31, 2013)

	Number of books	Journals	Newspapers
Japanese	5,094	178 titles	4 titles
Foreign	19,654	542 titles	1 title

Open Laboratory

Professor:	Hiroaki SASAI
Technical Staff:	Kimihiro NORIZAWA
Supporting Staff:	Kayoko OHASHI

Outlines

Open Laboratory supports the comprehensive research for creative and advanced academic research on materials and devices, which should become the foundation of scientific and technological development on nanotechnology.

Current Research Projects

On 2012, the following 11 researchers used Open Laboratory.

Prof. Kazuyoshi ITOH	Graduate School of Engineering
Prof. Yusuke MORI	Graduate School of Engineering
Prof. Keisuke MORISHIMA	Graduate School of Engineering
Prof. Yoji SHIBUTANI	Graduate School of Engineering
Prof. Kohji MINOSHIMA	Graduate School of Engineering
Prof. Yoshimitsu YAMASAKI	Graduate School of Medicine
Prof. Tomoji KAWAI	Institute of Scientific and Industrial Research
Prof. Hikaru KOBAYASHI	Institute of Scientific and Industrial Research
Prof. Seiichi TAGAWA	Institute of Scientific and Industrial Research
Prof. Kazuhiko MATSUMOTO	Institute of Scientific and Industrial Research
Prof. Junichi TAKEYA	Institute of Scientific and Industrial Research

Academia Industry Relations Office

Director Professor:	Hikaru KOBAYASHI
Professors:	Kazuhiko MATSUMOTO, Takahiro KOZAWA Hiroaki SASAI, Masateru TANIGUCHI
Specially Appointed Professor:	Hirokazu SHIMIZU

Outlines

The Academia Industry Relations Office (AIR Office) of the Institute of Scientific and Industrial Research (ISIR), is dedicated to reinforcing collaboration between ISIR and the industrial community, thereby combining and developing research potential of the two sectors and promoting activities for new industrial creation and innovation. The AIR Office organizes a variety of activities to inform the industry community of the ISIR's research activities efficiently through the interaction with the industry community such as SANKEN Techno Salon and various Lecture events, and studies on prediction of new industry, novel system of new Industry generation, and intellectual property.

The major activities of AIR Office are: 1) A network development between ISIR and Industry, 2) Responding to inquiries from industry, 3) A liaison between academia and industrial research activities, 4) Creation of complementary opportunities for science and technology progress. AIR Office will make proposals for new business opportunity between academia and industry. New venture business activities and novel industrial products are the vision of AIR Office.

Activities

Introduction of ISIR's Research Activities to the Industrial Sector

- 1) SANKEN Techno Salon
 - 1st: May 17, 2012
 - 2nd: Aug.2, 2012
 - 3rd: Nov.2, 2012
 - 4th: Feb.1, 2013
- 2) Introduction of new technologies through the web site
- 3) Publication of a booklet for introduction of ISIR's research activities
- 4) Publicity of technologies at exhibitions: 5 exhibitions
- 5) Information exchange meeting with Industry: 2 meetings

Promotion of the Use of Company Research Park

New use: 4 companies (5 rooms)

Coordination of Joint Research etc.

3 joint researches

External Funding Support

2 fundings

New Industry Creation Study Group Support

1 group

Public Relations Office

Director, Professor: Yoichi YOSHIDA
Supporting Staff: Noriko MATSUMOTO

Outlines

Public Relations Office was opened on February 1, 2006. We provide the right information of our Research Institute for the public effectively. The major activities of Public Relations Office are: 1) To collect any required file to generate the basic plan of the publicity, 2) To support editing and issue the Memoirs of ISIR (annual report) and publications, 3) To collect any required document for creating and editing of official WEB of ISIR, 4) To perform Press Release except the subjects related to the section of general affairs, 5) To collect and preserve of any press release related to ISIR.

Technical Division

Head: Takanori TANAKA

Outlines

The Technical Division was established in 1982 to deal with professional duties providing better service for researchers. In the ISIR organization, the technician group is independent of the management and the research groups. The organization was the first one among similar organizations established in the national universities of Japan. The Division consists of two groups: Group of Machine and Group of Measurement, in which each group has two sections: Section of Machine/Circuit, Section of Glass in Group of Machine and Section of Measurement/Information, Section of Analysis/Data in Group of Measurement. The technicians work at various places: the Comprehensive Analysis Center, the Workshop, the Office of Information Network, the Research Laboratory for Quantum Beam Science, and the Nanoscience and Nanotechnology Center. The Division gives not only high-quality service to research groups but technical training to the researchers and students. The annual report is published to help and encourage training and activities of the members of the Division. In addition, the Division has started the safety lecture for utilizing various machines in the ISIR since 2004. The Technical Division makes every effort to promote the ISIR more important development under an independent administration system.

Administrative Office (31-March , 2013)

Director : Toshio SANDA

Planning Office

Staffs: Tomomi HIGASHIO
 Ayako YOSHIOKA
 Aya NISHIDA

General Affairs Division

Staffs: Mitsuyoshi SHIRAHAMA
 Sumiakio YAMAGUCHI
 Natsuko HORII
 Kazuko HANAMI

Supporting Staffs: Yukie YAMADA
 Junko HANASHIMA
 Mitsuru NISHISAKO
 Sachiko MITSUMORI
 Kazumi HAYASHI

Research Cooperation Division

Staffs: Hiromi NISHIKAWA
 Osamu NISHIMURA
 Kouichi YAMAMOTO
 Tamaki UEBAYASHI
 Misa TOKUMOTO
 Yuichi TANAKA
 Takayuki KOBAYASHI
 Aiko SATO
 Yukiyo KANDA
 Makoto OTSUKA
 Mina TANIZAWA
 Masako MORITA

Supporting Staffs: Yukako MORI
 Akiko YOKOYAMA
 Kumiko TERADA
 Kazune OTANI
 Kuniko NISHIMOTO

List of Achievements

Department of Photonic and Electronic Materials

Original Papers

- [1] Structural and Optical Characterization of GaN/AlGa_N Single Quantum Disk Nanorods, M. Almokhtar, S. Emura, H. Tambo, S. Hasegawa and H. Asahi: *Acta Physica Polonica A*, 123 (2013) 473-475.
- [2] Design of Spin Polarization Analyzer using Transverse-Longitudinal Correlation in Resistivities Induced by Spin–Orbit Interaction, Masamichi Sakai, Koichi Kakizaki, Shigehiko Hasegawa, Akira Kitajima, Akihiro Oshima, and Hiroyuki Awano: *Jpn. J. Appl. Phys.*, 52 (2013) 13004.
- [3] Observation of large Zeeman splitting in GaGdN/AlGa_N ferromagnetic semiconductor double quantum well superlattices, Yi Kai Zhou, Mohamed Almokhtar, Hitoshi Kubo, Nobuya Mori, Shuichi Emura, Shigehiko Hasegawa, Hajime Asahi: *Solid State Commun.*, 152 (2012) 1270–1273.
- [4] Coherent growth of GaGdN layers with high Gd concentration on GaN(0001), K. Higashi, S. Hasegawa, D. Abe, Y. Mitsuno, S. Komori, F. Ishikawa, M. Ishimaru, and H. Asahi: *Appl. Phys. Lett.*, 101 (2012) 221902.
- [5] Growth and Characterization of GaDyN/AlGa_N Multi-Quantum Well Structures, Y. Nakatani, Y. K. Zhou, M. Sano, S. Emura, S. Hasegawa, and H. Asahi: *e-J. Surf. Sci. Nanotech.*, 10 (2012) 499-502.
- [6] Optical properties of InGaP_N epilayer with low nitrogen content grown by molecular beam epitaxy, Kang Min Kim, Shogo Nonoguchi, Daivasigamani Krishnamurthy, Shuichi Emura, Shigehiko Hasegawa, and Hajime Asahi: *J. Appl. Phys.*, 112 (2012) 063507.
- [7] Rare-earth doped III-nitride semiconductors for semiconductor spintronics, Hajime Asahi, Shigehiko Hasegawa, Yi-Kai Zhou, Shuichi Emura: *J. Luminescence*, 132 (2012) 3136–3140.
- [8] Strong atomic ordering in Gd-doped GaN, Manabu Ishimaru, Kotaro Higashi, Shigehiko Hasegawa, Hajime Asahi, Kazuhisa Sato, and Toyohiko J. Konno: *Appl. Phys. Lett.*, 101 (2012) 101912.
- [9] An Approach to Temperature-Insensitive Band Gap II – InGaGdN Case, Shuichi Emura, Siti-Nooraya Mohd-Tawil, Daivasigamani Krishnamurthy, and Hajime Asahi: *Phys. Status Solidi B*, 249 (2012) 489-493.
- [10] Influence of Local Structure on Magnetic Properties of Layered Cobaltites PrBaCo₂O_{5+δ}, $\delta > 0.5$, S. Ganorkar, K. R. Priolkar, P. R. Sarode, A. Banerjee, R. Rawat, and Shuichi Emura: *J. Phys. : Condensed Matters*, 24 (2012) 476003–476009.
- [11] Multiple Scattering Approach to GaN:Gd Gd L₃-Edge XANES, Akihiro Koide, Takashi Fujikawa, Daijiro Abe and Shuichi Emura: *e-J. Surf. Sci. Nanotech.*, 10 (2012) 661–665.

International Conferences

- [1] Novel properties in GaN-based ferromagnetic semiconductor quantum wells (invited), Y. K. Zhou, Y. Nakatani, M. Sano, S. Emura, S. Hasegawa, H. Asahi: *Villa Conference on Energy, Materials, and Nanotechnology 2012*.
- [2] Growth and characterization of GaDyN-based double-barrier magnetic tunnel junctions (poster), Y. K. Zhou, M. Sano, S. Emura, S. Hasegawa, H. Asahi: *The 7th International Conference on Physics and Applications of Spin-related Phenomena in Semiconductors 2012*.
- [3] Mechanism of selective area growth of InP on Si(001) substrates using SiO₂ mask by gas-source molecular beam epitaxy (poster), S. Hasegawa, T. Shimoi, and H. Asahi: *The 17th International Conference on Molecular Beam Epitaxy*.

- [4]Photoluminescence Properties in GaGdN grown on GaN(0001) by PA-MBE (poster), K. Higashi, S. Hasegawa, S. Sano, Y. K. Zhou and H. Asahi: The 17th International Conference on Molecular Beam Epitaxy.
- [5]Growth parameter dependence of structural, electrical and magnetic properties in GaGdN layers grown on GaN(0001) (poster), S. Sano, S. Hasegawa, Y. Mitsuno, K. Higashi, M. Ishimaru, T. Sakurai, H. Ohta, and H. Asahi: The 17th International Conference on Molecular Beam Epitaxy.
- [6]Growth and characterization of GaN/GaDyN double barrier structures (poster), M. Sano, Y. K. Zhou, S. Emura, S. Hasegawa and H. Asahi: The 17th International Conference on Molecular Beam Epitaxy.
- [7]Influence of hydrogen incorporation on texture and grain size in YH₂ films (poster), Tomoya Okoshi, Masashi Hayakawa, Hiroaki Hiram, Masamichi Sakai, Koji Higuchi, Akira Kitajima, Akihiro Oshima, and Shigehiko Hasegawa: The 17th International Conference on Molecular Beam Epitaxy.
- [8]Crystal growth of magnetic dihydride Gd_xY_{1-x}H₂ for generation of spin current (poster), Takahito Sakuraba, Hiroaki Hiram, Masamichi Sakai, Zentaro Honda, Masashi Hayakawa, Tomoya Okoshi, Koji Higuchi, Akira Kitajima, Akihiro Oshima, and Shigehiko Hasegawa: The 17th International Conference on Molecular Beam Epitaxy.
- [9]Enhancement of hydrogen uptake for Y and Gd films by thin Ni surface overlayers (poster), Hiroaki Hiram, Masashi Hayakawa, Tomoya Okoshi, Masamichi Sakai, Koji Higuchi, Akira Kitajima, Akihiro Oshima, and Shigehiko Hasegawa: The 17th International Conference on Molecular Beam Epitaxy.
- [10]Growth and Characterization of Dilute Magnetic Semiconductor GaGdN Nanorods Grown on Si (poster), Mai Uenaka, Shigehiko Hasegawa, Mariko Kimura, and Hajime Asahi: International Workshop on Nitride Semiconductors 2012.
- [11]Growth and characterization of III-nitride based dilute magnetic semiconductors and their nanostructures (invited), Shigehiko Hasegawa, Yi-Kai Zhou, and Hajime Asahi: 2012 Energy Materials Nanotechnology Fall Meeting.
- [12]MBE Growth and Characterization of GaN-based Dilute Magnetic Semiconductor Nanostructures (invited), Shigehiko Hasegawa, Yi-Kai Zhou, and Hajime Asahi: 2012 Collaborative Conference on Crystal Growth.
- [13]Growth and Characterization of GaN-based Dilute Magnetic Semiconductor Nanostructures (poster), Shigehiko Hasegawa, Mariko Kimura, Mai Uenaka, and Hajime Asahi: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium 2013.
- [14]Structural and Optical Characterization of GaN/AlGa_xN Single Quantum Disk Nanorods (oral), M. Almokhtar, S. Emura, H. Tambo, D. Krishnamurthy, S. Hasegawa and H. Asahi: 2nd International Congress in Advances in Applied Physics and Material.

Contributions to International Conferences and Journals

S HASEGAWA	17th International Conference on Molecular Beam Epitaxy (General Affairs Chair)
S HASEGAWA	The 7th International Symposium on Surface Science (Local Arrangement Vice-Chair)
S HASEGAWA	ISRN Condensed Matter Physics (Editorial Board member)
S. EMURA	17th International Conference on Molecular Beam Epitaxy (Steering Committee member)
Y.K. ZHOU	17th International Conference on Molecular Beam Epitaxy (Steering Committee member)

Publications in Domestic Meetings

The Japan Society of Applied Physics	6 papers
The Physical Society of Japan	2 papers
The Vacuum Society of Japan	1 paper

Academic Degrees

Master Degree for Engineering K. Higashi	Study on growth and evaluation of nitride semiconductors and diluted magnetic semiconductors	
Master Degree for Engineering M. Yoneoka	Study on formation and magnetic property of Fe thin layer grown on GaN(0001)	
Master Degree for Science M. Kimura	Study on growth and evaluation of diluted magnetic semiconductor nanorods	
Master Degree for Science M. Sano	Growth and characterization of GaDyN/AlGaIn double barriers structure and their device applications	
Bachelor of Engineering Nurassyakirin Bin Hasbi	Study on surface structure and their electronic and magnetic property of ferromagnetic thin Fe film grown on GaN surface	

Grant-in-Aid for Scientific Research

S.Hasegawa	Developments of spin-dependent ballistic electron emission microscopy and its application to spin injection into semiconductors	¥2,340,000
Y. K. Zhou	Study on new spintronics materials and their device applications using spinodal decomposition	¥5,850,000

Cooperative Research

S.Hasegawa	Nissin Electronic	¥1,830,000
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Department of Semiconductor Electronics

Original Papers

- [1]Electric-field-induced band gap of bilayer graphene in ionic liquid, Y. Yamashiro, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: J. Vac. Soc. Technol. B, 30 (2012) 03D111.
- [2]Novel charge transport in DNA-templated nanowires, G. Wang, H. Tanaka, L. Hong, Y. Matsuo, K. Niikura, M. Abe, K. Matsumoto, T. Ogawa and K. Ijro: J. Mater. Chem., 22 (2012) 13691-13697.
- [3]Selective ion sensors based on ionophore-modified graphene field-effect transistors, K. Maehashi, Y. Sofue, S. Okamoto, Y. Ohno, K. Inoue and K. Matsumoto: Proc. of The 14th International Meeting on Chemical Sensors, 1 (2012) 305-308.
- [4]Fragment-Modified Graphene FET for Highly Sensitive Detection of Antigen-Antibody Reaction, S. Okamoto, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: Proc. of The 14th International Meeting on Chemical Sensors, 1 (2012) 519-522.
- [5]Carrier Transport Properties of the Field Effect Transistors with Graphene Channel Prepared by Chemical Vapor Deposition, R. Negishi, Y. Ohno, K. Maehashi, K. Matsumoto and Y. Kobayashi: Jpn. J. Appl. Phys., 51 (2012) 06DF03.
- [6]Immunosensors Based on Graphene Field-Effect Transistors Fabricated Using Antigen-Binding Fragment, S. Okamoto, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: Jpn. J. Appl. Phys., 51 (2012) 06DF08.
- [7]Carbon Nanotube-Based Floating Gate Memories with High-k Dielectrics, Y. Fujii, Takahiro Ohori,

Yasuhide Ohno, Kenzo Maehashi, Koichi Inoue, and Kazuhiko Matsumoto: Jpn. J. Appl. Phys., 51 (2012) 06FD11.

[8]Direct Synthesis of Graphene on SiO₂ Substrates by Transfer-Free Processes, K. Gumi, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: Jpn. J. Appl. Phys., 51 (2012) 06FD12.

[9]Horizontally Aligned Carbon Nanotubes on a Quartz Substrate for Chemical and Biological Sensing, S. Okuda, S. Okamoto, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: J. Phys. Chem. C, 116 (2012) 19490-19495.

[10]Diameter dependence of 1/f noise in carbon nanotube field effect transistors using noise spectroscopy, T. Kawahara, S. Yamaguchi, Y. Ohno, K. Maehashi, K. Matsumoto, S. Mizutani and K. Itaka: Appl. Surf. Sci., 267 (2012) 101-105.

International Conferences

[1]Nano Carbon Devices and Application (invited), K. Matsumoto: 19th International Symposium on VLSI Technology, Systems and Applications.

[2]Single charge electronics & stochastic resonance (invited), K. Matsumoto: 2nd IEEE Technology Time Machine -Symposium on Technologies Beyond 2020-.

[3]Nano Carbon Devices and ApplicationsK. Matsumoto (oral), : imec-Handai International Symposium 2012.

[4]Carbon Nanotube Bio Sensor (invited), K. Matsumoto: International Symposium on Carbon Nanotube Nanoelectronics 2012.

[5]Electrical Detection of Proteins Based on Carbon Nanotubes Field-Effect Transistors with Aligned Channels (poster), K. Koshida, S. Okuda, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: International Symposium on Carbon Nanotube Nanoelectronics 2012.

[6]Room Temperature Carbon Nanotube Multi Level Single Hole Memory with SiN_x/Al₂O₃ Wrapped Double Gate Insulator Layers (poster), T. Kamimura, Y. Hayashi and K/ Matsumoto: International Symposium on Carbon Nanotube Nanoelectronics 2012.

[7]Carrier Transport Properties of Turbostratic Multilayer Graphene Grown by Chemical Vapor Deposition (poster), R. Negishi, Y. Ohno, K. Maehashi, K. Matsumoto and Y. Kobayashi: International Symposium on Carbon Nanotube Nanoelectronics 2012.

[8]Carrier transport properties of multilayer graphene with turbostratic structure (poster), R. Negishi, Y. Ohno, K. Maehashi, K. Matsumoto and Y. Kobayashi: 13th International Conference on the Science and Application of Nanotubes.

[9]Band-Gap Engineering of Bilayer Graphene with Ionic-Liquid Gate (poster), Y. Ohno, Y. Yamashiro, T. Ikuta, K. Maehashi, K. Inoue and K. Matsumoto: 2nd International Symposium on Terahertz Nanoscience.

[10]Ionic-liquid-Gate Control of Bilayer Graphene (oral), Y. Yamashiro, T. Ikuta, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: International Conference on Nanoscience + Technology.

[11]Highly Sensitive Biosensors Based on Fragment Antigen-Binding Modified Graphene Field-Effect Transistors (oral), Y. Ohno, S. Okamoto, K. Maehashi, and K. Matsumoto: International Conference on Nanoscience + Technology.

- [12]Quantum Nano Memory using Nano Carbon Material (poster), K. Matsumoto and T. Kamimura: International Conference on Nanoscience + Technology.
- [13]Electrical-Biosensing Performance of Horizontally Aligned Carbon Nanotube Device on Quartz Substrate (oral), K. Maehashi, S. Okuda, K. Koshida, Y. Ohno, K. Inoue and K. Matsumoto: International Conference on Nanoscience + Technology.
- [14]Highly-sensitive Bio-Sensors using Nano Carbon Devices (invited), K. Matsumoto: The 2012 International Conference on Flexible and Printed Electronics.
- [15]Electric-field Dependence of G-band Spectra in Bilayer Graphene (poster), Y. Yamashiro, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: 2012 International Conference on Solid State Devices and Materials.
- [16]Efficient Reduction and Restoration of Graphene oxide films as a Channel in Field Effect Transistor: Toward Sensor applications (oral), R. Negishi, K. Kuramoto, Y. Ohno, T. Nishino, T. Yamaguchi, K. Maehashi, K. Matsumoto, K. Ishibashi and Y. Kobayashi: 2012 International Conference on Solid State Devices and Materials.
- [17]Single Charge Nano Memory using Nano Carbon Material (oral), T. Kamimura and K. Matsumoto: AVS 59th International Symposium and Exhibition.
- [18]Recent advance in graphene-based nano-biosensors (invited), K. Matsumoto, K. Maehashi, Y. Ohno and K. Inoue: 3rd International Symposium on Graphene Devices.
- [19]Direct Graphene Growth with Multi Metal Layers without Using Chemical Vapor Deposition (oral), K. Gumi, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: 25th International Microprocesses and Nanotechnology Conference.
- [20]Carbon Nanotube-Based Memory with Atomic-Layer-Deposited Dielectrics (oral), Y. Fujii, T. Kamimura, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: 25th International Microprocesses and Nanotechnology Conference.
- [21]Position-Controlled Direct Graphene Synthesis on SiO₂ Surface by Laser Irradiation (poster), K. Koshida, K. Gumi, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: 25th International Microprocesses and Nanotechnology Conference.
- [22]Highly Sensitive Biosensors based on Fragment-Modified Graphene FET (poster), S. Okamoto, T. Ikuta, S. Zaifuddin, Y. Ohno, K. Matsumoto, K. Inoue and K. Matsumoto: 25th International Microprocesses and Nanotechnology Conference.
- [23]Sensor Application based on CVD-synthesized graphene (poster), S. Zaifuddin, S. Okamoto, T. Ikuta, Y. Ohno, K. Maehashi, M. Miyake, and K. Matsumoto: 25th International Microprocesses and Nanotechnology Conference.
- [24]Electrical detection of chemical and biological species by graphene field-effect transistors (invited), Y. Ohno: 2012 Graphene International Conference.
- [25]Room Temperature Operation of Multilevel Single Hole Memory of Carbon Nanotube Wrapped by Double-Gate Insulator Layers of SiN_x/Al₂O₃ (poster), T. Kamimura: 3rd International Symposium on Terahertz Nanoscience.
- [26]Improvement of Retention Characteristics of Carbon Nanotube NVM (poster), Y. Fujii, T. Kamimura, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: 8th Handai Nanoscience and Nanotechnology

International Symposium.

[27]Improvement in Sensitivity of Detection of Antigen Using Graphene FET (poster), S. Okamoto, T. Ikuta, Z. Sakinah, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: 8th Handai Nanoscience and Nanotechnology International Symposium.

[28]Multichannel Sensor Based on CVD-synthesized Graphene (poster), S. Zaifuddin, S. Okamoto, T. Ikuta, Y. Ohno, K. Maehashi, M. Miyake, and K. Matsumoto: 8th Handai Nanoscience and Nanotechnology International Symposium.

[29]The Rise of Direct Graphene Synthesis on SiO₂ Using Multi Metal Layers (poster), K. Gumi, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: 8th Handai Nanoscience and Nanotechnology International Symposium.

[30]Direct Graphene Growth on SiO₂ by Laser Irradiation for Graphene FETs (poster), K. Koshida, K. Gumi, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: 8th Handai Nanoscience and Nanotechnology International Symposium.

[31]Synthesis of Calcium-intercalated Multi-layer Graphene (poster), T. Ikuta, Y. Yamashiro, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: 8th Handai Nanoscience and Nanotechnology International Symposium.

[32]G-band Spectra of Bilayer Graphene with Dual Gate Structure (poster), Y. Yamashiro, M. Nakamura, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: 8th Handai Nanoscience and Nanotechnology International Symposium.

[33]Fabrication of Carbon Nanotube-Based Memory with High-k Dielectric Layered Structure (poster), Y. Fujii, T. Kamimura, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: The 16th SANKEN International Symposium and the 11th SANKEN Nanotechnology Symposium.

[34]Application of Graphene based Biosensor using Antigen-Binding Fragment (poster), S. Okamoto, T. Ikuta, Z. Sakinah, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: The 16th SANKEN International Symposium and the 11th SANKEN Nanotechnology Symposium.

[35]Sensor Array Based on CVD-synthesized Graphene (poster), M. Z. Nursakinah, S. Okamoto, T. Ikuta, Y. Ohno, K. Maehashi, M. Miyake, and K. Matsumoto: The 16th SANKEN International Symposium and the 11th SANKEN Nanotechnology Symposium.

[36]Synthesis of calcium-intercalated few-layer graphene by vapor transport (poster), T. Ikuta, Y. Yamashiro, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: The 16th SANKEN International Symposium and the 11th SANKEN Nanotechnology Symposium.

[37]Simple-step Fabrication of Graphene Field-effect Transistors (poster), K. Koshida, K. Gumi, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: The 16th SANKEN International Symposium and the 11th SANKEN Nanotechnology Symposium.

[38]Direct graphene growth on oxides: graphitization of amorphous carbon using multi metal layers (poster), K. Gumi, K. Inoue, Y. Ohno, K. Maehashi, and K. Matsumoto: The 16th SANKEN International Symposium and the 11th SANKEN Nanotechnology Symposium.

[39]Fabrication and Properties of Few-Layer Graphene Synthesized by Chemical Vapor Deposition (poster), M. Nakamura, S. Okamoto, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: The 16th SANKEN International Symposium and the 11th SANKEN Nanotechnology Symposium.

[40]G-band Spectra of Bilayer Graphene in Ionic Liquid (poster), Y. Yamashiro, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: The 16th SANKEN International Symposium and the 11th SANKEN Nanotechnology Symposium.

[41]Carbon Nanotube-Based Memory with Au nanoparticle floating dot (poster), K. Seike, Y. Fujii, T. Kamimura, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: The 16th SANKEN International Symposium and the 11th SANKEN Nanotechnology Symposium.

[42]Chemical and Biological Sensing Based on Horizontally Aligned Carbon Nanotube Field-Effect Transistors (oral), K. Maehashi, S. Okuda, K. Koshida, Y. Ohno, K. Inoue and K. Matsumoto: International Thin-Film Transistor Conference 2013.

[43]Fabrication of Graphene Field-Effect Transistors Using Laser Irradiation (poster), K. Koshida, K. Gumi, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: International Thin-Film Transistor Conference 2013.

Books

[1] Graphene based novel material field: Physics, growth, and Applications, Y. Ohno and K. Matsumoto,, NTS, 2013.

Patents

[1]Single electron transistor Y. Majima, T. Teranishi, Y. Azuma, G. Hackenberger, K. Matsumoto, K. Maehashi, Y Ohno, JP2012-42588

Publications in Domestic Meetings

Japan Society of Applied Physics Meeting 18 papers

The Surface Science Society of Japan 1 paper

Grant-in-Aid for Scientific Research

K.Maehashi	Electric-field-induced band gap of graphene in ionic liquid and fabrication of nanodevices	¥8,190,000
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Entrusted Research

K.Matsumoto	Leading Research and Development of Nanostructured Carbon Material	Development of Leading Edge Research of Innovative Nanocarbon materials /High Sensitive Graphene FET Bio Sensor	¥69,000,000
K.Matsumoto	Core Research for Evolutionary Science and Technology	Quantum Nano Devices by Control of Quantum Nano Interface	¥63,700,000

Cooperative Research

K.Matsumoto	Merck	¥3,000,000
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Department of Advanced Electron Devices

Original Papers

[1]Flexible Three-Dimensional Organic Field-Effect Transistors Fabricated by an Imprinting Technique, R. Nakahara, M. Uno, T. Uemura, K. Takimiya, and J. Takeya: Adv. Mater., 24 (2012) 5212-5216.

[2]High-performance organic transistors with high-k dielectrics: A comparative study on solution-processed single crystals and vacuum-deposited polycrystalline films of 2,9-didecyl-dinaphtho[2,3-b:2',3'-f]thieno[3,2-b]thiophene, W. Ou-Yang, T. Uemura, K. Miyake, S. Onish, T. Kato, M. Katayama, M. Kang, K. Takimiya, M. Ikeda, H. Kuwabara, M. Hamada, and J. Takeya: Appl. Phys. Lett., 101 (2012) 223304.

[3]Band-like transport in solution-crystallized organic transistors, T. Uemura, K. Nakayama, Y. Hirose, J.

Soeda, M. Uno, W. Li, M. Yamagishi, Y. Okada, J. Takeya: *Current Applied Physics*, 12 (2012) S88–S91.

[4]Electroconductive π -Junction Au Nanoparticles, M. Kanehara, J. Takeya, T. Uemura, H. Murata, K. Takimiya, H. Sekine, and T. Teranishi: *Bull. Chem. Soc. Jpn.*, 85 (2012) 957-961.

[5]Relaxation Dynamics of Photoexcited Excitons in Rubrene Single Crystals Using Femtosecond Absorption Spectroscopy, S. Tao, N. Ohtani, R. Uchida, T. Miyamoto, Y. Matsui, H. Yada, H. Uemura, H. Matsuzaki*, T. Uemura, J. Takeya, and H. Okamoto: *Phys. Rev. Lett.*, 109 (2012) 097403.

[6]High-power three-dimensional polymer FETs, K. Nakayama, T. Uemura, M. Uno, T. Okamoto, I. Osaka, K. Takimiya, J. Takeya: *Current Applied Physics*, 12 (2012) S92–S95.

[7]Relaxation Dynamics of Labyrinthine Submonolayer Films, K. Sudoh, T. Irisawa, K. Katsuno Matsumoto, M. Uwaha: *Surf. Sci.*, 609 (2013) L1-L4.

International Conferences

[1]High-Mobility Organic Active Matrices Based on Solution-Crystallized TFT Arrays (invited), T. Uemura, M. Uno, Y. Kanaoka and J. Takeya: The 19th International Display Workshops in conjunction with Asia Display 2012 IDW/AD'12.

[2]Crystalline Organic TFTs for Active-Matrix Display Panels (invited), J. Takeya, T. Uemura, M. Uno and Y. Kanaoka: The 19th International Display Workshops in conjunction with Asia Display 2012 IDW/AD'12.

[3]Solution-Crystallized High-Mobility Organic Active Matrices and Display Panels (invited), J. Takeya, T. Uemura, M. Uno and Y. Kanaoka: The 19th International Display Workshops in conjunction with Asia Display 2012 IDW/AD'12.

[4]Intermolecular electronic coherence and high-speed operation in organic transistors (invited), J. Takeya: International Workshop on Organic Field-effect Transistors and Functional Interfaces.

[5]Intermolecular electronic coherence in organic single-crystal transistors and high-speed organic electronics (invited), J. Takeya: Material Research Society, Fall Meeting.

[6]Intermolecular Electronic Coherence in Organic Single-crystal Transistors and High-speed Organic Electronics , J. Takeya and T. Uemura: The fifth international symposium on Atomically Controlled Fabrication Technology.

[7]Hole Transporting Properties in Single-crystal of U-shaped Furan- and Thiophene-containing π -conjugated Organic Materials , K. Nakahara, T. Okamoto, C. Mitsui, K. Miwa, M. Yamagishi, T. Uemura, H. Sato, A. Yamano, J. Takeya: The fifth international symposium on Atomically Controlled Fabrication Technology.

[8]A novel device structure for reducing contact resistances in organic field-effect transistors , K. Nakayama, T. Uemura, M. Uno, and J. Takeya: 2012 International Conference on Flexible and Printed Electronics(ICFPE2012).

[9]Single-crystal structures and Hole Transport Properties of Dinaphtho[2,1-b; 1',2'-d] chalcogenophenes , K. Nakahara, T. Okamoto, C. Mitsui, K. Miwa, M. Yamagishi, T. Uemura, H. Sato, A. Yamano, J. Takeya: 2012 International Conference on Flexible and Printed Electronics(ICFPE2012).

[10]High-mobility and high-speed organic single crystal transistors (invited), J. Takeya: Gordon Research Conference.

[11]High-power and air-stable three-dimensional polymer FETs , K. Nakayama, T. Uemura, M. Uno, I. Osaka, K. Takimiya, and J. Takeya: MRS spring meeting.

[12]Dinaphtho[1,2-b:2',1'-d]chalcogenophenes: investigation of the effect of the chalcogen atoms on the molecular orbitals, crystal structures, and FET performances , C. Mitsui, T. Okamoto, Y. Takatsuki, M. Yamagishi, Y. Hirose, K. Miwa, H. Sato, A. Yamano, T. Uemura, J. Takeya: MRS spring meeting.

[13]Organic single-crystal transistors under high pressure , Y. Okada, K. Sakai, S. Kitaoka, T. uemura, and J. Takeya: MRS spring meeting.

Patents

[1]Organic transistor and method for manufacturing same J. Takeya, T. Uemura, M. Uno, JP2011-171136

[2]Compound for forming self-assembled mono-molecular film, and organic semiconductor element containing same. J. Takeya, T. Okamoto, T. Uemura, JP2011-177539

[3]Organic thin-film transistor and method for manufacturing same J. Takeya, T. Uemura,

Publications in Domestic Meetings

3rd Symposium on Ionic Liquid	1 paper
Annual Meeting of Japan Society for Molecular Science	3 papers
Physical Society of Japan 2012 Fall Meeting	8 papers
23rd Symposium on Physical Organic Chemistry	4 papers
The 73rd Japan Society of Applied Physics Autumn Meeting, 2012	11 papers

Grant-in-Aid for Scientific Research

J. Takeya	Development of device and physics for organic single crystal interface	¥11,050,000
K. Sudoh	Formation of Three Dimensional Microstructures using Surface-Diffusion-Driven Shape Changes on Si Surfaces	¥650,000
T. Uemura	Devepolment of carrier transport mechanisum elucidation of organic semiconductor contributing to molecular fluctuation and high performance transistor	¥6,240,000
C. Mitsui	Creation of new pi-electron system and application of organic semiconducting devices	¥1,560,000

Entrusted Research

J. Takeya	Promoting Technology Transfer and Innovation, JST	Development of flexible display based on AF-TFT using new high-performance polymer-based semiconductors and solution process	¥16,699,000
J. Takeya	New Energy and Industrial Technology Development Organization (NEDO)	Development of matrix for thin film display using innovative high-performance organic transistor	¥47,999,000
J. Takeya	Promoting Technology Transfer and Innovation, JST	Development of logic devices for thin-film display driver using the world's top high performance solution-processable organic transistor	¥3,398,000
J. Takeya	Osaka Prefecture	Research development association of high-performance organic devices by means of solution process	¥5,000,000

J. Takeya	Japan Science and Technology Agency (JST)	Development of global young researchers for promote nanodevice research	¥22,990,000
J. Takeya	New Energy and Industrial Technology Development Organization (NEDO)	Development of plastic IC tags using innovative high-performance organic transistor	¥31,701,000
K. Sudoh	Promoting Technology Transfer and Innovation, JST	Development of MEMS/FIB-based Technique for Measurement of the Mechanical Properties of Single-Layer Graphene	¥390,000

Contribution to Research

J. Takeya	JNC Corp.	¥100,000,000
J. Takeya	JNC Corp.	¥10,000,000
J. Takeya	STARC Corp.	¥3,300,000
K. Sudoh	Fuji Electric, Tetsuo IDE	¥490,000
T. Okamoto	JNC Corp.	¥9,500,000

Cooperative Research

J. Takeya	JNC Corp.	¥5,000,000
J. Takeya	Electroplating Engineers of Japan LTD.	¥500,000
J. Takeya	DICEL	¥500,000
J. Takeya	STARC	¥7,500,000
J. Takeya	DENSO Co.	¥3,000,000
J. Takeya	Samsung R&D Institute Japan Co.LTD.	¥6,810,000
J. Takeya	Seinan industries, Co.LTD.	¥2,000,000
J. Takeya	Sumitomo Chemical Co. LTD.	¥1,012,000
J. Takeya	FUJIFILM Co.	¥8,000,000

Department of Intelligent Media

Original Papers

- [1]The OU-ISIR Gait Database Comprising the Treadmill Dataset, Y. Makihara,H. Mannami,A. Tsuji,M.A. Hossain,K. Sugiura,A. Mori,Y. Yagi: IPSJ Trans. on Computer Vision and Applications, 4 (2012) 53-62.
- [2]Group Context-aware Person Identification in Video Sequences, H. Iwama,Y. Makihara,Y. Yagi: IPSJ Trans. on Computer Vision and Applications, 4 (2012) 87-99.
- [3]Shape Estimation of Translucent Objects Based on Attenuation of Single Scattering, C. Inoshita,Y. Mukaigawa,Y. Matsushita,Y. Yagi: The IEICE transactions on information and systems, J95-D (8) (2012) 1598-1608.
- [4]Foreground Extraction by Pseudo-synchronization of Camera and Range Sensor, H. Nakajima,I. Mitsugami,H. Yamazoe,H. Habe,Y. Makihara, Y. Yagi: Transactions of the Virtual Reality Society of Japan, 17 (3) (2012) 109-118.
- [5]The OU-ISIR Gait Database Comprising the Large Population Dataset and Performance Evaluation of Gait Recognition, H. Iwama,M. Okumura,Y. Makihara,Y. Yagi: IEEE Trans. on Information Forensics and Security, 7 (5) (2012) 1511-1521.
- [6]Capturing Textured 3D Shapes based on Infrared One-shot Grid Pattern, Kazuhiro Sakashita,Ryusuke Sagawa,Ryo Furukawa,Hiroshi Kawasaki,Yasushi Yagi: IPSJ Transactions on Computer Vision and Applications, 4 (2012) 161-169.

International Conferences

- [1]Video from Nearly Still: an Application to Low Frame-rate Gait Recognition, N. Akae,A. Mansur,Y. Makihara,Y. Yagi: Proc. of the 25th IEEE Conf. on Computer Vision and Pattern Recognition, (2012) 1537-1543.
- [2]Shape from Single Scattering for Translucent Objects, C. Inoshita,Y. Mukaigawa,Y. Matsushita,Y. Yagi: Proc. of the 12th European Conference on Computer Vision, (2012) 371-384.
- [3]Tracking abnormalities in video capsule endoscopy using surrounding features with a triangular constraint, Yukiko Yanagawa,Tomio Echigo,Hai Vu,Hirotoishi Okazaki,Yasuhiro Fujiwara,Tetsuo Arakawa,Yasushi Yagi: Proc. of the 9th IEEE International Symposium on Biomedical Imaging: From Nano to Macro, (2012) 578-581.
- [4]Arbitrary View Transformation Model for Gait Person Authentication, D. Muramatsu,A. Shiraishi,Y. Makihara,Y. Yagi: Proc. of IEEE 5th Int. Conf. on Biometrics: Theory, Applications and Systems, (39) (2012) 1-6.
- [5]Gait-based Person-Verification System for Forensics, H. Iwama,D. Muramatsu,Y. Makihara,Y. Yagi: Proc. IEEE 5th Int. Conf. on Biometrics: Theory, Applications and Systems, (49) (2012) 1-8.
- [6]Gait Recognition using Images of Oriented Smooth Pseudo Motion, Y. Makihara,B.S. Rossa,Y. Yagi: Proc. of IEEE 5th Int. Conf. on Biometrics: Theory, Applications and Systems, (2012) 1309-1314.
- [7]Attacks Using Random Forgery Against DTW-Based Online Signature Verification Algorithm, Daigo Muramatsu,Yasushi Yagi: Proc. of 2012 IEEE Int. Conf. on Systems, Man, and Cybernetics, (2012) 1303-1308.
- [8]Pedestrian Detection based on Appearance, Motion, and Shadow Information, Junqiu Wang,Yasushi Yagi: Proc. of 2012 IEEE Int. Conf. on Systems, Man, and Cybernetics, (2012) 750-755.
- [9]Point Cloud Transport, H. Nakajima,Y. Makihara,H. Hsu,I. Mitsugami,M. Nakazawa,H. Yamazoe,H. Habe,Y. Yagi,: Proc. of 2012 IEEE Int. Conf. on Systems, Man, and Cybernetics, (2012) 3803-3806.
- [10]Inertial-sensor-based Walking Action Recognition using Robust Step Detection and Inter-class Relationships, T.T. Ngo,Y. Makihara,H. Nagahara,Y. Mukaigawa,Y. Yagi: Proc. of the 21st Int. Conf. on Pattern Recognition, (2012) 3811-3814.
- [11]Person Re-identification using View-dependent Score-level Fusion of Gait and Color Features, R. Kawai,Y. Makihara,C. Hua,H. Iwama,Y. Yagi: Proc. of the 21st Int. Conf. on Pattern Recognition, (2012) 2694-2697.
- [12]Can Gait Fluctuations Improve Gait Recognition?, Y. Makihara,Y. Fujihara,,Y. Yagi: Proc. of the 21st Int. Conf. on Pattern Recognition, (2012) 3276-3279.
- [13]View-invariant Gait Recognition from Low Frame-rate Videos, A. Mansur,Y. Makihara,Y. Yagi: Proc. of the 21st Int. Conf. on Pattern Recognition, (2012) 2383-2386.
- [14]Easy Depth Sensor Calibration, H. Yamazoe,H. Habe,I. Mitsugami,Y. Yagi: Proc. of the 21st Int. Conf. on Pattern Recognition, (2012) 465-468.
- [15]Dynamic Scene Reconstruction using Asynchronous Multiple Kinects, M. Nakazawa,I. Mitsugami,Y. Makihara,H. Nakajima,H. Yamazoe,H. Habe,Y. Yagi: Proc. of the 21st Int. Conf. on Pattern Recognition, (2012) 469-472.
- [16]8-D Reflectance Field for Computational Photography, Seiichi Tagawa, Yasuhiro Mukaigawa,

Yasushi Yagi: Proc. of the 21st Int. Conf. on Pattern Recognition, (2012) 2181-2185.

[17]Position Estimation of Near Point Light Sources using Clear Hollow Sphere, T. Aoto,T. Taketomi,T. Sato,Y. Mukaigawa,N. Yokoya: Proc. of the 21st Int. Conf. on Pattern Recognition, (2012) 3721-3724.

[18]Grid-based Active Stereo with Single-colored Wave Pattern for Dense One-shot 3D Scan, Ryusuke Sagawa,Kazuhiro Sakashita,Nozomu Kasuya,Hiroshi Kawasaki,Ryo Furukawa,Yasushi Yagi: Proc. of the 2nd Joint 3DIM/3DPVT Conf., (2012) 363-370.

[19]Gait-based Person Authentication by Wearable Cameras, Kohei Shiraga,Ngo Trung,Ikuhisa Mitsugami,Yasuhiro Mukaigawa,Yasushi Yagi: Proc. of the 9th Int. Conf. on Networked Sensing Systems, (2012) .

Patents

[1]Pedestrian detection from video Y. Yagi,Y. Makihara,C. Hua,S. Iwasaki,K. Miyagawa, H. Li, JP2012-258488

Contributions to International Conferences and Journals

Y. Yasushi	2012 IEEE Int. Conf. on Robotics and Automation (Editorial committee)
Y. Yasushi	2012 IEEE Int. Conf. on Computer Vision and Pattern Recognition (Program committee)
Y. Yasushi	2012 IEEE Int. Conf. on System, Man, and Cybernetics (Publicity committee)
Y. Yasushi	EMC 2012 (Program committee)
Y. Yasushi	2012 European Conf. on Computer Vision (Review committee)
Y. Yasushi	International Journal of Computer Vision (Editorial committee)
Y. Yasushi	2012 Int. Conf. on Pattern Recognition (Area chair)
Y. Yasushi	2012 Asian Conf. on Computer Vision (Steering committee)
Y. Yasushi	2013 Asian Conf. on Pattern Recognition (General chair)
Y. Yasushi	ROBIO2012 (Program committee)
Y. Yasushi	2013 IEEE Int. Conf. on Robotics and Automation (Editorial committee)
Y. Yasushi	2013 IEEE Int. Conf. on Computer Vision and Pattern Recognition (Program committee)
Y. Mukaigawa	2012 IEEE Int. Conf. on Computer Vision and Pattern Recognition (Program committee)
Y. Mukaigawa	2012 Asian Conf. on Computer Vision (Area chair)
Y. Mukaigawa	2012 Int. Conf. on Pattern Recognition (Program committee)
Y. Mukaigawa	2013 Pacific-Rim Symposium on Image and Video Technology (Area chair)
Y. Mukaigawa	2013 IEEE Int. Conf. on Computer Vision and Pattern Recognition (Program committee)
Y. Mukaigawa	International Journal of Computer Vision (Editorial committee)
Y. Mukaigawa	2013 IEEE/RSJ International Conference on Intelligent Robots and Systems (Associate editor)
Y. Mukaigawa	2013 Int. Conf. on Computer Vision (Review committee)
Y. Makihara	2012 Int. Conf. on Pattern Recognition (Program committee)
Y. Makihara	2012 European Conf. on Computer Vision (Review committee)
Y. Makihara	2012 Asian Conf. on Computer Vision (Program committee)
Y. Makihara	2012 Pacific-Rim Conference on Multimedia (Program committee)
Y. Makihara	2013 Asian Conf. on Pattern Recognition (Program committee)
Y. Makihara	2013 IEEE Int. Conf. on Automatic Face and Gesture Recognition (Program committee)
Y. Makihara	2013 IEEE Int. Conf. on Computer Vision and Pattern Recognition (Program committee)
Y. Makihara	2013 Int. Conf. on Computer Vision (Review committee)
Y. Makihara	2013 Pacific-Rim Symposium on Image and Video Technology (Review committee)

I. Mitsugami	2012 Asian Conf. on Computer Vision (Program committee)		
I. Mitsugami	2012 Int. Conf. on Pattern Reccognition (Publicity chair)		
Publications in Domestic Meetings			
The Institute of Electronics, Information and Communications Engineers			9 papers
Information Processing Society of Japan			7 papers
Integrative Medicine Japan			1 paper
Academic Degrees			
Doctor Degree for Information Science	Techniques for gait-based visual surveillance		
H. Iwama			
Doctor Degree for Information Science	Computational Photography Based on 8-D Reflectance Field		
S. Tagawa			
Master Degree for Information Science	Person Re-identification by Fusing Gait and Color Features Considering View Changes		
R. Kawai			
Master Degree for Information Science	Wearable Surveillance System for Children and its Evaluation		
K. Shiraga			
Master Degree for Information Science	Photometric Decoding for Scene Analysis		
T. Takatani			
Master Degree for Information Science	2D/3D Gait measurement by Kinect		
H. Nakajima			
Grant-in-Aid for Scientific Research			
Y. Yagi	Wearable ambient surveillance by lensless omnidirectional sensor and its application to schoolchild crime prevention		¥44,980,000
Y. Mukaigawa	Safe visualization of 3D structure in human body by computational photography		¥55,900,000
Y. Makihara	High-accuracy gait recognition by fluctuation analysis		¥3,900,000
Y. Makihara	Proposal of Cross-modal Biometrics		¥1,430,000
I. Mitsugami	Development of 3D shape reconstruction method for glossy surface		¥1,690,000
D. Muramatsu	Development of multi-modal biometric person authentication method using writing style		¥1,430,000
Entrusted Research			
Y.Yagi	Japan Science and Technology Agency	Behavior Understanding based on Intention-Gait Model	¥50,440,000
Y.Yagi	Ministry of Education, Culture, Sports, Science and Technology	Human sensing system for criminal investigation	¥24,927,000
Cooperative Research			
Y. Yagi	Olympus Co, Ltd.		¥1,650,000
Y. Yagi	Panasonic Co.		¥2,100,000
Y. Yagi	Yokohama Research Laboratory, Hitachi, Ltd.		¥8,000,000

Department of Reasoning for Intelligence

Original Papers

[1]Joint estimation of linear non-Gaussian acyclic models, S. Shimizu: Neurocomputing, 81 (2012) 104-107.

[2]Sequential change-point detection based on density-ratio estimation, Y. Kawahara, M. Sugiyama: Statistical Analysis and Data Mining, 5 (2) (2012) 114-127.

- [3]Separation of stationary and non-stationary sources with a generalized eigenvalue problem, H. Hara, Y. Kawahara, T. Washio, P. von Bunau, T. Tokunaga, K. Yumoto: Neural Networks, 33 (2012) 7-20.
- [4]Active Learning for Regression via Density Power Divergence, Y. Sogawa, T. Ueno, Y. Kawahara, T. Washio: Transactions of the Japanese Society for Artificial Intelligence, 28 (1) (2013) 13-21.
- [5]Simultaneous pursuit of out-of-sample performance and sparsity in tracking portfolio, A. Takeda, M. Niranjan, J. Goto, Y. Kawahara: Computational Management Science, 10 (1) (2013) 21-49.
- [6]Derivation of a mathematical expression for predicting the time to cardiac events in patients with heart failure: a retrospective clinical study, A. Yoshida, M. Asakura, H. Asanuma, A. Ishii, T. Hasegawa, T. Minamino, S. Takashima, H. Kanzaki, T. Washio, M. Kitakaze: Hypertension Research, doi: 10.1038/hr.2012.200 (2012) 1-7.
- [7]DEMass: a new density estimator for big data, K. M. Ting, T. Washio, J. R. Wells, F. T. Liu, S. Aryal: Knowledge and Information Systems: An International Journal, (Knowl Inf Syst: KAIS), 34 (2) (2013) DOI 10.1007/s10115-013-0612-3.
- [8]Learning a Common Substructure of Multiple Graphical Gaussian Models, S. Hara, T. Washio: Neural Networks, 38 (2012) 23-38.
- [9]Fast and Accurate PSD Matrix Estimation by Row Reduction, H. Kuwajima, T. Washio, L. Ee-Peng: IEICE TRANSACTIONS on Information and Systems, E95-D (11) (2012) 2599-2612.
- [10]Separation of stationary and non-stationary sources with a generalized eigenvalue problem, S. Hara, Y. Kawahara, T. Washio, P. V. Bunau, T. Tokunaga, K. Yumoto: Neural Networks, 33 (2012) 7-20.
- International Conferences**
- [1]Estimation of causal orders in a linear non-Gaussian acyclic model: a method robust against latent confounders, T. Tashiro, S. Shimizu, Aapo Hyvärinen, T. Washio: Proc. 22nd International Conference on Artificial Neural Networks (ICANN2012), 1 (2012) 491-498.
- [2]Bootstrap confidence intervals in DirectLiNGAM, K. Thamvitayakul, S. Shimizu, T. Ueno, T. Washio, T. Tashiro: Proc. RIKD: Workshop on Reliability Issues in Knowledge Discovery, ICDM 2012. The IEEE International Conference on Data Mining, 2012 (2012) 660-668.
- [3]Mining Rules for Rewriting States in a Transition-Based Dependency Parser, A. Inokuchi, A. Yamaoka, T. Washio, Y. Matsumoto, M. Asahara, M. Iwatate, H. Kazawa: Proc. of 12th Pacific Rim International Conference on Artificial Intelligence, (2012) 133-145.
- [4]Mining Rules for Rewriting States in a Transition-based Dependency Parser for English, A. Inokuchi, A. Yamaoka: Proc. of 24th International Conference on Computational Linguistics, (2012) 1275-1290.
- [5]Robust active learning for linear regression via density power divergence, Y. Sogawa, T. Ueno, Y. Kawahara, T. Washio: Neural Information Processing (Lecture Notes in Computer Science), 7665 (2012) 594-602.
- [6]Weighted likelihood policy search with model selection, T. Ueno, K. Hayashi, T. Washio, Y. Kawahara: Advances in Neural Information Processing Systems, 25 (2012) 2366-2374.
- [7]Enhancing the Analysis of Large Multimedia Applications Execution Traces with FrameMiner, C. K. Kengne, L. C. Fopa, N. Ibrahim, A. Termier, M.-C. Rousset, T. Washio: Proc. PTDM: Workshop on Practical Theories of Data Mining, ICDM 2012. The IEEE International Conference on Data Mining, 2012

(2012) 595-602.

[8]Anomalous Neighborhood Selection, S. Hara、 T. Washio: Proc. OEDM: Workshop on Optimization Based Techniques for Emerging Data Mining, ICDM 2012. The IEEE International Conference on Data Mining, 2012 (2012) 474-480.

[9]Group Sparse Inverse Covariance Selection with a Dual Augmented Lagrangian Method, S. Hara、 T. Washio: Neural Information Processing, Lecture Notes in Computer Science, 7665 (2012) 108-115.

[10]A Novel Structural ARMA Modeling Approach to Reactor Noise Analysis, M. Demeshko、 T. Washio: REACTOR NOISE Knowledge Transfer Meeting 2012 (RNKTM2012), .

[11]A Novel Structural ARMA Modeling Approach to Reactor Noise Analysis (oral), M. Demeshko、 T. Washio: REACTOR NOISE Knowledge Transfer Meeting 2012 (RNKTM2012), ISSN 1805-6156, Paper ID No.5.

Review Papers

Recent Development of Intelligent Information Processing with Submodularity, Y. Kawahara、 K. Nagano、 T. Washio, The Journal of the Japanese Society for Artificial Intelligence, Japanese Society for Artificial Intelligence, 27[3] (2012), 252-260.

Estimation Technique of Solar Radiation Intensity for Analyzing Output of Solar Power Station, K. Yasunami、 T. Inoue、 T. Washio, The Journal of the Institute of Electronics, Information and Communication Engineers, The Institute of Electronics, Information and Communication Engineers, 95[10] (2012), 885-888.

Contributions to International Conferences and Journals

T. WASHIO	Journal of Data Mining and Knowledge Discovery (Editorial Board Member)
T. WASHIO	Asian Conference on Machine Learning (ACML) (Steering Committee Member)
T. WASHIO	Pacific-Asia Conference on Knowledge Discovery and Data Mining. Future Conference (PAKDD) (Steering Committee Member)
T. WASHIO	The 16th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD2012) (Workshop Co-Chair)
T. WASHIO	2011 International Workshop on Learning and data Mining for Robotics (LEMIR 2011) (Program Committee Member)
T. WASHIO	IEEE International Workshop on Data Mining for Service (DMS2011) (Program Committee Member)
T. WASHIO	Second Workshop on Algorithms for Large-Scale Information Processing in Knowledge Discovery (ALSIP 2011) (Program Committee Member)
T. WASHIO	Statistical Analysis and Data Mining (SAM) (Guest Editor)
T. WASHIO	KDD 2012 : 18th ACM SIGKDD Knowledge Discovery and Data Mining (Program Committee Member)
T. WASHIO	The 21st ACM International Conference on Information and Knowledge Management (CIKM 2012) (Program Committee Member)
T. WASHIO	ICDM 2012 IEEE International Conference on Data Mining (Program Committee Member)
T. WASHIO	ECML/PKDD'13: The European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (Guest Editorial Board Member)
T. WASHIO	ICDM 2013 IEEE International Conference on Data Mining (Workshop Co-Chair)
T. WASHIO	KDD 2012 : 18th ACM SIGKDD Knowledge Discovery and Data Mining (Workshop Program Committee Member)
T. WASHIO	ECML/PKDD'13: The European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (Program Committee Member)
T. WASHIO	NIPS2013: Neural Information Processing Systems 2013 (Reviewer)

T. WASHIO	SDM2013 : SIAM International Conference on Data Mining (Senior Program Committee Member)
T. WASHIO	The 22nd International Conference on Information and Knowledge Management (CIKM 2013) (Program Committee Member)
A. INOKUCHI	The 16th Pacific-Asia Conference on Knowledge Discovery and Data Mining (Program Committee)
A. INOKUCHI	2012 SIAM International Conference on Data Mining (Program Committee)
A. INOKUCHI	The 10th IEEE International Symposium on Parallel and Distributed Processing with Applications (Organizing Committee)
A. INOKUCHI	The 8th International Conference on Advanced Data Mining and Applications (Organizing Committee)
A. INOKUCHI	the 2nd International Conference on Pattern Recognition Applications and Methods (Organizing Committee)
A. INOKUCHI	The 17th Pacific-Asia Conference on Knowledge Discovery and Data Mining (Organizing Committee)
A. INOKUCHI	2013 SIAM International Conference on Data Mining (Organizing Committee)
A. INOKUCHI	the 20th EuroMPI 2013 conference (Organizing Committee)
A. INOKUCHI	The 11th IEEE International Symposium on Parallel and Distributed Processing with Applications (Organizing Committee)
A. INOKUCHI	the 3rd International Conference on Pattern Recognition Applications and Methods (Organizing Committee)
A. INOKUCHI	2013 ASE/IEEE International Conference on Big Data (Organizing Committee)

Publications in Domestic Meetings

The 26th Annual Conference of the Japanese Society for Artificial Intelligence	2 papers
The 40th Annual Meeting of the Behaviormetric Society of Japan	1 paper
The 87th Workshop of Special Interest Group on Fundamental Problems of Artificial Intelligence	1 paper
The Third Workshop on Latent Dynamics	1 paper
The 26th Annual Conference of The Japanese Society for Artificial Intelligence	9 papers
Special Interest Group on Fundamental Problem of Artificial Intelligence, The Japanese Society for Artificial Intelligence	3 papers
Special Interest Group on Fundamental Problem of Artificial Intelligence, The Japanese Society for Artificial Intelligence	1 paper
Information-Based Inductive Sciences and Machine Learning (IBISML2012)	2 papers

Academic Degrees

Bachelor Degree for Engineering Y. Oura	Portfolio Selection via Nonlinear Feature Selection
Bachelor Degree for Engineering K. Kadowaki	Studies on causal structure learning in longitudinal data: A non-Gaussian approach
Bachelor Degree for Engineering N. Tanaka	Studies on causal structure learning in a linear non-Gaussian acyclic model with latent confounders: A Bayesian approach
Bachelor Degree for Engineering H. Yabe	Studies on data generation process estimation by using prior knowledge of binary data
Master Degree for Engineering T. Tashiro	Studies on causal structure learning in a linear non-Gaussian acyclic model with latent confounders
Master Degree for Engineering A. Yamaoka	An Application of the Graph Sequence Mining Method to Transition-based Dependency Parsers
Master Degree for	Bootstrap confidence intervals in LiNGAM

Engineering			
K. Tamvitayakul			
Doctor Degree for Engineering	Study on Learning Invariant Patterns with Second Order Statistics		
S. Hara			
Doctor Degree for Engineering	Techniques for Estimating Variable Relations from Small Samples		
Y. Sogawa			
Grant-in-Aid for Scientific Research			
T. Washio	Development of Statistical Estimation Principle for Extremely High Dimensional Data and Its Application to Large Scale Data Mining		¥4,940,000
T. Washio	Learning Probabilistic Simulation Models of Event and Scenario Occurrences under Rare and Special Conditions		¥2,210,000
S. Shimizu	Causal structure learning from multiple high-dimensional datasets and its application to life sciences		¥1,950,000
Y. Kawahara	Data Analysis meethod for super high dimensinal data using discrete structure		¥780,000
A. Inokuchi	Development of Multidimensional Databases for Analzing Time Interval Data in Heterogeneous Schemas		¥6,760,000
Entrusted Research			
T. Washio	National Cerebral and Cardiovascular Center	Practice of Advanced Estimation Theory	¥500,000
T. Washio	Fujitsu Laboratories LTD.	Study on Technical Basis for Data Analysis	¥2,000,000
Y. Kawahara	Japan Science and Technology Agency	Knowledge discovery from super-high dimensional data based on combinatorial computation	¥12,584,000
Cooperative Research			
T. Washio	Japan Science and Technology Agency		¥1,080,000
Y. Kawahara	NEC Co.		¥1,575,000
Other Research Fund			
Y. Kawahara	Japan Society for the Promotion of Science		¥2,450,000

Department of Knowledge Systems

Original Papers

- [1]On scalability of the Semantic Web, R. Mizoguchi: Journal of Zhejiang University - Science C, 13 (4) (2012) 245-246.
- [2]CHARM as Activity Model to Share Knowledge and Transmit Procedural Knowledge and its Application to Nursing Guidelines Integration, S. Nishimura, Y. Kitamura, M. Sasajima, A. Williamson, C. Kinoshita, A. Hirao, K. Hattori, R. Mizoguchi: Journal of Advanced Computational Intelligence and Intelligent Informatics, 17 (2) (2013) 208-220.
- [3]A Comprehensive Evaluation of the Definitions of Services, K. Sumita, Y. Kitamura, M. Sasajima, R. Mizoguchi: Journal of Japan Industrial Management Association, 63 (3) (2012) 138-153.
- [4]Dynamic Is-a Hierarchy Generation based on Viewpoints, K. Kozaki, K. Hihara, R. Mizoguchi: Transactions of the Japanese Society for Artificial Intelligence, 27 (3) (2012) 235-244.

International Conferences

- [1]Ontological Analyses of Roles, R. Mizoguchi, K. Kozaki, Y. Kitamura: Federated Conference on Computer Science and Information Systems - FedCSIS 2012, (2012) 489-496.

- [2]Intelligent Decision-Making Approach Based on Fuzzy-Causal Knowledge and Reasoning, A. Peña-Ayala, R. Mizoguchi: Advanced Research in Applied Artificial Intelligence, Lecture Notes in Computer Science, 7345 (2012) 534-543.
- [3]A Basic Model of Metacognition: A Repository to Trigger Reflection, A. Peña-Ayala, R. Dominguez de Leon, R. Mizoguchi: Intelligent Tutoring Systems, Lecture Notes in Computer Science, 7315 (2012) 712-713.
- [4]Ontological Modeling of Interoperable Abnormal States, Y. Yamagata, H. Kou, K. Kozaki, R. Mizoguchi, T. Imai, K. Ohe: Semantic Technology, Lecture Notes in Computer Science, 7774 (2012) 33-48.
- [5]Browsing Causal Chains in a Disease Ontology, K. Kozaki, H. Kou, Y. Yamagata, T. Imai, K. Ohe, R. Mizoguchi: Poster & Demo Notes of 11th International Semantic Web Conference (ISWC 2012), (2012) .
- [6]A Model of Derived Roles, K. Kozaki, Y. Kitamura, R. Mizoguchi: Knowledge Engineering and Knowledge Management, Lecture Notes in Computer Science, 7603 (2012) 227-236.
- [7]A Consensus-Building Support System based on Ontology Exploration, K. Kozaki, O. Saito, R. Mizoguchi: Proceedings of the International Workshop on Intelligent Exploration of Semantic Data (IESD), (2012) .
- [8]Towards A Unified Definition of Function, R. Mizoguchi, Y. Kitamura, S. Borgo: Frontiers in Artificial Intelligence and Applications, Formal Ontology in Information Systems, 239 (2012) 103-116.
- [9]An Ontology of Gene, H. Masuya, R. Mizoguchi: CEUR Workshop Proceedings, ICBO2012, 897 (2012) 27-31.
- [10]Identity Tracking of a Disease as a Causal Chain, K. Kozaki, R. Mizoguchi, T. Imai, K. Ohe: CEUR Workshop Proceedings, ICBO2012, 897 (2012) 131-136.
- [11]Articulation of Scenario Construction of Lessons Based on Ontological Engineering, Y. Hayashi, R. Mizoguchi: CEUR Workshop Proceedings, TaPTA, 894 (2012) .

Books

- [1]Theory and Practice of Ontological Engineering(The Japanese Society for Artificial Intelligence) R. Mizoguchi, “Theory and Practice of Ontological Engineering”, Ohmsha, (274) 2012.
- [2]Fundamental Concepts of Ontological Engineering and its Dissemination(Y. Kitamura, The Japanese Society for Artificial Intelligence) Y. Kitamura, “Ontology: recent dissemination and applications”, Ohmsha, (1-17) 2012.
- [3]Classification and Trend Analysis of Utilization of Ontology(Y. Kitamura, The Japanese Society for Artificial Intelligence) K.Kozaki, “Ontology: recent dissemination and applications”, Ohmsha, (91-113) 2012.
- [4]Goal-oriented Modeling and Applications of Artifact Functions and Mobile-User Actions(Y. Kitamura, The Japanese Society for Artificial Intelligence) Y. Kitamura, M. Sasajima, R. Mizoguchi, “Ontology: recent dissemination and applications”, Ohmsha, (207-229) 2012.

Contributions to International Conferences and Journals

- | | |
|--------------|--|
| R. MIZOGUCHI | International Artificial Intelligence in Education Society (Executive Committee) |
| R. MIZOGUCHI | Asia-Pacific Society for Computers in Education(APSCE) (Board member) |
| R. MIZOGUCHI | Steering committee of Joint International Semantic Technology Conferences (JIST) |

	(Board member)	
R. MIZOGUCHI	International Association for Ontology Applications (IAOS) (Board member)	
R. MIZOGUCHI	IEEE Transactions on Learning Technologies (Associate editor)	
R. MIZOGUCHI	ACM Transactions on Interactive Intelligent Systems (Associate editor)	
R. MIZOGUCHI	International Journal of Applied Ontology (Editorial board)	
R. MIZOGUCHI	Research and Practice in Technology Enhanced Learning (Editorial board)	
R. MIZOGUCHI	International Journal of Artificial Intelligence in Education (Editorial board)	
R. MIZOGUCHI	Frontiers in AI and Application (Editorial board)	
R. MIZOGUCHI	International Journal of Web Engineering and Technology (Editorial board)	
R. MIZOGUCHI	Journal of Educational Technology & Society (Editorial board)	
R. MIZOGUCHI	The 19th International Conference on Computers in Education (ICCE2012) Conf. on AIED/ITS & Adaptive Learning (PC member)	
R. MIZOGUCHI	11th International Conference on Intelligent Tutoring Systems: ITS 2012 (Senior Program Committee member)	
R. MIZOGUCHI	7th European Conference on Technology Enhanced Learning (PC member)	
R. MIZOGUCHI	International Conference on Knowledge Engineering and Ontology Development: KEOD 2012 (PC member)	
R. MIZOGUCHI	9th Extended Semantic Web Conference (PC member)	
R. MIZOGUCHI	The 2nd Joint International Semantic Technology Conference (JIST2012) (General Chair)	
R. MIZOGUCHI	The International Workshop on Intelligent Exploration of Semantic Data (IESD) (Organizing Committee)	
Y. KITAMURA	ASME Journal of Computing and Information Science in Engineering (Associate editor)	
Y. KITAMURA	International Journal of Advanced Engineering Informatics (Editorial board)	
Y. KITAMURA	Journal of Advanced Mechanical Design, Systems, and Manufacturing (Editorial board)	
Y. KITAMURA	The 2nd Joint International Semantic Technology Conference (JIST2012) (Local Organizing Chair)	
Y. KITAMURA	The 2nd Joint International Semantic Technology Conference (JIST2012) (PC member)	
Y. KITAMURA	7th International Conference on Formal Ontology in Information System (FOIS 2012) (PC member)	
Y. KITAMURA	4th CIRP International Conference on Industrial Product Service Systems (CIRP IPS2 2012) (Organizing Committee)	
Y. KITAMURA	Ninth International Symposium on Tools and Methods of Competitive Engineering (TMCE 2012) (International Paper Review panel)	
K. KOZAKI	The 2nd Joint International Semantic Technology Conference (JIST2012) (Publicity Chair)	
K. KOZAKI	The 2nd Joint International Semantic Technology Conference (JIST2012) (PC member)	
K. KOZAKI	Journal of Information Processing (Editorial board)	
K. KOZAKI	The International Workshop on Intelligent Exploration of Semantic Data (IESD) (Organizing Committee)	
M. SASAJIMA	The 6th International Conference on Autonomic and Autonomous Systems (ICAS 2012) (PC member)	
M. SASAJIMA	IEICE Trans. on Information & Systems (Editorial board)	

Publications in Domestic Meetings

The Japanese Society for Artificial Intelligence	17 papers
The Architectural Institute of Japan (AIJ)	2 papers
Japan Society for Educational Technology	1 paper
Japan Society for Fuzzy Theory and Intelligent Informatics	1 paper
Japan Association for Medical Informatics	3 papers
The Japan Academy of Nursing Administration and Policies	1 paper

Joint Conference on Informatics in Biology, Medicine and Pharmacology 1 paper

Academic Degrees

Doctor Degree for Engineering	Development of Effective Education Systems by Integration of Educational Theories and Computer Technologies	
J. Lee		
Master Degree for Engineering	Development of Multistep Expansion based Concept Search System for Ontologies	
Y. Kitagawa		
Master Degree for Engineering	Investigation on Goal-Oriented Model of Clinical Pathways and Its Management Framework	
G. Nishijima		
Bachelor Degree for Engineering	Structuring of Web Access Log Data based on a Web Behavior Ontology	
A. Itoh		
Bachelor Degree for Engineering	A Consideration on Systematic Definition of Functional Vocabulary of Information and Communication	
Y. Kobayashi		

Grant-in-Aid for Scientific Research

R. Mizoguchi	Development of the next-generation knowledge systems using ontological engineering	¥11,570,000
Y. Kitamura	Development of a reference ontology of function and knowledge sharing systems based on an interdisciplinary approach	¥4,290,000
M. Sasajima	Hierarchical modeling of the nursing care manual and development of its browser	¥4,420,000
R. Mizoguchi	Development of a Basic Technology for Information Integration of Mouse/Rat Phenotypes	¥520,000

Entrusted Research

R. MIZOGUCHI	The University of Tokyo	Research on development of a medical knowledge database for medical information systems; Design of a semantic relational model	¥15,015,000
R. MIZOGUCHI	The University of Tokyo	Development of Ontology-based Knowledge Processing Mechanism	¥9,000,000

Contribution to Research

Y. Kitamura	Niigata Machine Techno co., Ltd.	¥450,000
Y. Kitamura	Niigata Mechatronics co., Ltd.	¥120,000
Y. Kitamura	Niigata Machine Techno co., Ltd.	¥450,000

Cooperative Research

K. Kozaki	Consumer first, Inc.	¥5,280,000
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Department of Architecture for Intelligence

Original Papers

[1] Mining of Co-occurring Clusters for Damage Pattern Extraction of a Fuel Cell, D. Inaba, K. Fukui, K. Sato, J. Mizusaki and M. Numao: Journal of Japanese Society for Artificial Intelligence, 27 (3) (2012) 121-132.

[2] How Did We Used Twitter, How Communicate in Twitter at Catastrophic Earthquake in Japan, K. Shinoda, T. Sakaki, F. Toriumi, K. Kazama, S. Kurihara, I. Noda, and Y. Matsuo: Journal of Japan Society for Fuzzy Theory and Intelligent Informatics, 25 (1) (2013) 598-608.

International Conferences

[1] Learning system for adapting users with user's state classification by vital sensing, J. Nakase, K.

- Moriyama, K. Kiyokawa, M. Numao, M. Oyama and S. Kurihara: Proc. The 2nd International Workshop on Ambient Information Technologies(AMBIT2013), (2013) .
- [2]Effective Awakening Interaction Learning System that Uses Vital Sensing, J. Nakase, K. Moriyama, K. Kiyokawa, M. Numao, M. Oyama and S. Kurihara: Proc. 2013 IEEE SENSORS APPLICATIONS SYMPOSIUM, (2013) 104-108.
- [3]Neighborhood-based Smoothing of External Cluster Validity Measures, K. Fukui and M. Numao: The 16th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD 2012) (Lecture Notes in Artificial Intelligence), 7301 (2012) 354-365.
- [4]Co-occurring Cluster Mining for Damage Patterns Analysis of a Fuel Cell, D. Inaba, K. Fukui, K. Sato, J. Mizusaki and M. Numao: The 16th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD 2012) (Lecture Notes in Artificial Intelligence), 7301 (2012) 49-60.
- [5]Modeling Affect and Intentions in Unsupervised Learning Environments, P. Inventado, R. Legaspi, R. Cabredo and M. Numao: Proc. The 3rd International Workshop on Empathic Computing (IWEC-2012), (2012) .
- [6]Estimating Emotions on Music Based on Brainwave Analyses, Y. Yamano, R. Cabredo, P. Inventado, R. Legaspi, K. Moriyama, K. Fukui, S. Kurihara and M. Numao: Proc. The 3rd International Workshop on Empathic Computing (IWEC-2012), (2012) .
- [7]EEG-Based Music Emotion Recognition using Regression Analysis, R. Cabredo, R. Legaspi, P. Inventado and M. Numao: Proc. The 3rd International Workshop on Empathic Computing (IWEC-2012), (2012) .
- [8]Generation of Chord Progression Using Harmony Search Algorithm for a Constructive Adaptive User Interface, N. Otani, S. Kurihara and M. Numao: The 12th Pacific Rim International Conference on Artificial Intelligence (PRICAI 2012) (Lecture Notes in Artificial Intelligence), 7458 (2012) 400-410.
- [9]Towards the Design and Development of Anticipation-based Event Selection Modeling for Survival Horror Games, V. Vachiratamporn, R. Legaspi and M. Numao: Proceedings in Information and Communications Technology, 7 (2012) 212-223.
- [10]Sidekick Retrospect: A Self-Regulation Tool for Unsupervised Learning Environments, P. Inventado, R. Legaspi, R. Cabredo and M. Numao: Proceedings in Information and Communications Technology, 7 (2012) 224-235.
- [11]Investigating the Relation between Brainwaves and Emotions in Music, Y. Yamano, R. Cabredo, P. Inventado, R. Legaspi, K. Moriyama, K. Fukui, S. Kurihara and M. Numao: Proceedings in Information and Communications Technology, 7 (2012) 236-245.
- [12]A Study on Activity Predictive Modeling for Prompt and Delayed Services in Smart Space, D. Sodkomkham, R. Legaspi, S. Kurihara and M. Numao: Proceedings in Information and Communications Technology, 7 (2012) 316-328.
- [13]An Emotion Model for Music Using Brain Waves, R. Cabredo, R. Legaspi, P. Inventado and M. Numao: Proc. 13th International Society for Music Information Retrieval Conference (ISMIR-2012), (2012) 265-270.
- [14]Student learning behavior in unsupervised learning environment, P. Inventado, R. Legaspi and M. Numao: Proc. 20th International Conference on Computers in Education (ICCE 2012), (2012) 730-737.

- [15] Aiding digital natives learn positive learning behaviors through reflection, R. Legaspi, P. Inventado, R. Cabredo and M. Numao: Proc. 20th International Conference on Computers in Education (ICCE 2012), (2012) 806-810.
- [16] Multi-agent traffic light control framework based on direct and indirect coordination, T. Shirai, Y. Konaka, J. Yano, S. Nishimura, K. Kagawa, T. Morita, M. Numao, and S. Kurihara: Proc. 7th International Workshop on Agents in Traffic and Transportation, (2012) 1-9.
- [17] Investigating the Relation between Brainwaves and Emotions in Music (poster), Y. Yamano, R. Cabredo, P. Inventado, R. Legaspi, K. Moriyama, K. Fukui, S. Kurihara and M. Numao: The 16th SANKEN International Symposium, Osaka, Japan, Jan. 22-23, 2013.
- [18] Data Mining for Revealing Damage Phenomena in a Fuel Cell (invited), K. Fukui, D. Inaba, K. Sato and M. Numao: The 16th SANKEN International Symposium, Osaka, Japan, Jan. 22-23, 2013.
- [19] Damage Evaluation of Solid Cells by Intelligent Information Processing on Acoustic Emission Events (oral), D. Inaba, K. Fukui, K. Sato, J. Mizusaki, N. Kuwata, J. Kawamura and M. Numao: Pacific Rim Meeting on Electrochemical and Solid-State Science (PRiME 2012), Honolulu, Hawaii, Oct. 7-12, 2012.
- [20] Data Mining for Damage Evaluation Support of an Energy Device (poster), K. Fukui: The 9th Japanese-German Frontiers of Science Symposium (JGFoS), Potsdam, Germany, Oct. 26-28, 2012.
- [21] Revealing Damage Mechanism of a Fuel Cell: Data Mining for a Physical Phenomenon (invited), K. Fukui: Workshop on Computation: Theory and Practice (WCTP 2012), Manila, Philippines, Sep. 27-28, 2012.

Contributions to International Conferences and Journals

M. NUMAO	The 3rd International Workshop on Empathic Computing (IWEC-12) (Chair)
M. NUMAO	Workshop on Computation Theory and Practice (WCTP-2012) (Co-chair)
M. NUMAO	The 12th Pacific Rim International Conference on Artificial Intelligence (Publicity Chair)
M. NUMAO	The 12th Pacific Rim International Conference on Artificial Intelligence (Special Session Organizer)
M. NUMAO	The 16th Pacific-Asia Conference on Knowledge Discovery and Data Mining (Program Committee Member)
M. NUMAO	Frontiers of Science(FoS) Symposium (Advisory Board)
M. NUMAO	The 4th International Workshop on Empathic Computing (IWEC-13) (Organizing Committee)
S. KURIHARA	The 11th International Conference on Autonomous Agents and Multiagent Systems (AAMAS2012) (Sponsorship co-chair)
S. KURIHARA	9th International Workshop on Networked Sensing Systems (INSS2012) (Program Committee Member)
S. KURIHARA	7th International Workshop on Agents in Traffic and Transportation (ATT2012) (Program Committee Member)
S. KURIHARA	IEEE International Conference on Computational Intelligence and Computing Research (ICCIC2012) (Program Committee Member)
S. KURIHARA	The 4th IEEE International Symposium on UbiSafe Computing (UbiSafe2012) (Program Committee Member)
S. KURIHARA	The 11th IEEE International Conference on Trust, Security and Privacy in Computing and Communications (IEEE TrustCom-12) (Program Committee Member)
S. KURIHARA	13th International Workshop on Multi-Agent Based Simulation (Program Committee Member)

S. KURIHARA	The Pacific Rim International Conference on Artificial Intelligence 2012 (PRICAI2012) (Program Committee Member)
S. KURIHARA	The 2012 IEEE/WIC/ACM International Conference on Intelligent Agent Technology (IAT'12) (Program Committee Member)
S. KURIHARA	IEEE/WIC/ACM Web Intelligence 2012 (WI'12) (Program Committee Member)
S. KURIHARA	AMBIENT 2012, The Second International Conference on Ambient Computing, Applications, Services and Technologies (Program Committee Member)
S. KURIHARA	The 4th FTRA International Conference on Information Technology Convergence and Services (ITCS 2012) (Program Committee Member)
S. KURIHARA	The 2012 FTRA International Workshop on Advanced Future Multimedia Services (AFMS 2012) (Program Committee Member)
S. KURIHARA	The First International Conference on Intelligent Systems and Applications (INTELLI 2012) (Program Committee Member)
S. KURIHARA	The Eighth International Conference on Autonomic and Autonomous Systems (ICAS 2012) (Program Committee Member)
S. KURIHARA	The Fifth International Conference on Advances in Computer-Human Interactions (ACHI 2012) (Program Committee Member)
S. KURIHARA	The 12th International Conference on Autonomous Agents and Multiagent Systems (AAMAS2013) (Workshop co-chair)
S. KURIHARA	The Fifth International Workshop on Emergent Intelligence on Networked Agents (WEIN'13) (Organizer)
S. KURIHARA	The 14th International Workshop on Multi-Agent-Based Simulation (MABS'13) (Program Committee Member)
S. KURIHARA	AMBIENT 2013, The 3rd International Conference on Ambient Computing, Applications, Services and Technologies (Program Committee Member)
S. KURIHARA	The 3rd International Workshop on Empathic Computing (IWEC-12) (Program Committee Member)
S. KURIHARA	The 4th International Workshop on Empathic Computing (IWEC-13) (Program Committee Member)
K. MORIYAMA	IEICE Transactions on Information & Systems (Associate Editor)
K. MORIYAMA	International Journal of Organizational and Collective Intelligence (International Editorial Review Board Member)
K. MORIYAMA	IEEE Computational Intelligence Society, the Adaptive Dynamic Programming and Reinforcement Learning Technical Committee (ADPRLTC) (Member)
K. MORIYAMA	The 2012 International Joint Conference on Neural Networks (IJCNN2012) Special Session "Real World Applications of Reinforcement Learning" (Program Committee Member)
K. MORIYAMA	Workshop on Computation: Theory and Practice (WCTP2012) (Program Committee Member)
K. MORIYAMA	The 2013 IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning (ADPRL2013) (Program Committee Member)
K. MORIYAMA	The 12th International Conference on Autonomous Agents and Multiagent Systems (AAMAS2013) (Program Committee Member)
K. MORIYAMA	The 4th International Workshop on Empathic Computing (IWEC-13) (Program Committee Member)
K. MORIYAMA	The 23rd International Joint Conference on Artificial Intelligence (IJCAI2013) (Program Committee Member)
K. MORIYAMA	The 2013 International Joint Conference on Neural Networks (IJCNN2013) (Reviewer)
K. FUKUI	Journal of Information Processing (Editorial Committee Member)
K. FUKUI	Workshop on Computation: Theory and Practice (WCTP2012) (Program Committee Member)
K. FUKUI	The 4th International Workshop on Empathic Computing (IWEC-13) (Program Committee Member)

Publications in Domestic Meetings

National Convention of Information Processing Society of Japan	1 paper
Intelligent System Symposium, The Society of Instrument and Control Engineers	1 paper
Meeting of The Japanese Society for Evolutionary Computation	1 paper
SIG-SAI, The Japanese Society for Artificial intelligence	1 paper
SIG-DOCMAS, The Japanese Society for Artificial intelligence	3 papers
Annual Conference of The Japanese Society for Artificial intelligence	13 papers

Academic Degrees

Doctor Degree for Information Science R. Cabredo	Classification of Music-Induced Emotions using Psychophysiological Sensors	
Master Degree for information Science D. Inaba	Co-occurring Cluster Mining: Frequent Pattern Mining for Numerical Observation Event Sequence	
Master Degree for information Science J. Nakase	User Adapted Interaction Learning Method and Interaction Devise Planning Algorithm for Ambient Information Foundation	
Master Degree for information Science D. Sodkomkham	Predicting Human Mobility	
Master Degree for information Science J. Chu	A Study on Classification by Jaccard Coefficient Label Query using Related Keywords	

Grant-in-Aid for Scientific Research

M. Numao	Constructing Empathic Computing Mechanism	¥8,580,000
S. Kurihara	Environmental Adaptive and Dynamical Transformation of Cooperation Form Mechanism in Multi-Agent Planning	¥3,640,000
S. Kurihara	Emerging Mechanism of Hierarchical Structure for Massive and Complex System	¥650,000
K. Fukui	Co-occurring Cluster Mining and its Envitionmental Contribution	¥1,300,000

Entrusted Research

K. Fukui	Japan Science and Technology Agency	Evaluation Method for Next Generation Ennergy Device based on Artificial Intelligence	¥1,560,000
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Contribution to Research

M. Numao	Daikin Industries, Ltd.	¥300,000
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"Department of Quantum Information Optics (Alliance Laboratory of ISIR, Osaka Univ. and RIES, Hokkaido Univ.)"**Original Papers**

[1]A nanodiamond - tapered fiber system with high single-mode coupling efficiency as key element for integrated quantum technology and nanophotonics, T. Schröder, M.Fujiwara, T.Noda, H.Q.Zhao, O.Benson and S.Takeuchi: Opt.Exp., 20 (10) (2012) 10490-10497.

[2]Generation of broadband spontaneous parametric fluorescence using multiple bulk nonlinear crystals, M.Okano, R.Okamoto, A.Tanaka, S.Subashchandran and S.Takeuchi: Opt.Exp., 20 (13) (2012) 13977-13987.

[3]Experimental evaluation of diffusion constant in a thin polymer film by triplet lifetime analysis of single molecules, T.Chiba, H.Fujiwara, J.Hotta, S.Takeuchi and K.Sasaki: J, 238 (M) (2012) 24-28.

[4]Highly indistinguishable heralded single-photon sources using parametric down conversion, M.Tanida, R.Okamoto and S.Takeuchi: Opt.Exp., 20 (14) (2012) 15275-15285.

- [5]Suppression of fluorescence phonon sideband from nitrogen vacancy centers in diamond nanocrystals by substrate effect, H.Q.Zhao, M.Fujiwara and S.Takeuchi: Opt.Exp., 20 (14) (2012) 15628-158635.
- [6]Coupling of ultrathin tapered fibers with high-Q microsphere resonators at cryogenic temperatures and observation of phase-shift transition from undercoupling to overcoupling, M.Fujiwara, T.Noda, A.Tanaka, K.Toubaru, H.Q.Zhao and S.Takeuchi: Opt.Exp., 20 (17) (2012) 19545-19553.
- [7]Effect of substrates on the temperature dependence of fluorescence spectra of nitrogen vacancy centers in diamond nanocrystals, H.Q.Zhao, M.Fujiwara and S.Takeuchi: Jpn. J. Appl. Phys., 51 (9) (2012) 090110.
- [8]Experimental demonstration of adaptive quantum state estimation, R.Okamoto, M.Iefuji, S.Oyama, K.Yamagata, H.Imai, A.Fujiwara and S.Takeuchi: Phys.Rev.Lett., 109 (13) (2012) 130404.
- [9]Embedded TiO_2 waveguides for sensing nanofluorophores in a microfluidic channel, M.Furuhashi, M.Fujiwara, T.Ohshiro, K.Matsubara, M.Tsutsui, M.Taniguchi, S.Takeuchi and T.Kawai: Appl.Phys.Lett., 101 (15) (2012) 153115.
- [10]Noncollinear parametric fluorescence by chirped quasi-phase matching for monocycle temporal entanglement, A.Tanaka, R.Okamoto, H.H.Lim, S.Subashchandran, M.Okano, L.Zhang, L.Kang, J.Chen, P.Wu, T.Hirohata, S.Kurimura and S.Takeuchi: Opt.Exp., 20 (23) (2012) 25228-25238.

International Conferences

- [1]Highly Efficient Coupling of Photons from Single CdSe/ZnS Nanocrystals into Single-Mode Optical Fibers (poster), M.Fujiwara, K.Toubaru, T.Noda, H.Q.Zhao and S.Takeuchi: CLEO-QELS 2012 (Conference on Lasers and Electro-Optics and Quantum Electronics and Laser Science Conference), San Jose, CA, USA, 6-11 May, 2012.
- [2]Realization of ultra-broadband entangled photons and application to quantum sensing (invited), S. Takeuchi, R. Okamoto, M. Okano, A. Tanaka, S. Subashchandran, S. Kurimura, N. Nishizawa, J. Chen, P. Wu and T. Hirohata: Quantum2012, Trino, Italy, 20-26 May, 2012.
- [3]Realization of ultra-broadband entangled photons and application to quantum sensing (invited), S.Takeuchi, R.Okamoto, M.Okano, A.Tanaka, S.Subashchandran, S.Kurimura, N.Nishizawa, J.Chen, P.Wu, T.Hirohata: 21th International Laser Physics Workshop, Calgary, Canada, 23-27 Jul., 2012.
- [4]Experimental realization of an entanglement microscope (poster), T.Ono, R.Okamoto, S.Takeuchi: SPIE Optics+Photonics "Quantum Communications and Quantum Imaging X", California, USA, 12-16, Aug., 2012.
- [5]Demonstration of adaptive quantum estimation with photons (invited), R.Okamoto, M.Iefuji, K.Yamagata, H.Imai, M.Fujiwara, H.Q.Zhao, A.Fujiwara and S.Takeuchi: SPIE Optics+Photonics "Quantum Communications and Quantum Imaging X", California, USA, 12-16, Aug., 2012.
- [6]Toward the realization of efficient indistinguishable single photon sources using diamond NV centers on optical nanofibers (oral), H.Q.Zhao, M.Fujiwara, T.Schröder, O. Benson and S.Takeuchi: 12th Asian Quantum Information Science Conference (AQIS2012), Suzhou, China, 23-26, Aug., 2012.
- [7]Efficient coupling of ultrathin tapered fibers with nanomitters and microsphere resonators (invited), M.Fujiwara, T.Noda, A.Tanaka, K.Toubaru, H.Q.Zhao and S.Takeuchi: Photon 12: Institute of Physics'premier event in optics and photonics, UK, 3-6 Sep., 2012.
- [8]Recent progress in Stoichiometric Lithium Tantalate (oral), S.Kurimura, L.H.Hong, I.Shoji, N.Mio,

S.Takeuchi: NLO50(50 Years of Nonlinear Optics International Symposium, Barcelona, Spain, 7-10, Oct., 2012.

[9]Nano photonics for quantum information science (invited), S.Takeuchi: RIES-CIS Symposium, Hokkaido, Japan, 25 Oct., 2012.

[10]Dispersion-tolerant quantum optical coherence tomography by broadband spontaneous parametric fluorescence (poster), M.Okano, R.Okamoto, A.Tanaka, S.Subashchandran, S.Ishida, N.Nishizawa and S.Takeuchi: The 13th RIES-Hokudai International Symposium "律"[ritsu] joined with The 1st International Symposium of Nano-Macro Materials, Devices, and System Research Alliance Project, Hokkaido, Japan, 13-14, Dec., 2012.

[11]Implementation of quantum controlled-SWAP operation using a photonic quantum circuit (poster), M.Tanida, T.Ono, R.Okamoto, S.Takeuchi: The 13th RIES-Hokudai International Symposium "律"[ritsu] joined with The 1st International Symposium of Nano-Macro Materials, Devices, and System Research Alliance Project, Hokkaido, Japan, 13-14, Dec., 2012.

[12]Ultra-broadband correlated photon spectroscopy towards realization of mono-cycle photonic entanglement (poster), A.Tanaka, R.Okamoto, H.H.Lim, S.Subashchandran, Y.Eto, M.Okano, L.Zhang, L.Kang, J.Chen, P.Wu, T.Hirohata, S.Kurimura and S.Takeuchi: The 16th SANKEN International Symposium 2013, Osaka, Japan, 22-23, Jan., 2012.

[13]Spectral properties of ultra-broadband entangled photons generated from chirped-MgSLT crystal towards monocycle entanglement generation (oral), A.Tanaka, R.Okamoto, H.H.Lim, S.Subashchandran, M.Okano, L.Zhang, L.Kang, J.Chen, P.Wu, T.Hirohata, S.Kurimura and S.Takeuchi: SPIE Photonics West 2013, California, USA, 2-7, Feb., 2012.

[14]Experimental demonstration of adaptive quantum state estimation (invited), R.Okamoto, M.Iefuji, S.Oyama, K.Yamagata, H.Imai, A.Fujiwara and S.Takeuchi: SPIE Photonics West 2013, California, USA, 2-7, Feb., 2012.

Review Papers

Quantum nanophotonic devices using nano-optical tapered fibers, M. Fujiwara, S. Takeuchi, Chemical Industry, Chemical Industry, 63[9] (2012), 25-30.

Novel photonic quantum science by periodically poled optical devices - Toward the realization of the mono-cycle entangled photons -, S. Takeuchi, R. Okamoto, M. Okano, S. Subashchandran, OPTRONICS, 31[371] (2012), 121-125.

Controlling photons with single photons, S. Takeuchi, Nikkei electronics, Nikkei BP, [1102] (2013), 65-66.

Publications in Domestic Meetings

QIT26	1 paper
The 7th KAKENHI Quantum cybernetics General Meeting	7 papers
Nano,Macro Materials, Devices and System Reserch Alliance	1 paper
JSP 2012 Fall meetings	6 papers
QIT27	5 papers
FIRST Quantum Information Processing Project Kakenhi-Quantum Cybernetics	4 papers
Project Annual Meeting 2012	
68th Annual Meeting of the Physical Society of Japan	1 paper
60st Spring Meeting, 2012; The Japan Society of Applied Physics	1 paper

Academic Degrees

Doctor Degree for The realization of highly indistinguishable heralded single photon sources and the

Engineering M. Tanida	implementation of a Controlled-SWAP photonic quantum circuit		
Master Degree for Engineering Science T. Yokoi	Study of highly-efficient generation of quantum entangled photon pairs and its influence on two-photon quantum interference		
Grant-in-Aid for Scientific Research			
S. Takeuchi	Realization of quantum cybernetics using photonic quantum circuits		¥24,830,000
S. Takeuchi	Realization of an efficient quantum memory for single photons using a diamond color center as a λ -type atom		¥12,480,000
M. Fujiwara	Developing sensitive absorption-based spectroscopy by using nanophotonic structures for single non-fluorescent molecules		¥1,040,000
Entrusted Research			
S. Takeuchi	Japan Science and Technology Agency (JST)	Toward the realization of monocycle entangled photons for novel nonlinear quantum optics	¥30,303,000
S. Takeuchi	Japan Society for the Promotion of Science	Realization of entanglement microscope and supersensitive phase measurement	¥13,843,000
Contribution to Research			
S. Takeuchi	Research Foundation for Opto-Science and Technology		¥2,076,000

Department of Quantum Functional Materials

Original Papers

- [1]Fermi level tuning and a large activation gap achieved in the topological insulator $\text{Bi}_2\text{Te}_2\text{Se}$ by Sn doping, Zhi Ren, A. A. Taskin, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Physical Review B, 85 (15) (2012) 155301/1-6.
- [2]Landau level spectroscopy of surface states in the topological insulator $\text{Bi}_{0.91}\text{Sb}_{0.09}$ via magneto-optics, A. A. Schafgans, K. W. Post, A. A. Taskin, Yoichi Ando, Xiao-Liang Qi, B. C. Chapler, and D. N. Basov: Physical Review B, 85 (19) (2012) 195440/1-6.
- [3]Manifestation of Topological Protection in Transport Properties of Epitaxial Bi_2Se_3 Thin Films, A. A. Taskin, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Physical Review Letters, 109 (6) (2012) 066803/1-5.
- [4]Ambipolar transport in bulk crystals of a topological insulator by gating with ionic liquid, Kouji Segawa, Zhi Ren, Satoshi Sasaki, Tetsuya Tsuda, Susumu Kuwabata, and Yoichi Ando: Physical Review B, 86 (7) (2012) 075306/1-7.
- [5]Spin Polarization of Gapped Dirac Surface States Near the Topological Phase Transition in $\text{TlBi}(\text{S}_{1-x}\text{Se}_x)_2$, S. Souma, M. Komatsu, M. Nomura, T. Sato, A. Takayama, T. Takahashi, K. Eto, Kouji Segawa, and Yoichi Ando: Physical Review Letters, 109 (18) (2012) 186804/1-5.
- [6]Achieving Surface Quantum Oscillations in Topological Insulator Thin Films of Bi_2Se_3 , A. A. Taskin, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Advanced Materials, 24 (41) (2012) 5581-5585.
- [7]Experimental realization of a topological crystalline insulator in SnTe , Y. Tanaka, Zhi Ren, T. Sato, K. Nakayama, S. Souma, T. Takahashi, Kouji Segawa, and Yoichi Ando: Nature Physics, 8 (11) (2012) 800-803.
- [8]Anomalous suppression of the superfluid density in the $\text{Cu}_x\text{Bi}_2\text{Se}_3$ superconductor upon progressive Cu intercalation, M. Kriener, Kouji Segawa, Satoshi Sasaki, and Yoichi Ando: Physical Review B, 86 (18)

(2012) 180505/1-5.

[9]Structural study of $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$ exfoliated nanocrystals, A. Lupascu, Renfei Feng, L. J. Sandilands, Zixin Nie, V. Baydina, Genda Gu, Shimpei Ono, Yoichi Ando, D. C. Kwok, N. Lee, S.-W. Cheong, K. S. Burch, and Young-June Kim: Applied physics letters, 101 (22) (2012) 223106/1-4.

[10]Odd-Parity Pairing and Topological Superconductivity in a Strongly Spin-Orbit Coupled Semiconductor, Satoshi Sasaki, Zhi Ren, A. A. Taskin, Kouji Segawa, Liang Fu, and Yoichi Ando: Physical Review Letters, 109 (21) (2012) 217004/1-5.

[11]Manipulation of Topological States and the Bulk Band Gap Using Natural Heterostructures of a Topological Insulator, K. Nakayama, K. Eto, Y. Tanaka, T. Sato, S. Souma, T. Takahashi, Kouji Segawa, and Yoichi Ando: Physical Review Letters, 109 (23) (2012) 236804/1-5.

[12]Checkerboard to stripe charge ordering transition in $\text{TbBaFe}_2\text{O}_5$, D. K. Pratt, S. Chang, W. Tian, A. A. Taskin, Yoichi Ando, J. L. Zarestky, A. Kreyssig, A. I. Goldman, and R. J. McQueeney: Physical Review B, 87 (4) (2013) 045127/1-5.

[13]Anomalous metallic state above the upper critical field of the conventional three-dimensional superconductor AgSnSe_2 with strong intrinsic disorder, Zhi Ren, M. Kriener, A. A. Taskin, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Physical Review B, 87 (6) (2013) 064512/1-6.

International Conferences

[1]Topological Insulators and Superconductors: Materials Frontier (plenary), Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[2] ^{77}Se NMR study of possible topological superconductors $\text{Cu}_x\text{Bi}_2\text{Se}_3$ (poster), F. Iwase, G.-q. Zheng, Y. S. Hor, M. Kriener, K. Segawa, Z. Ren, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[3]Gating with ionic liquid on bulk single crystals of a topological insulator (poster), K. Segawa, Z. Ren, S. Sasaki, T. Tsuda, S. Kuwabata, and Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[4]Soft point-contact spectroscopy of $\text{Cu}_x\text{Bi}_2\text{Se}_3$ (poster), S. Sasaki, M. Kriener, K. Segawa, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[5]Molecular Beam Epitaxial Growth of Topological Insulators on Insulating Substrates (poster), A. Taskin, S. Sasaki, K. Segawa, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[6]Small superfluid density in $\text{Cu}_x\text{Bi}_2\text{Se}_3$ (poster), M. Kriener, S. Segawa, S. Sasaki, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[7]Optimizing the $\text{Bi}_{2-x}\text{Sb}_x\text{Te}_{3-y}\text{Se}_y$ solid solutions to approach the intrinsic topological insulator regime (poster), Z. Ren, A. A. Taskin, S. Sasaki, K. Segawa, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[8]Transport Properties of Topological Insulators with Cobalt Films Deposited on their Surface (poster), K. Eto, S. Sasaki, Z. Ren, K. Segawa, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

- [9]Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: Colloquium, Physics Section, EPFL, Lausanne, Switzerland, May 21, 2012.
- [10]Transport Studies of the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: International Workshop on Strongly Correlated Electron Systems in High Magnetic Fields (SCEF), Les Houches, France, May 21-25, 2012.
- [11]Progress in Topological Insulator Materials for 2D Devices (invited), Y. Ando: NSF/AFOSR Workshop on 2D Materials and Devices Beyond Graphene, Arlington, VA, U.S.A., May 30-31, 2012.
- [12]Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: Seminar, Air Force Research Laboratory, Dayton, OH, U.S.A., June 1, 2012.
- [13]Probing the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: Advanced Research Workshop on Non-equilibrium and Coherent Phenomena at Nanoscale (Meso-2012), Landau Institute, Chernogolovka, Russia, June 17-23, 2012.
- [14]Soft point-contact spectroscopy of $\text{Cu}_x\text{Bi}_2\text{Se}_3$ (poster), S. Sasaki, M. Kriener, K. Segawa, K. Yada, Y. Tanaka, M. Sato, and Y. Ando: Gordon Research Conference the 2012 correlated electron systems, South Hadley, U.S.A., June 24-29, 2012.
- [15]Probing the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: The 19th International Conference on Magnetism (ICM 2012), Busan, Korea, July 8-13, 2012.
- [16]Optimizing the $\text{Bi}_{2-x}\text{Sb}_x\text{Te}_{3-y}\text{Se}_y$ solid solutions to approach the intrinsic topological insulator regime (poster), Z. Ren, A. A. Taskin, S. Sasaki, K. Segawa, Y. Ando: The 19th International Conference on Magnetism (ICM 2012), Busan, Korea, July 8-13, 2012.
- [17]Probing the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: Japanese-German Symposium 2012, Shuzenji, Japan, July 14-17, 2012.
- [18]Experiments Toward Identifying a Topological Superconductor (plenary), Y. Ando: International Conference on Materials & Mechanisms of Superconductivity (M²S 2012), Washington DC, U.S.A., July 29-August 3, 2012.
- [19]Topological Insulators: A New Materials Frontier (invited), Y. Ando: Super-PIRE 2nd Workshop, Hyatt Regency Bethesda, Maryland, U.S.A., August 3, 2012.
- [20]Probing the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: CECAM workshop on Topological Materials, Bremen, Germany, August 13-17, 2012.
- [21]Experimental study of three-dimensional topological insulators/superconductors (invited), Kouji Segawa: APCTP Focus Program on Quantum Condensation (QC12), APCTP Headquarters, Pohang, Korea, August 13-24, 2012.
- [22]Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: Special Seminar, Department of Electrical Engineering, UCLA, U.S.A., September 10, 2012.
- [23]Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: GLAM Special Seminar, Geball Laboratory for Advanced Materials, Stanford University, U.S.A., September 13, 2012.
- [24]Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: Colloquium, Department of Physics, Harvard University, U.S.A., November 9, 2012.

[25]Exploring Topological Insulator and Superconductor Materials (invited), Y. Ando: International Symposium Nanoscience and Quatum Physics (nanoPHYS'12), International House of Japan, Roppongi, Tokyo, December 17-19, 2012.

[26]Exploring Topological Insulator and Superconductor Materials (invited), Y. Ando: QS²C Theory Forum: International Symposium on Strongly Correlated Quantum Science, University of Tokyo, Japan, January 26-29, 2013.

[27]Search for topological superconductivity in superconducting topological insulators (invited), S. Sasaki: American Physical Society March Meeting, Baltimore, U.S.A., March 18-22, 2013.

[28]Manifestation of topological protection in transport properties of epitaxial Bi₂Se₃ thin films (invited), A. Taskin: American Physical Society March Meeting, Baltimore, U.S.A., March 18-22, 2013.

Review Papers

Topological superconductors and Majorana particles, Y. Ando, Forum of superconductivity science and technology news, The Society of Non-Traditional Technology, 133 (2012), 6-8.

Introduction to topological insulator, Y. Ando, , The Japan Society of Applied Physics, 81[12] (2012), 1020-1023.

Contributions to International Conferences and Journals

Y. Ando Europhysics Letters (EPL) (Co-Editor)

Y. Ando the 7th International Conference “Science and Engineering of Novel Superconductors” of the Forum on New Materials (International Advisory Board)

Publications in Domestic Meetings

8th Intensive-Interactive meeting "Topology of Cold Atom Gases" of Topological Quantum Phenomena in Condensed Matter with Broken Symmetries 1 paper

Meeting 2012 for G1 working group of five-institute alliance 1 paper

Fall meeting of the physical society of Japan 2012 12 papers

10th Intensive-Interactive meeting "Topological Superconductivity/Superfluidity" of Topological Quantum Phenomena in Condensed Matter with Broken Symmetries 1 paper

68th annual meeting of the physical society of Japan 9 papers

Academic Degrees

Ph. D. Synthesis and Characterization of Topological Insulators and Related Materials

K. Eto

Master Degree of Science Single-Crystal Growth of Candidate Materials for Topological Superconductor Sn_{1-x}In_xTe and Pb_{1-x}Tl_xTe

T. Ueyama

Master Degree of Science Efforts toward Obtaining Single-Phase Topological Superconductor Cu_xBi₂Se₃

K. Kinoshita

Grant-in-Aid for Scientific Research

Y. Ando Creation of Innovative Devices Based on Topological Insulators ¥40,950,000

K. Segawa Precise control of physical properties of topological insulators/superconductors with electrochemical technique ¥2,210,000

S. Sasaki Elucidation of the symmetry of superconducting gap of topological superconductor CuxBi2Se3 and other novel materials ¥2,730,000

K. Segawa Novel phenomea in the elcetron fluids with broken inversion symmetry ¥9,100,000

K. Eto Magnetic transport studies about candidate materials of pyrochlore oxide ¥700,000

Contribution to Research

Department of Semiconductor Materials and Processes**Original Papers**

- [1] Properties of charge states in MOS structure with ultrathin oxide layer, S. Jurecka, H. Kobayashi, M. Takahashi, T. Matsumoto, E. Pincik: Appl. Surf. Sci., 258 (21) (2012) 8409-8414.
- [2] Passivation of Si-based structures in HCN and KCN solutions, E. Pinčík, H. Kobayashi, J. Rusnák, M. Takahashi, M. Mikula, W.-B. Kim, M. Kučera, R. Brunner, S. Jurečka: Appl. Surf. Sci., 258 (21) (2012) 8397-8405.
- [3] Changes in minority carrier lifetime of hydrogen-terminated Si surfaces in dry- and wet-air, F. F. Jr. Corpuz, T. Matsumoto, W.-B. Kim, H. Kobayashi: ECS. Solid-State Lett., 1 (6) (2012) 89-91.
- [4] Optimum condition to fabricate 5–10 nm SiO₂/Si structure using advanced nitric acid oxidation of Si (NAOS) method with Si source, K. Imamura, T. Matsumoto, H. Kobayashi: J. Appl. Phys., 112 (12) (2012) 124322.
- [5] Acoustic spectroscopy and electrical characterization of Si/NAOS-SiO₂/HfO₂ structures, P. Bury, T. Matsumoto, I. Bellan, M. Janek, H. Kobayashi: Appl. Surf. Sci., 269 (-) (2013) 50-54.
- [6] About electrical properties of passivated SiO₂/Si structures prepared electro-chemically in HClO₄ solutions, E. Pinčík, H. Kobayashi, J. Rusnák, M. Takahashi, R. Brunner: Appl. Surf. Sci., 269 (-) (2013) 148-154.
- [7] FTIR spectroscopy of silicon oxide layers prepared with perchloric acid, M. Kopani, M. Mikula, M. Takahashi, J. Rusnák, E. Pinčík: Appl. Surf. Sci., 269 (-) (2013) 106-109.

International Conferences

- [1] Application of Ultra-thin SiO₂ layer formed by the nitric acid oxidation of Si (invited), T. Matsumoto, Y. Yamada, H. Tsuji, K. Taniguchi, Y. Kubota, S. Imai, S. Terakawa, H. Kobayashi: Progress in Applied Surface, Interface and Thin Film Science 2012, Florence, Italy, May 14-18, 2012.
- [2] Thin film transistors (TFTs) with stacked gate oxide formed by the nitric acid oxidation of Si (NAOS) method and application to low power liquid crystal displays (LCD) and ring oscillator (invited), S. Imai, T. Matsumoto, Y. Kubota, H. Tsuji, N. Suzuki, S. Terakawa, H. Kobayashi: Progress in Applied Surface, Interface and Thin Film Science 2012, Florence, Italy, May 14-18, 2012.
- [3] New surface technologies for improvement of conversion efficiencies of crystalline Si solar cells (invited), H. Kobayashi, T. Matsumoto, M. Takahashi, W.-B. Kim: Progress in Applied Surface, Interface and Thin Film Science 2012, Florence, Italy, May 14-18, 2012.
- [4] Photovoltaic effect of Si nanoparticles fabricated from Si swarf and improvement of the performance by nitric acid oxidation of Si (poster), M. Maeda, T. Matsumoto, H. Kobayashi: Progress in Applied Surface, Interface and Thin Film Science 2012, Florence, Italy, May 14-18, 2012.
- [5] Photovoltaic Effect of Si Nanoparticles and Improvement by Nitric Acid Oxidization (poster), M. Maeda, Taketoshi matsumoto, Hikaru Kobayashi: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, December 10-11, 2012.
- [6] Chemical Methods to Improve Crystalline Si Solar Cell Characteristics (plenary), H. Kobayashi: The 16th SANKEN International Symposium 2013 and The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, January 22-23, 2013.

[7]Fabrication of visible light luminescent Si nanoparticles and application to photovoltaic devices (poster), M. Maeda, T. Matsumoto, H. Kobayashi: The 16th SANKEN International Symposium 2013 and The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, January 22-23, 2013.

[8]Ultra-low reflectivity SI surfaces fabricated by surface structure chemical transfer method (poster), D. Irishika, K. Imamura, H. Kobayashi: The 16th SANKEN International Symposium 2013 and The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, January 22-23, 2013.

[9]Defect passivation cleaning method for crystalline Si solar cells: Removal of metal contaminants and increase in minority carrier lifetime (poster), K. Kimura, M. Takashi, H. Kobayashi: The 16th SANKEN International Symposium 2013 and The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, January 22-23, 2013.

Review Papers

Application of the defect passivation etch-less (DPEL) and nitric acid oxidation of Si (NAOS) methods to T F T production, H. Kobayahsi, Display, Techno Times, 19[2] (2013), 30-36.

Patents

[1]Semiconductor device manufacturing method, semiconductor device, and transfer memberane H. Kobayashi, PCT/JP2012/070089

[2]Methods of formation of oxide films, semiconductor apparatuses with oxide films, and methods of production of the semiconductor apparatuses H. Kobayashi, JP2005-208133

[3]Method of formation of insulating films, and production method of semiconductor apparatuses H. Kobayashi, JP2006-218012

[4]Method of production of semiconductor apparatuses,apparatuses of production of semiconductor apparatuses, production programs of semiconductor apparatuses, processing agent of semiconductor, and component for structure transfer H. Kobayashi, TW101128780

Contributions to International Conferences and Journals

H. Kobayashi	Progress in Applied Surface, Interface and Thin Film Science 2012 (Chairman of Scienetific Committee)
M. Takahashi	Progress in Applied Surface, Interface and Thin Film Science 2012 (Scienetific Committee, Programme and Organizing Committee)

Publications in Domestic Meetings

Annual meeting of society of nano science and techninology	1 paper
Surface and Interface Spectroscopy	3 papers
Japan Applied Surface Science Meeting	7 papers
Network Joint Research Center for Materials and Devices	1 paper

Academic Degrees

Docter Degree for Science	Development of Chemical Structure Transferring Process and Formation of Ultralow Reflectance Si Surfaces
T. Fukushima	

Entrusted Research

H. Kobayashi	CREST-JST	Research and development of system displays using the nitric acid oxidation of Si (NAOS) method	¥107,978,000
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Contribution to Research

H. Kobayashi	President of Canon Marketing Japan Inc., Masami Kawasaki	¥9,400,000
H. Kobayashi	President of Canon Marketing Japan Inc., Masami Kawasaki	¥8,900,000
H. Kobayashi	President of Canon Marketing Japan Inc., Masami Kawasaki	¥8,630,000
H. Kobayashi	President of Canon Marketing Japan Inc., Masami Kawasaki	¥970,000

Cooperative Research

H. Kobayashi IDEC Co.

¥17,815,000

Department of Metallic Materials Process**Original Papers**

- [1] Biocompatible Low Young's Modulus Achieved by Strong Crystallographic Elastic Anisotropy in Ti-15Mo-5Zr-3Al Alloy Single Crystal, S.-H. Lee, M. Todai, M. Tane, K. Hagihara, H. Nakajima, T. Nakano: Journal of the Mechanical Behavior of Biomedical Materials, 14 (2012) 48-54.
- [2] Compressive properties of lotus-type porous iron, M. Vesenjak, A. Kovačič, M. Tane, M. Borovinšek, H. Nakajima, Z. Ren: Computational Materials Science, 65 (2012) 37-43.
- [3] Fabrication of porous aluminum with directional pores through continuous casting technique, T. Ide, Y. Iio, H. Nakajima: Metallurgical and Materials Transactions A, 43 (13) (2012) 5140-5152.
- [4] Elevated temperature compression behaviors of lotus-type porous NiAl, J. W. Lee, S. K. Hyun, M. S. Kim, M. G. Kim, T. Ide, H. Nakajima: Intermetallics, 29 (2012) 27-34.
- [5] Ductility improvement of intermetallic compound NiAl by unidirectional pores, J.W. Lee, S.K. Hyun, M.S. Kim, M.G. Kim, T. Ide, H. Nakajima: Materials Letters, 74 (2012) 213-216.
- [6] ω Transformation in Cold Worked Ti-Nb-Ta-Zr-O Alloys with Low Body-centered Cubic Phase Stability and Its Correlation with Their Elastic Properties, M. Tane, T. Nakano, S. Kuramoto, M. Niinomi, N. Takesue, H. Nakajima: Acta Materialia, 61 (1) (2013) 139-150.

International Conferences

- [1] Self-diffusion of oxygen in amorphous Al_2O_3 thin films (poster), T. Toda, R. Nakamura, S. Tsukui, M. Ishimaru, M. Tane, H. Nakajima: 8th Handai Nanoscience and Nanotechnology International Symposium- Nanoscience and Nanotechnology for Energy Harvesting and Saving -December 10-11 (2012), Icho-Kanikan, Osaka University, Japan.
- [2] Effective-mean-field Theory for Macroscopic Elastic Properties and Some Related Properties of Elastic Inhomogeneous Materials (invited), M. Tane: Micromechanics of Advanced Structural Materials - Prof. Toshio Mura Memorial Symposium, Tsukuba, Japan, June 7-8, 2012.

Publications in Domestic Meetings

2012 Spring Meeting, The Japan Institute of Metals and Materials	5 papers
The 44th Autumn Meeting, The Society of Chemical Engineers, Japan	1 paper
The 122th Fall Meeting, The Japan Institute of Light Metals	2 papers
2012 Spring Meeting, Smart Processing Society for Materials, Environment & Energy	1 paper
3rd Meeting for Material Properties, 2012	1 paper
Meeting for Young Researchers, The Japan Institute of Light Metals	1 paper

Academic Degrees

Master Degree for Engineering A. Oda	Compressive and tensile deformation of lotus-type porous magnesium
Master Degree for Engineering T. Toda	Diffusion of oxygen in amorphous oxide thin films
Master Degree for Engineering S. Morita	Fabrication of lotus-type porous copper using hydrogen gas and hydride
Doctor Degree for Engineering	Fabrication and mechanical properties of lotus-type porous carbon steels, and their application to structural parts

Grant-in-Aid for Scientific Research

Entrusted Research

Contribution to Research

Cooperative Research

T.Ide	Komatsu Ltd.	¥1,500,000
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Original Papers

[10]Low-Temperature and pressureless Ag-Ag Direct Bonding for Light Emitting Diode Die-Attachment,

- M. Kuramoto, T. Kunimune, S. Ogawa, M. Niwa, K.S. Kim, K. Suganuma: IEEE T. Compon. Pack. T, 2 (4) (2012) 548-552.
- [11]High-Conductivity Adhesive for Light-Emitting Diode Die-Attachment by Low-Temperature Sintering of Micrometer-Sized Ag Particles, T. Kunimune, M. Kuramoto, S. Ogawa, M. Niwa, M. Nogi, K. Suganuma: IEEE T. Compon. Pack. T, 2 (6) (2012) 909-915.
- [12]Effects of Cu Contents in Flux on Microstructure and Joint Strength of Sn-3.5Ag Soldering with an Electroless Ni-P/Au Surface Finish, Hitoshi Sakurai, Keun-Soo Kim, Kiju Lee, Chang-Jae Kim, Youichi Kukimoto, Katsuaki Suganuma: Microelectronics Reliability, 52 (11) (2012) 2716-2722.
- [13]Synthesis and application of Ag nanowires via a trace salt assisted hydrothermal process, Jinting Jiu, Takehiro Tokuno, Masaya Nogi, Katsuaki Suganuma: Journal of Nanoparticle Research, 14 (2012) 975.
- [14]Ag / TiO₂ core-shell nanocables prepared with a one-step polyol process, J. Jiu, M. Nogi, T. Sugahara, K. Suganuma, M. Tsujimoto, and S. Isoda: Journal of Nanoparticle Research, 14 (2012) 1241.
- [15]Transparent, Conductive, and Printable Composites Consisting of TEMPO-Oxidized Nanocellulose and Carbon Nanotube, Hirotaka Koga, Tsuguyuki Saito, Takuya Kitaoka, Masaya Nogi, Katsuaki Suganuma, Akira Isogai: Biomacromolecules, 14 (4) (2013) 1160-1165.
- [16]Thermoelectric Properties and Microstructures of AgSbTe₂-added p-type Pb_{0.16}Ge_{0.84}Te, A. Yusufu, K. Kurosaki, T. Sugahara, Ohishi, H. Muta, and S. Yamanaka: Physica Status Solidi (a), 209 (2012) 167-170.
- [17]Structure and Thermoelectric Properties of Ca_{2-x}Sr_xFeMoO₆ (0 ≤ x ≤ 0.3) double-perovskite, T. Sugahara, N. V. Nong, and M. Ohtaki: Mater. Chem. Phys, 133 (2012) 630-634.
- [18]Structure and Thermoelectric properties of Double-Perovskite Oxides : Sr_{2-x}K_xFeMoO₆, T. Sugahara, T. Araki, K. Suganuma, and M. Ohtaki: J. Ceram. Soc. Japan, 120 (2012) 1-6.
- [19]High-temperature thermoelectric properties of non-stoichiometric Ag_{1-x}InTe₂ with chalcopyrite Structure, A. Yusufu, K. Kurosaki, T. Sugahara, Ohishi, H. Muta, and S. Yamanaka: Materials Science and Engineering B, 177 (2012) 999-1002.
- [20]Chalcopyrite CuGaTe₂: A High-Efficiency Bulk Thermoelectric Material, Theerayuth Plirdpring, Ken Kurosaki, Atsuko Kosuga, Tristan Day, Samad Firdosy, Vilupanur Ravi, G. Jeffrey Snyder, Adul Harnwungmong, Tohru Sugahara, Yuji Ohishi, Hiroaki Muta, Shinsuke Yamanaka: Advanced Materials, 24 (2012) 3622-3626.
- [21]Transparent electrodes fabricated via the self-assembly of silver nanowires using a bubble template, Takehiro Tokuno, Masaya Nogi, Jinting Jiu, Tohru Sugahara, and Katsuaki Suganuma: Langmuir, 28 (2012) 9298-9302.
- [22]Strongly adhesive and flexible transparent silver nanowire conductive film fabricated with high-intensity pulsed light technique, Jinting Jiu , Masaya Nogi , Tohru Sugahara , Takehiro Tokuno , Teppei Araki , Natsuki Komoda , Katsuaki Suganuma , Hiroshi Uchida and Kenji Shinozaki: Journal of Materials Chemistry, 22 (2012) 23561-23567.
- [23]Absorption layers of ink vehicles for inkjet-printed lines with low electrical resistance, Changjae Kim, Masaya Nogi*, Katsuaki Suganuma, Yukie Saitou, Jun Shirakami: RSC Advances, 2 (2012) 8447-8451.
- [24]Hybrid transparent electrodes of silver nanowires and carbon nanotubes: a low-temperature solution process, Takehiro Tokuno, Masaya Nogi, Jinting Jiu, Katsuaki Suganuma: Nanoscale Research Letters, 7

(2012) 281.

[25] Inkjet-printed lines with well-defined morphologies and low electrical resistance on repellent pore-structured polyimide films, Changjae Kim, Masaya Nogi, Katsuaki Suganuma, Yo Yamato: ACS Applied Materials & Interfaces, 4 (2012) 2168–2173.

[26] Electrical conductivity enhancement in inkjet-printed narrow lines through gradual heating, Changjae Kim, Masaya Nogi, Katsuaki Suganuma: Journal of Micromechanics and Microengineering, 22 (2012) 035016.

[27] Sn-3.5Ag/electroless Au/Ni electrode contact structure utilizing Cu compound added flux, H. Sakurai, Y. Kukimoto, K. Suganuma: The Transactions of the Institute of Electronics, Information and Communication Engineers, J-95C (11) (2012) 317-323.

[28] Relation between crystal axis directions and bending/buckling of Sn Whiskers generated by mechanical stress, Y. Mizuguchi, Y. Murakami, S. Tomiya, T. Asai, T. Kiga, K. Suganuma: The Transactions of the Institute of Electronics, Information and Communication Engineers, J-95C (11) (2012) 333-342.

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[30] Low temperature printed wiring technology using β -keto carbonic acid silver ink, K. Hirose, M. Kawazome, T. Sekiguchi, M. Hatamura, K. Suganuma: The Transactions of the Institute of Electronics, Information and Communication Engineers, J-95C (11) (2012) 394-399.

[31] Loading rate effects on the fracture of Ni/Au nano-coated acrylic particles, J. Y. He, S. Nagao, H. Kristiansen, Z. L. Zhang: Exp. Polym. Lett., 6 (3) (2012) 198-203.

[32] Mystery of current spike: nanoscale plasticity revisited, R. Nowak, D. Chrobak, S. Nagao, D. Vodnick, M. Berg: Mater. Sci. Technol., 28 (2012) 1202-1206.

[33] Nanoindentation study on insight of plasticity related to dislocation density and crystal orientation in GaN, M. Fujikane, T. Yokogawa, S. Nagao, R. Nowak: Appl. Phys. Lett., 101 (2012) 201901.

[34] The effect of micro via-in pad design on surface-mount assembly defects: Part II – voiding and flux spattering, Y.-W. Lee, K.-S. Kim, K. Suganuma: Soldering & Surface Mount Technology, 25 (1) (2013) 4-14.

International Conferences

[1] Effect of Sn Whisker Mitigation by Addition of a Small Amount of Bi, Jung-Lae Jo; Kyoko Hamasaki; Toru Sugahara; Masanobu Tsujimoto; Katsuaki Suganuma: TMS2013 142nd Annual Meeting & Exhibition.

[2] Application of pure Zn for void-free Si wafer bonding without metallization layer, S.W. Park, S. Nagao, T. Sugahara, K. Suganuma: The 16th SANKEN International Symposium 2013/ The 11th SANKEN Nanotechnology Symposium.

[3] Film thickness effect on tin whisker growth by thermal cycling, Jung-Lae Jo, Tohru Sugahara, Shijo Nagao and Katsuaki Suganuma: The 16th SANKEN International Symposium 2013/ The 11th SANKEN Nanotechnology Symposium.

[4] Effect of Sn whisker mitigation by addition of a small amount of Bi, Jung-Lae Jo, Shijo Nagao, Kyoko Hamasaki, Tohru Sugahara, Masanobu Tsujimoto, Katsuaki Suganuma: The 16th SANKEN

International Symposium 2013/ The 11th SANKEN Nanotechnology Symposium.

[5]Interface nanomechanics and dynamics , S. Nagao: The 16th SANKEN International Symposium 2013/ The 11th SANKEN Nanotechnology Symposium.

[6]Thermo Mechanical Reliability of Low Energy Ag Die Bonding (invited), T. Sugahara, S. Sakamoto, K. Sukanuma: International Welding / Joining Conference Korea 2012,.

[7]Effects of additional Ni and Co on microstructural evolution in Sn-Ag-Bi-In solder under current stressing , Youngseok Kim, Toru Sugahara, Shijo Nagao, Katsuaki Sukanuma, Minoru Ueshima, Hans-Juergen Albrecht, Klaus Wilkeand Joerg Strogies: IEEE CPMT Symposium Japan 2012.

[8]Effect of Ag Film Deposition Temperature on Ag Direct Bonding , Chulmin Oh, Shijo Nagao, Teppei Kunimune, Masafumi Kuramoto, and Katsuaki Sukanuma: 8th Handai Nanoscience and Nanotechnology International Symposium.

[9]Conductivity Enhancement of Deposited Metal Arrays Fabricated by Printing and Sputtering Methods on Mechanically Nanofibrillated Cellulose Substrate , Ming-chun Hsieh, Changjae Kim, Masaya Nogi, and Katsuaki Sukanuma: 8th Handai Nanoscience and Nanotechnology International Symposium.

[10]Improvements of Antenna Performance by Inkjet Printed Mirror Coating , Natsuki Komoda, Masaya Nogi, Kanji Otsuka, and Katsuaki Sukanuma: 8th Handai Nanoscience and Nanotechnology International Symposium.

[11]Untreated Nanostructured Paper: A Flexible Material for Printable Electronics , Thi Thi Nge, Masaya Nogi, and Katsuaki Sukanuma: 8th Handai Nanoscience and Nanotechnology International Symposium.

[12]Thermomechanical Reliability of Ag Sinter Joining in Thermal Cycling , Soichi Sakamoto, Shijo Nagao, Toru Sugahara, and Katsuaki Sukanuma: 8th Handai Nanoscience and Nanotechnology International Symposium.

[13]Fabrication of Copper Electrodes by Intense Pulsed Light Sintering Technique , Teppei Araki, Tohru Sugahara, Masaya Nogi, Katsuaki Sukanuma, Hiroshi Uchida, and Kenji Shinozaki: 8th Handai Nanoscience and Nanotechnology International Symposium.

[14]Ag Nanomaterials: Synthesis and Application in Printed Electronics , Jinting Jiu, Takehiro Tokuno, Natsuki Komoda, Masaya Nogi, Tohru Sugahara, Katsuaki Sukanuma, Hiroshi Uchida, Kenji Shinozaki: BIT's 1st Annual World Congress of Advance Materials-2012.

[15]High-intense pulse light sintering of copper oxide to copper in air , Jinting Jiu, Tohru Sugahara, Masaya Nogi, Katsuaki Sukanuma, Hiroshi Uchida, Kenji Shinozaki,: ICFPE2012.

[16]Preparation of Ag Nanowires and Application in Optoelectronic Devices , Jinting Jiu, Tohru Sugahara, Masaya Nogi, Katsuaki Sukanuma: BIT's 2st Annual World Congress of Nano-S&T-2012.

[17]Conductivity enhancement of deposited metal arrays fabricated by printing and sputtering methods on mechanically nanofibrillated cellulose substrate , Ming-chun Hsieh, Changjae Kim, Masaya Nogi and Katsuaki Sukanuma: 8th Handai Nanoscience and Nanotechnology International Symposium.

[18]Paper substrates consisting of cellulose nanofiber for electrical conductive arrays , Ming-chun Hsieh, Changjae Kim, Masaya Nogi, Hirotaka Koga, Thi Thi Nge, Katsuaki Sukanuma: ICC2012.

[19]High conductivity enhancement of deposited electrical array by using mechanically nano-fibrillated paper as a substrate , Ming-chun Hsieh, Changjae Kim, Masaya Nogi, Hirotaka Koga, Thi Thi Nge,

Katsuaki Suganuma: ICFPE2012.

[20]Effect of Cu-Bearing Flux on the Joint Strength and Microstructure of Aged Sn-3.5Ag/ENIG Joint , Hitoshi Sakurai, Keun-Soo Kim, Youichi Kukimoto, Katsuaki Suganuma: 2012 TMS Annual Meeting & Exhibition.

[21]Effect of Crystal Orientation on Mechanically Induced Sn Whiskers of Sn–Cu plating , Yukiko Mizuguchi, Yosuke Murakami, Shigetaka Tomiya, Tadashi Asai, Tomoya Kiga, and Katsuaki Suganuma: TMS2012.

[22]Silver paste antenna printed on flexible substrate , Natsuki Komoda, Masaya Nogi, Katsuaki Suganuma, Kazuo Kohno, Yutaka Akiyama, Kanji Otsuka: 2012 MRS Spring Meeting.

[23]Printing of flexible antenna and its performance , Natsuki Komoda, Masaya Nogi, Katsuaki Suganuma, Kanji Otsuka: 2012 CMOS Emerging Technologies.

[24]Silver nanowire antenna printed on polymer and paper substrates , Natsuki Komoda, Katsuaki Suganuma, Masaya Nogi, Hirotaka Koga, Kanji Otsuka: IEEE NANO 2012.

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[31]Facile production of optically-transparent cellulose nanofiber paper , Tetsuji Inui, Masaya Nogi, Hirotaka Koga, Thi Thi Nge, Ming-chun Hsieh, Katsuaki Sugauma: The 2012 International Conference on Flexible and Printed Electronics.

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[45]Strain Rate Controlled Nanoindentation Examination and Incipient Plasticity in Bulk GaN Crystal , Masaki Fujikane, Toshiya Yokogawa, Shijo Nagao and Roman Nowak: International Workshop on Nitride Semiconductors 2012 (Japan).

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Development of Printed Electronics and Standardization, Display, Techno Times Co.,Ltd, 18[5] (2012), 1-5.

Mechanism of whisker, Journal of the Surface Finishing Society of Japan, The Surface Finishing Society of Japan, 66[11] (2012), 677-680.

Printed Electronics, Chemistry & Education, the Chemical Society of Japan, 60 (2012), 528-529.

Inspire the Future by Printed Electronics, Display, Techno Times Co.,Ltd, 9[1] (2013), 10-15.

Printed Electronics : 1.MaterialTechnology, Plastics Age, Plastics Age Co., Ltd, 58[1] (2013), 70-74.

Printed Electronics : 2. Printed Technology and Practical use, Plastics Age, Plastics Age Co., Ltd, 58[2] (2013), 106-110.

Printed Electronics : 3. Standardization, Plastics Age, Plastics Age Co., Ltd, 58[3] (2013), 103-108.

Books

[1]Tin Whisers(K.N.Subramanian) K.Suganuma, "Lead-free Solders: Materials Reliability for Electronics", John Wiley and Sons Ltd, (323-335) 2012.

[2]Pb-free soldures and die-attach materials toward next generation power devices K.Suganuma, "Functional materials developments for energy reduction and storage in future", Technical Information Institute Co.,LTD., (472-478) 2012.

[3]Conductive adhesives and their reliability K.Suganuma, "Evaluation and improvements on reliability of adhesives", Information Organization, (130-137) 2012.

[4]Reliability improvements of conductive adhesives K.Suganuma, "Novel miniaturization technologies in new product development", Technical Information Institute Co.,LTD., (398-403) 2012.

Patents

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[2]Production method of transparent conductive films K.Suganuma. M.Nogi, J.Jiu, T.Sugahara, H.Uchida, K. Shinozaki, PCT/JP2013/056497

[3]Transparent conductive adhesives and their applications to electronic devices , 2012-021897

[4]Conductive pattern formation and conductive pattern materials curable by lighth irradiation or by microwave heating K. Suganuma, M. Nogi, T. Sugahara, H. Uchida, K. Shinozaki, 2012-061816

[5]Light irradiation system and light irradiation method K. Suganuma, M. Nogi, T. Sugahara, H. Uchida, K. Shinozaki, 2012-101052

[6]Transparent and conductive ink, and method of transparent and conductive pattern formation , 2012-101049

[7]Production method of transparent conductive substrate, and the transparent substrate, electro capacitance touch-panel , 2012-101053

[8]Metal layer formation materials and metal layer formation method K. Suganuma, M. Nogi, T. Sugahara, H. Uchida, K. Shinozaki, 2012-155426

[9]Anisotropic conductive films and anisotropic conductive materials , 2013-076840

Contributions to International Conferences and Journals

K.Suganuma International Conference on Electronics Packaging" and "IMAPS All Asia Conference (Organizing Committee)

K.Suganuma The 2012 International Conference on Flexible and Printed Electronics (Organizing Committee)

Publications in Domestic Meetings

the 13th Nanoindentation Seminar

1 paper

the 19th Annual Meeting of the Cellulose Society

3 papers

the 26th Spring Meeting of the Japan Institute of Electronics Packaging	3 papers
2012 General Assembly of the IEICE Societies	1 paper
the 61st Symposium on Macromolecules	1 paper
International Conference on Electronics Packaging 2013	1 paper
2012 JIEP Workshop	1 paper
the 63rd Annual Meeting of the Japan Wood Research Society	3 papers
2012 Spring Joint Symposium of Japan Society of Applied Physics	1 paper
the 27th Spring Meeting of the Japan Institute of Electronics Packaging	2 papers
the 93rd Spring Meeting of Japan Chemical Society	2 papers
Activity report and general meeting of progress of next generation battery innovation	1 paper
Cellulose Society; Hokkaido and Tohoku branch seminar	1 paper
Next generation nanotechnology forum	1 paper
Osaka smart energy seeds competition and matching	1 paper
Nanocellulose Symposium 2013	1 paper
The Society of Polymer Science	1 paper
9th Color materials IT seminar	1 paper
68th ISIR Academy	1 paper
NEDO project report	1 paper
51st Functional paper research	1 paper
ChemBio Hybrid Lecture	1 paper
Innovation Japan	1 paper
Innovation Initiative 1st seminar	1 paper
18th Pulp Technology Seminar	1 paper
Dynamic process with pulsed light for electronic materials and device fabrications	1 paper
Micro and Nano fabrication research seminar	1 paper

Academic Degrees

Doctor of Engineering S.Sakamoto	Joining by Ag Flake Paste Sintering	
Doctor of Engineering N.Komoda	Development and Evaluation of Printed Antenna made of Ag Nanowires	
Doctor of Engineering Y.Mizuguchi	Relations between Crystal Orientations and Sn Whisker Forming grown by Mechanical Stress	
Doctor of Engineering S.Park	High-power semiconductor die-attachment: Application of Zn with minor metal additions	
Doctor of Engineering Changjae Kim	Inkjet printing of highly conductive lines with metallic nanoparticle inks	
Doctor of Engineering Takehiro Tokuno	Fabrication and characterization of transparent electrodes using silver nanowires	

Grant-in-Aid for Scientific Research

K.Suganuma	Hetero-phase Interface Science of Power Semiconductors under Extreme Conditions	¥83,200,000
K.Suganuma	Low-temperature metal nanoink joining in air	¥1,820,000
T.Araki	Development of Stretchable Conductors with Resistance to Environmental	¥900,000

Entrusted Research

K. Suganuma	JAPERA	Development of radio frequency radiation for wiring printing TFT	¥20,000,000
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K. Suganuma		chip Development of conductive adhesive connection technology	¥525,000
K. Suganuma	JST	Development of mass synthesis Ag nano-sized particles with oxidation resistance low temperature sintering	¥6,880,000

Contribution to Research

K. Suganuma	Daisel Chemical Industries, Ltd	¥500,000
K. Suganuma	Bando Chemical Industries, Ltd	¥500,000
K. Suganuma	Printed Electronics Association	¥5,000,000
K. Suganuma	Toray Research Center	¥300,000
K. Suganuma	C. Uyemura & Co., Ltd	¥1,000,000
K. Suganuma	Showa Denko K.K.	¥1,000,000
K. Suganuma	Senju Metal Industrial Co.	¥1,000,000
K. Suganuma	Printed Electronics Association	¥900,000
K. Suganuma	Printed Electronics Association	¥900,000
K. Suganuma	Kishu Giken Kogyo Co., Ltd	¥3,000,000
T. Tokuno	Tanaka Holdings Co., Ltd.	¥200,000

Cooperative Research

K. Suganuma	Siemens Japan K.K.	¥3,210,000
K. Suganuma	NOF corporation	¥13,200,000
K. Suganuma	FUJITSU TEN LIMITED	¥2,070,000
K. Suganuma	Showa Denko K.K.	¥13,200,000
K. Suganuma	ITEC.co., Ltd.	¥6,303,000
K. Suganuma	Tamura Thermal Device corporation	¥3,960,000
K. Suganuma	DENSO Corporation	¥9,350,000
K. Suganuma	Solar Research Institute inc	¥23,100,000
K. Suganuma	C. Uyemura & Co., Ltd	¥420,000
K. Suganuma	NISSIN.co., Ltd	¥500,000
K. Suganuma	DIC Corporation	¥2,200,000
K. Suganuma	NEC Corporation	¥525,000
K. Suganuma	Toray Research Center	¥0,000

Department of Excited Solid-State Dynamics

Original Papers

[1] Utility and constraint on the use of pump-probe photoelectron spectroscopy for detecting time-resolved surface photovoltage, S. Tanaka: Journal of Electron Spectroscopy and Related Phenomena, 185 (2012) 152-158.

Review Papers

Development of femtosecond time-resolved electron microscope, J. Yang, N. Naruse, K. Kan, T. Kondoh, K. Tanimura, Y. Yoshida, Radiation Chemistry vol.94 (2012), 3-12.

Publications in Domestic Meetings

Japan Physical Society 7 papers

Grant-in-Aid for Scientific Research

K. Tanimura	Innovation of structural materials science: Femtosecond time-resolved atomic imaging	¥100,750,000
J. Kanasaki	Ultrafast dynamics of photogenerated valence holes in semiconductors by femtosecond time-resolved photoemission spectroscopy	¥1,430,000

Contribution to Research

K. Tanimura	UNISOKU Co., Ltd.,	¥1,000,000
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Department of Accelerator Science**Original Papers**

[1] Consistent analysis of the 2^+ excitation of the ^{12}C Hoyle state populated in proton and α -particle inelastic scattering, M. Freer, M. Itoh, T. Kawabara, H. Fujita, H. Akimune, Z. Buthelezi, J. Carter, R. W. Fearick, S. V. Förtsch, M. Fujiwara, U. Garg, N. Hashimoto, K. Kawase, S. Kishi, T. Murakami, K. Nakanishi, Y. Nakatsugawa, B. K. Nayak, R. Neveling, S. Okumura, S. M. Perez, P. Papka, H. Sakaguchi, Y. Sasamoto, F. D. Smit, J. A. Swartz, H. Takeda, S. Terashima, M. Uchida, I. Usman, Y. Yasuda, M. Yosoi, and J. Zenihiro: *Physical Review C*, 86 (3) (2012) 034320.

[2] Giant monopole resonance in even- A Cd isotopes, the asymmetry term in nuclear incompressibility, and the “softness” of Sn and Cd nuclei, D. Patel, U. Garg, M. Fujiwara, H. Akimune, G.P.A. Berg, M.N. Harakeh, M. Itoh, T. Kawabata, K. Kawase, B.K. Nayak, T. Ohta, H. Ouchi, J. Piekarewicz, M. Uchida, H.P. Yoshida, M. Yosoi: *Physics Letters B*, 718 (2) (2012) 447-450.

[3] Negative effect of crystallization on the mechanism of laser damage in a $\text{HfO}_2/\text{SiO}_2$ multilayer, R. Tateno, H. Okada, T. Otake, K. Kawase, J.K. Koga, A. Kosuge, K. Nagashima, A. Sugiyama, and K. Kashiwagi: *Journal of Applied Physics*, 112 (2012) 123103.

[4] Soft-X-Ray Harmonic Comb from Relativistic Electron Spikes, A. S. Pirozhkov, M. Kando, T. Zh. Esirkepov, P. Gallegos, H. Ahmed, E. N. Ragozin, A. Ya. Faenov, T. A. Pikuz, T. Kawachi, A. Sagisaka, J. K. Koga, M. Coury, J. Green, P. Foster, C. Brenner, B. Dromey, D. R. Symes, M. Mori, K. Kawase, T. Kameshima, Y. Fukuda, L. Chen, I. Daito, K. Ogura, Y. Hayashi, H. Kotaki, H. Kiriya, H. Okada, N. Nishimori, T. Imazono, K. Kondo, T. Kimura, T. Tajima, H. Daido, P. Rajeev, P. McKenna, M. Borghesi, D. Neely, Y. Kato, and S.V. Bulanov: *Physical Review Letters*, 108 (13) (2012) 135004.

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[6] Growth and surface structure of thin Co films on $\text{Au}(001)$ studied by scanning tunnelling microscopy, T. Kawagoe, T. Miyamachi and S. Suga: *Jpn. J. Appl. Phys.*, 51 (2012) 025602.

[7] Microscopic and spectroscopic studies of light-induced magnetization switching of GdFeCo by photoemission electron microscope (PEEM), T. Ohkuchi, H. Fujiwara, M. Kotsugi, A. Tsukamoto, K. Arai, S. Isogami, A. Sekiyama, J. Yamaguchi, K. Fukushima, T. Nakamura, K. Kodama, M. Tsunoda, R. Adam, C. M. Schneider, T. Kinoshita, and S. Suga: *Jpn. J. Appl. Phys.*, 51 (2012) 073001.

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[1] FEL Gain Measurement with a Novel Method (poster), Masaki Fujimoto, Ryukou Kato, Keigo Kawase, Akinori Irizawa, Fumiyoshi Kamitsukasa, Hiroki Ohsumi, Masaki Yaguchi, Goro Isoyama, Shigeru Kashiwagi, Shigeru Yamamoto: The 34th International Free-Electron Laser Conference (FEL2012), Nara, Japan, August 26-31, 2012.

[2] Terahertz Free Electron Laser at Osaka University (poster), Akinori Irizawa, Keigo Kawase, Ryukou Kato, Masaki Fujimoto, Fumiyoshi Kamitsukasa, Hiroki Ohsumi, Masaki Yaguchi, Shigemasa Suga, Goro Isoyama: International Symposium on Frontiers in THz Technology (FTT2012), Nara, Japan, November 26-30, 2012.

- [3]Multi-bunch Beam Generation by Photo-cathode RF Gun for KEK-STF (poster), M. Kuriki, H. Iijima, S. Hosoda, K. Kawase, G. Isoyama, R. Kato, K. Watanabe, H. Hayano, H. Sugiyama, J. Urakawa, A. Kuramoto, Y. Takahashi, S. Kashiwagi, K. Sakaue: The 3rd International Particle Accelerator Conference (IPAC2012), New Orleans, Louisiana, USA, May 20-25, 2012.
- [4]1 ms Multi-bunch Electron Beam Acceleration by a Normal Conducting RF Gun and Superconducting Accelerator (poster), M. Kuriki, H. Iijima, S. Hosoda, K. Kawase, G. Isoyama, R. Kato, K. Watanabe, H. Hayano, J. Urakawa, A. Kuramoto, S. Kashiwagi, K. Sakaue: The 26th International Linear Accelerator Conference (LINAC12), Tel Aviv, Israel, 9-14 September, 2012.
- [5]Establishment of Radiation Science for Recovery from Nuclear Power Plant Accident – Research Laboratory for Quantum Beam Science (plenary), Goro Isoyama: The 16th SANKEN International Symposium 2013 / The 11th SANKEN Nanotechnology Symposium 2013, Osaka University, Ibaraki, Osaka, Japan, Jan. 22-23, 2013.
- [6]Development of 27 MHz Micropulse Operation in the L-band Linac at ISIR, Osaka University (poster), K. Kawase, R. Kato, A. Irizawa, M. Fujimoto, F. Kamitsukasa, H. Ohsumi, M. Yaguchi, S. Suemine, G. Isoyama: The 16th SANKEN International Symposium 2013 / The 11th SANKEN Nanotechnology Symposium 2013, Osaka University, Ibaraki, Osaka, Japan, Jan. 22-23, 2013.
- [7]Novel Method for Evaluation of the FEL Gain (poster), Masaki Fujimoto, Ryukou Kato, Keigo Kawase, Akinori Irizawa, Fumiyoshi Kamitsukasa, Hiroki Ohsumi, Masaki Yaguchi, Goro Isoyama: The 16th SANKEN International Symposium 2013 / The 11th SANKEN Nanotechnology Symposium 2013, Osaka University, Ibaraki, Osaka, Japan, Jan. 22-23, 2013.
- [8]Characteristics evaluation of superconducting hot-electron bolometers for FEL experiments (poster), Hiroki Ohsumi: The 16th SANKEN International Symposium 2013 / The 11th SANKEN Nanotechnology Symposium 2013, Osaka University, Ibaraki, Osaka, Japan, Jan. 22-23, 2013.
- [9]Spectral Behavior of High Power Terahertz FEL (poster), R. Kato, H. Ohsumi, A. Irizawa, K. Kawase, M. Fujimoto, F. Kamitsukasa, M. Yaguchi, S. Suemine, G. Isoyama: The 16th SANKEN International Symposium 2013 / The 11th SANKEN Nanotechnology Symposium 2013, Osaka University, Ibaraki, Osaka, Japan, Jan. 22-23, 2013.
- [10]A high-power semiconductor switch for the L-band linac (poster), F. Kamitsukasa, A. Tokuchi, S. Suemine, K. Furukawa, K. Kubo, R. Kato, K. Kawase, A. Irizawa, M. Fujimoto, H. Ohsumi, M. Yaguchi, G. Isoyama: The 16th SANKEN International Symposium 2013 / The 11th SANKEN Nanotechnology Symposium 2013, Osaka University, Ibaraki, Osaka, Japan, Jan. 22-23, 2013.
- [11]Terahertz Spectroscopy and Imaging by means of ISIR THz-FEL at Osaka University (poster), A. Irizawa, R. Kato, K. Kawase, M. Fujimoto, F. Kamitsukasa, H. Ohsumi, M. Yaguchi, S. Suemine, S. Suga, G. Isoyama: The 16th SANKEN International Symposium 2013 / The 11th SANKEN Nanotechnology Symposium 2013, Osaka University, Ibaraki, Osaka, Japan, Jan. 22-23, 2013.
- [12]Diversity of recoil effects on photoelectron emission from valence and core level states in V compounds (poster), S. Suga, A. Sekiyama, H. Fujiwara, S. Imada, T. Miyamachi, A. Yamasaki, Y. Nakatsu, S. Itoda, S. Komori, S. Niitaka, H. Takagi, K. Yoshimura, M. Yabashi, K. Tamasaku, A. Higashiya, T. Ishikawa, P. Baltzer, M. Shang and T. Fujikawa: The 12th International Conference on Electron Spectroscopy and Structure: ICES-12, Saint-Malo, France, September 16-21, 2012.
- [13]ELEPES of YbB12 and SmB6 Kondo semiconductor families by microwave excited Xe and Kr electron cyclotron resonance lamp (poster), S. Suga, J. Yamaguchi, A. Sekiyama, G. Funabashi, H. Fujiwara, M. Y. Kimura, H. Sugiyama, Y. Tomida, S. Komori, T. Ikeda, T. Mori, T. Yamaguchi, Y. Nakatani, T. Balashov, W. Wulfhekel, S. Yeo, S.-I. Lee, T. Takabatake and F. Iga: The 12th

International Conference on Electron Spectroscopy and Structure: ICESS-12, Saint-Malo, France, September 16-21, 2012.

[14]Metal-Insulator Transition of LiRh₂O₄ Observed By Extremely Low Energy Photoemission and HAXPES (poster), H. Fujiwara, Y. Wakabayashi, Y. Nakatsu, S. Ikeda, T. Kiss, Y. Okamoto, S. Niitaka, H. Takagi, A. Higashiya, M. Yabashi, K. Tamasaku, T. Ishikawa, S. Suga and A. Sekiyama: The 12th International Conference on Electron Spectroscopy and Structure: ICESS-12, Saint-Malo, France, September 16-21, 2012.

[15]Evidence of constant U across Metal-Insulator Transition, and Fermi Surfaces of V₂O₃ Revealed By HAXPES and Micro Soft-X-ray ARPES (poster), H. Fujiwara, Y. Wakabayashi, T. Kiss, K. Fukushima, S. Kitayama, S.-K. Mo, J. Denlinger, P. Metcalf, J. W. Allen, S. Suga, T. Muro, and A. Sekiyama: The 12th International Conference on Electron Spectroscopy and Structure: ICESS-12, Saint-Malo, France, September 16-21, 2012.

[16]Bulk-Sensitive Photoemission Study on Sr₂IrO₄ (poster), A. Yamasaki, T. Aso, Y. Nishitani, T. Mori, H. Fujiwara, T. Kiss, A. Sekiyama, K. Terashima, S. Imada, A. Higashiya, A. Irizawa, T. Muro, M. Yabashi, K. Tamasaku, H. Yoshida, M. Isobe, T. Ishikawa and S. Suga: The 12th International Conference on Electron Spectroscopy and Structure: ICESS-12, Saint-Malo, France, September 16-21, 2012.

[17]Kondo resonance in bulk and 2D subsurface and surface accompanying genuine bulk valence transition in YbInCu₄ revealed by h ν dependence of photoemission in 0.7–8 keV (invited), Shigemasa Suga, Akira Sekiyama, Shin Imada, Akinori Irizawa, Kazuyoshi, Yoshimura, A. Higashiya, M. Yabashi, K. Tamasaku and T. Ishikawa: International Workshop on "Correlated Electrons at Surfaces and Interfaces", 1-4 October 2012, Würzburg/Germany.

Patents

[1]Imaging system and imaging method N. Oda, T. Sudou, S. Ohkubo, G. Isoyama, R. Kato, A. Irizawa, K. Kawase, 2013-030165

Contributions to International Conferences and Journals

R. KATO The 34th International Free-Electron Laser Conference (FEL2012), Nara, Japan, August 26-31, 2012 (Local Organizing Committee)

Publications in Domestic Meetings

The Particle Accelerator Society of Japan	7 papers
Topical Meeting for FEL & High Power Radiation	3 papers
The Japan Society of Applied Physics	1 paper
The Japan Society of Infrared Science and Technology	1 paper

Academic Degrees

Master Degree for Science	Development of a high-power semiconductor switch for a klystron modulator aiming for highly stable operation of free-electron laser
F. Kamitsukasa	
Master Degree for Science	Development of a high-power semiconductor switch for a klystron modulator aiming for highly stable operation of free-electron laser
F. Kamitsukasa	

Grant-in-Aid for Scientific Research

G. Isoyama	Development of a high-intensity and high-efficiency coherent light source using a novel method	¥2,860,000
G. Isoyama	Development of a new operating range of free-electron laser	¥12,870,000
K. Kaase	Development of laser oscillator with two focal points for intense Compton backscattered gamma-ray source	¥780,000
A. Irizawa	Upgrading of spectromicroscopy under multi-extreme conditions and the study of strongly-correlated electron systems	¥1,040,000
S. Suga	Spectroscopy of strongly correlated electron systems in the photon energy range from 10 meV up to 10 keV	¥1,300,000

Entrusted Research

G. Isoyama	High Energy Accelerator Research Organization	Technology development and training of junior researchers for renewal of the L-band electron linac at ISIR, Osaka University	¥3,000,000
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Cooperative Research

G. Isoyama	NEC Corporation		¥500,000
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Department of Beam Materials Science**Original Papers**

[1] Acid Generation Mechanism for Extreme Ultraviolet Resists Containing Pinanediol Monosulfonate Acid Amplifiers: A Pulse Radiolysis Study, K. Enomoto, K. Arimitsu, A. Yoshizawa, R. Joshi, H. Yamamoto, A. Oshima, T. Kozawa, and S. Tagawa: Jpn. J. Appl. Phys., 51 (2012) 046502.

[2] Lower Limit of Line Edge Roughness in High-Dose Exposure of Chemically Amplified Extreme Ultraviolet Resists, T. Kozawa: Jpn. J. Appl. Phys., 51 (2012) 06FC01.

[3] Modeling and Simulation of Acid Diffusion in Chemically Amplified Resists with Polymer-Bound Acid Generator, T. Kozawa, J. J. Santillan, and T. Itani: Appl. Phys. Express, 5 (2012) 074301.

[4] Eco-friendly electron beam lithography using water-developable resist material derived from biomass, S. Takei, A. Oshima, T. Wakabayashi, T. Kozawa, and S. Tagawa: Appl. Phys. Lett., 101 (2012) 033106.

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[9] Effect of Ultrahigh-Density Ionization of Resist Films on Sensitivity Using Extreme-Ultraviolet Free-Electron Laser, K. Okamoto, T. Kozawa, K. Oikawa, T. Hatsui, M. Nagasono, T. Kameshima, T. Togashi, K. Tono, M. Yabashi, H. Kimura, Y. Senba, H. Ohashi, R. Fujiyoshi, and T. Sumiyoshi: Appl. Phys. Express, 5 (2012) 096701.

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- [21]Mechanism of radiation-induced reactions in aqueous solution of coumarin-3-carboxylic acid: Effects of concentration, gas and additive on fluorescent product yield, S. Yamashita, G. Baldacchino, T. Maeyama, M. Taguchi, Y. Muroya, M. Lin, A. Kimura, T. Murakami, and Yosuke Katsumura: *Free Radic. Res.*, 46 (2012) 861-871.
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International Conferences

- [1]Ellipsometrical detection of optical trapped nanoparticles by periodically localized light (oral), N. Taki, Y. Mizutani, T. Iwata, T. Kojima, H. Yamamoto, T. Kozawa: SPIE Photonics Europe conference 8430 Optical Micro- and Nanometrology.

- [2]Analysis of Stochastic Effect in Line-and-Space Patterns Fabricated by Extreme Ultraviolet Lithography (oral), T. Kozawa, J. J. Santillan, and T. Itani: 2012 International Symposium on Extreme Ultraviolet Lithography (Brussels,Belgium, 30 Sep.-4 Oct. 2012).
- [3]Relationship between Stochastic Effect and Resist Pattern Defect in Extreme Ultraviolet Lithography (oral), T. Kozawa, J. J. Santillan, and T. Itani: SPIE Advanced Lithography (San Jose, California, USA, 24-28 Feb. 2013).
- [4]Modeling and Simulation of Acid Diffusion in Chemically Amplified Resists with Polymer-Bound Acid Generator (oral), T. Kozawa, J. J. Santillan, and T. Itani: EIDEC Symposium 2012 (Shinagawa, Tokyo, Japan, 11 May 2012).
- [5]Status and Challenge of Chemically Amplified Resists for Extreme Ultraviolet Lithography (oral), T. Kozawa: 2012 International Workshop on EUVL (Maui, Hawaii, USA, 4-8 June, 2012).
- [6]Resist properties required for 6.67 nm extreme ultraviolet lithography (oral), T. Kozawa and A. Erdmann: 10th Fraunhofer IISB Lithography Simulation Workshop (Hersbruck, Germany, 20-22 Sep. 2012).
- [7]Dissolution Kinetics in Polymer-Bound and Polymer-Blended Photo-Acid Generators (oral), H. Yamamoto, T. Kozawa, and S. Tagawa: 29th International Conference of Photopolymer Science and Technology.
- [8]Location Control of Nanoparticles Using Combination of Top-down and Bottom-up Nano-fabrication (oral), H. Yamamoto, A. Ohnuma, T. Kozawa, and B. Ohtani: 29th International Conference of Photopolymer Science and Technology.
- [9]Formation of Nano Reaction Field Using Combination of Top-down and Bottom-up Nanofabrication (poster), Hiroki Yamamoto, Akira Ohnuma, Bunsho Ohtani, Takahiro Kozawa: 38th International Micro & Nano Engineering Conference (MNE 2012).
- [10]Study on Dissolution Behavior of Polymer-Bound and Polymer-Blended Photo-Acid Generators (poster), H. Yamamoto, T. Kozawa, and S. Tagawa: 25th International Microprocesses and Nanotechnology Conference.
- [11]Study on Resist Processes in Chemically Amplified EUV Resists (oral), H. Yamamoto, T. Kozawa, and S. Tagawa: 2nd.International EUV Resist Symposium.
- [12]Study on Dissolution Behavior of Polymer-bound and Polymer-blended Photo-acid Generator (PAG) Resists (oral), H. Yamamoto, T. Kozawa, and S. Tagawa: 2013 SPIE conference [8682].
- [13]Reactions of Iron-Sulfur Cluster in the Oxidative Stress Sensor SoxR with Superoxide and Nitric Oxide as Revealed by Pulse Radiolysis (poster), M. Fujikawa, K. Kobayashi, T. Kozawa: Gordon Research Conference : Metals in Biology.
- [14]Conformational Changes of SoxR upon Redox Changes of the [2Fe-2S] Cluster (poster), K. Kobayashi, M. Fujikawa, T. Kozawa, M. Mizuno, Y. Mizutani: Gordon Research Conference : Metals in Biology.

Contributions to International Conferences and Journals

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|-----------|--|
| T. Kozawa | 2012 International Symposium on Extreme Ultraviolet Lithography (Steering Committee) |
| T. Kozawa | 2012 International Workshop on EUVL (Technical Steering Committee) |
| T. Kozawa | 25th International Microprocesses and Nanotechnology Conference (Program Vice) |

	Chair, Steering Committee)	
H. Yamamoto	25th International Microprocesses and Nanotechnology Conference (Program Committee)	
Publications in Domestic Meetings		
Chemical society of Japan		1 paper
Japan Society of Applied Physics		2 papers
Japan Society of Radiation Chemistry		6 papers
Society of Polymer Science, Japan		2 papers
Japanese Biochemical Society		1 paper
Grant-in-Aid for Scientific Research		
T.Kozawa	Study on nanometer scale reactions and reaction fields using quantum beams	¥6,370,000
K.Kobayashi	Structural change of DNA bound to transcription factor response to environmental change	¥1,560,000
H.Yamamoto	Creation and Control of Metal Nano-structure Using Combination of Top-down and Bottom-up Nanofabrication	¥1,430,000
Cooperative Research		
T.Kozawa	Nissan Chemical Industries,Ltd	¥1,000,000
T.Kozawa	Tokyo Ohka Kogyo.Co.,Ltd	¥1,000,000
Y.Muroya	Central Research Institute of Electric Power Industry	¥1,000,000

Department of Molecular Excitation Chemistry

Original Papers

- [1]Hole Transfer in LNA and 5-Me-2'-deoxyzebularine-Modified DNA, K. Kawai, M. Hayashi, and T. Majima: J. Am. Chem. Soc., 134 (22) (2012) 9406-9409.
- [2]Folding Dynamics of Cytochrome c Using Pulse Radiolysis, J. Choi, M. Fujitsuka, S. Tojo, and T. Majima: J. Am. Chem. Soc., 134 (32) (2012) 13430-13435.
- [3]Superstructure of TiO₂ Crystalline Nanoparticles Yields Effective Conduction Pathways for Photogenerated Charges, Z. Bian, T. Tachikawa, and T. Majima: J. Phys. Chem. Lett., 3 (11) (2012) 1422-1427.
- [4]Superior Electron-Transport and Photocatalytic Ability of Metal Nanoparticle-Loaded TiO₂ Superstructures, Z. Bian, T. Tachikawa, W. Kim, W. Choi, and T. Majima: J. Phys. Chem. C, 116 (48) (2012) 25444-25453.
- [5]Intramolecular Charge Resonance in Dimer Radical Anions of Di-, Tri-, Tetra-, and Pentaphenylalkanes, S. Tojo, M. Fujitsuka, and T. Majima: J. Org. Chem., 77 (11) (2012) 4932-4938.
- [6]Selective Oxidative Degradation of Organic Pollutants by Singlet Oxygen-Mediated Photosensitization: Tin Porphyrin versus C60 Aminofullerene Systems, H. Kim, W. Kim, Y.Mackeyev, G.-S. Lee, H.-J. Kim, T. Tachikawa, S. Hong, S. Lee, J. Kim, L. J. Wilson, T. Majima, P. J. J. Alvarez, W. Choi, and J. Lee: Environ. Sci. Technol., 46 (17) (2012) 9606-9613.
- [7]Excess Electron Transfer Dynamics in DNA Hairpins Conjugated with N,N-Dimethylaminopyrene as a Photosensitizing Electron Donor, M. J. Park, M. Fujitsuka, H. Nishitera, K. Kawai, and T. Majima: Chem. Commun., 48 (89) (2012) 11008-11010.
- [8]Size-dependent fluorescence properties of [n]cycloparaphenylenes (n = 8-13), hoop-shaped pi-conjugated molecules, M. Fujitsuka, D. W. Cho, T. Iwamoto, S. Yamago, and T. Majima: Phys. Chem. Chem. Phys., 14 (42) (2012) 14585-14588.
- [9]Dimerization Reaction of Regioisomeric Bis(phenylethynyl)benzene Radical Anions during Pulse

Radiolysis, M. Fujitsuka, S. Samori, S. Tojo, M. M. Haley, and T. Majima: *ChemPlusChem*, 77 (8) (2012) 682-687.

[10] Super-Resolution Mapping of Reactive Sites on Titania-Based Nanoparticles with Water-Soluble Fluorogenic Probes, T. Tachikawa, T. Yonezawa, and T. Majima: *ACS Nano*, 7 (1) (2013) 263-275.

[11] Role of Interparticle Charge Transfers in Agglomerated Photocatalyst Nanoparticles: Demonstration in Dye-Sensitized TiO₂ System, Y. Park, W. Kim, D. Monllor-Satoca, T. Tachikawa, T. Majima, W. Choi: *J. Phys. Chem. Lett.*, 4 (1) (2013) 189-194.

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[13] Hole-Trapping of G-Quartets in a G-Quadruplex, J. Choi, J. Park, A. Tanaka, M. J. Park, Y. J. Jang, M. Fujitsuka, S. K. Kim, and T. Majima: *Angew. Chem. Int. Ed.*, 52 (4) (2013) 1134-1138.

[14] Photochemical Dissociation of Pyrene Dimer Radical Cation, S. Samori, M. Fujitsuka, and T. Majima: *Res. Chem. Intermed.*, 39 (1) (2013) 449-461.

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[18] γ -Ray Radiolysis and Theoretical Study on Radical Ions of Star-Shaped Oligofluorenes having a Truxene or Isotruxene as a Core, M. Fujitsuka, S. Tojo, J.-S. Yang, and T. Majima: *Chem. Phys.*, (2013) .

International Conferences

[1] Charge Transfer in DNA (invited), T. Majima: 24th IUPAC Photochemistry, Coimbra, Portugal, July 15-20, 2012.

[2] Hole and Excess Electron Transfer in DNA (invited), T. Majima: Gordon Research Conference on "Radiation Chemistry", New Hampshire, USA, July 30-Aug. 3, 2012.

[3] Charge Transfer Dynamics in DNA at The Single Molecule Level (oral), *K. Kawai, A. Maruyama, T. Majima: XX International Roundtable on Nucleosides, Nucleotides and Nucleic Acids, Canada, Aug. 6-8, 2012.

[4] Single Molecule Imaging of TiO₂ Photocatalytic Reactions (invited), T. Majima: 18th International Workshop on "Single Molecule Spectroscopy and Ultra Sensitive Analysis in the Life Sciences", Berlin, Germany, Sep. 5-7, 2012.

[5] Single-Molecule, Single-Particle Approaches for Exploring the Structure and Kinetics of Nanocatalysts (invited), T. Majima: 2012 RCAS-ANNA Symposium on "Recent development in nanomaterials-structures, dynamics and applications" , Taipei, Taiwan, Oct. 4-5, 2012.

[6] Single-Molecule, Single-Particle Approaches for Exploring the Structure and Kinetics of Nanocatalysts

(invited), T. Majima: Japan-India Bilateral Seminar on Supramolecular Nanomaterials for Energy Innovaiton, Kagawa, Japan, Oct.15-16, 2012.

[7]Hole Transfer through DNA: Mechanism and Single-Molecule Level Analysis (oral), *K. Kawai, A. Maruyama, T. Majima: Japan-India Bilateral Seminar on Supramolecular Nanomaterials for Energy Innovaiton, Kagawa, Japan, Oct.15-16, 2012.

[8]Folding/Unfolding Dynamics of Cytochrome c. (oral), *J. Choi, T. Majima: KCS 110th National Meeting, Busan, Korea, Oct. 17-19, 2012.

[9]Electron Transfer-triggered Folding Dynamics of Cytochrome c (poster), *J. Choi, M. Fujitsuka, S. Tojo, and T. Majima: Asian Photochemistry Conference, Osaka, Japan, Nov. 12-14, 2012.

[10]Hole-transfer dynamics determined by DNA flexibility (oral), *K. Kawai, M. Hayashi, and T. Majima: The 39th International Symposium on Nucleic Acids Chemistry (ISNAC 2012), Aichi, Japan, Nov. 16, 2012.

[11]Development of TiO₂ photocatalysts (invited), T. Majima: Forum on Advanced Materials, Asan, Korea, Nov. 27, 2012.

[12]Single molecule level DNA analysis based on charge transfer measurement (oral), *K. Kawai, A. Maruyama, T. Majima: The First International Symposium on Biofunctional Chemistry (ISBC2012), Tokyo, Japan, Nov. 28-29, 2012.

[13]Radiation chemical studies toward sustainable society (oral), *M. Fujitsuka and T. Majima: SANKEN International Symposium, Osaka, Japan, Jan. 22-23, 2012.

[14]Gamma-Ray Radiolysis and Theoretical Study on Radical Ions of Star-Shaped Oligofluorenes having a Truxene or Isotruxene as a Core (poster), *M. Fujitsuka, S. Tojo, J-S. Yang, and T. Majima: SANKEN International Symposium, Osaka, Japan, Jan. 22-23, 2012.

[15]Folding dynamics of cytochrome c investigated by pulse radiolysis (poster), *J. Choi, M. Fujitsuka, S. Tojo, T. Majima: SANKEN International Symposium, Osaka, Japan, Jan. 22-23, 2012.

[16]Radiation Chemistry of Polyphenylalkane (poster), *S. Tojo, M. Fujitaska, T. Majima: SANKEN International Symposium, Osaka, Japan, Jan. 22-23, 2012.

[17]Single-molecule fluorescence imaging of TiO₂ photocatalytic reactions (invited), *T. Tachikawa: Asia Symposium on Photochemistry, Japan Chemical Society.

[18]Dynamics of non-B DNA: G-quadruple, i-motif and A-motif (invited), *J. Choi: Asia Symposium on Photochemistry, Japan Chemical Society.

Review Papers

Preface to the Colloidal Nanoplasmonics Special Issue, L. M. Liz-Marzan and T. Majima, *Langmuir*, American Chemical Society, 28[24] (2012), 8825.

Single-Molecule, Single-Particle Approaches for Exploring the Structure and Kinetics of Nanocatalysts, T. Tachikawa and T. Majima, *Langmuir*, American Chemical Society, 28[24] (2012), 8933-8943.

Hole and Excess Electron Transfer in DNA, M. Fujitsuka and T. Majima, *Phys. Chem. Chem. Phys.*, Royal Society of Chemistry, 14[32] (2012), 11234-11244.

Excess Electron Transfer Dynamics in DNA, M. Fujitsuka and T. Majima, *Photochemistry*, The Japanese

Photochemistry Association, 43[2] (2012), 91-93.

Determination of Excess Electron Transfer Rate in DNA, M. Fujitsuka and T. Majima, Manufacturing & Technology, Manufacturing & Technology Promotion Association, 64[3] (2012), 104-106.

Reversible Conformational Switching of i-motif DNA Studied by Fluorescence Spectroscopy, J. Choi and T. Majima, Photochem. Photobiol., John Wiley & Sons, Inc., 89[3] (2013), 513-522.

Construction of DNA molecular wire based on the refinement of HOMO energy gap and the flexibility of DNA, K. Kawai, Emergence of highly elaborated π -space and its function., CMC Publishing Co., Ltd., (2013), 213-216.

Books

[1] Photoinduced Electron Transfer Processes in Biological and Artificial Supramolecules (Philip A. Gale and Jonathan W. Stead) M. Fujitsuka and T. Majima, "Supramolecular Chemistry from Molecules to Nanomaterials, 'Molecular Devices: Electron Transfer'", John Wiley & Sons, (2365-2396) 2012.

[2] Charge Transfer in DNA (Chrysostomos Chatgililoglu and Armido Studer) M. Fujitsuka and T. Majima, "Handbook of Radicals in Chemistry, Biology & Materials", John Wiley & Sons, 3 (1397-1424) 2012.

Patents

[1] Synthetic method of porous titanium dioxide mesocrystals T. Majima, T. Tachikawa, Z. Bian, JP2012-018148

[2] Synthetic method of porous titanium dioxide mesocrystals T. Majima, T. Tachikawa, Z. Bian, PCT/JP2013/051972

[3] TiO₂ mesocrystals doped by noble metal nanoparticles T. Majima, T. Tachikawa, Z. Bian, JP2012-110679

[4] Diamond composite particles M. Morita, S. Seino, T. Tachikawa, T. Majima, Y. Yoshioka, JP2012-246538

[5] Metal oxides mesocrystals T. Majima, T. Tachikawa, Z. Bian, JP2013-017258

Contributions to International Conferences and Journals

T. Majima	IUPAC Photochemistry 2012 (Organizing Committee)
T. Majima	Asian Photochemistry Conference (Chair person)
M. Fujitsuka	Asian Photochemistry Conference (Organizing Committee, Secretary General)
T. Majima	The 16th SANKEN International Symposium 2013 "Sustainable Society - After the Nuclear Power Plant Accident" (Chair person)
T. Majima	Bilateral Workshop on Radiation Chemistry (Chair person)
T. Majima	Asia Symposium on Photochemistry, Japan Chemical Society (Chair person)
T. Majima	Langmuir, American Chemical Society (Senior Editor)
T. Majima	ACS Applied Materials & Interfaces, American Chemical Society (Editorial Advisory Board)
T. Majima	ChemPlusChem, union of 16 European Chemical Societies, Wiley VHC (Editorial Board)
T. Majima	Rapid Communication in Photoscience, Korean Society of Photoscience (International Editorial Board)
T. Majima	Photochemistry and Photobiology, Wiley VHC (Associate Editor)

Publications in Domestic Meetings

The 34th Japan Photomedicine and Photobiology Meeting	1 paper
The 17th Japan Photobiology Meeting	3 papers
Japan Photochemistry Meeting 2012	5 papers
The 55th Japan Radiation Chemistry Meeting	1 paper
The 93th Japan Chemical Society Meeting	6 papers
The 6th symposium on Biofunctional Chemistry	1 paper
The 31st Japan Solid and Surface Photochemistry Meeting	1 paper

Academic Degrees

Doctor Degree for Science	Studies on Excess Electron Transfer in DNA Using Femtosecond Laser Flash Photolysis	
M. J. Park		
Master Degree for Science	Electron Injection and Charge Recombination in DNA Modified by Terthiophene	
M. Ishikawa		

Grant-in-Aid for Scientific Research

T.Majima	Higher excited-state chemistry and its application to environmental problems and nano- and biotechnology	¥6,110,000
T.Majima	TiO ₂ photocatalytic reaction mechanism with time- and space-resolved spectroscopic measurements towards the development of high efficient TiO ₂ photocatalysts	¥800,000
K.Kawai	Construction of DNA molecule wire with changing the helical torsion and HOMO energy gap	¥2,340,000
K.Kawai	Observation of molecular beacon at single molecule level	¥1,560,000
K.Kawai	Development of single-molecule level analysis techniques for RNA editing and chemical modifications	¥9,620,000
T.Tachikawa	Nanoimaging of biocatalytic activity using redox-responsive fluorescence probe	¥1,820,000
J. Choi	Investigation of the conformational dynamics of non-B DNA in vivo	¥2,730,000

Entrusted Research

T. Majima	Japan Science and Technology Agency (JST), CREST	Study on unstable reactive species of CPP	¥15,132,000
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Contribution to Research

T.Tachikawa	The Murata Foundation	¥1,500,000
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Department of Synthetic Organic Chemistry

Original Papers

[1] Enantioselective Synthesis of α -Alkylidene- γ -Butyrolactones: Intramolecular Rauht-Currier Reaction Promoted by Acid/Base Organocatalysts, S. Takizawa, T. M.-N. Nguyen, A. Grossmann, D. Enders, H. Sasai: *Angew. Chem. Int. Ed.*, 51 (2012) 5423-5426.

[2] Design and synthesis of spiro bis(1,2,3-triazolium) salts as chiral ionic liquids, Y. Yoshida, S. Takizawa, H. Sasai: *Tetrahedron: Asymmetry*, 23 (2012) 843-851.

[3] Facile synthesis of α -methylidene- γ -butyrolactones: Intramolecular Rauht-Currier reaction promoted by chiral acid-base organocatalysts, S. Takizawa, T. M.-N. Nguyen, A. Grossmann, M. Suzuki, D. Enders, H. Sasai: *Tetrahedron*, 69 (2013) 1202-1209.

[4] Asymmetric Auto-Tandem Catalysis with a Planar-Chiral Ruthenium Complex: Sequential Allylic Amidation and Atom-Transfer Radical Cyclization, N. Kanbayashi, K. Takenaka, T. Okamura, K. Onitsuka: *Angew. Chem. Int. Ed.*, 52 (2013) 4897-4901.

International Conferences

- [1]Development of Chiral Spiro Bis(isoxazoline) Ligand “SPRIX” (invited), H. Sasai: BIT’s 3rd Annual World Congress of Catalytic Asymmetric Synthesis-2012, Beijing, China, May 12-14, 2012.
- [2]Exploring Novel Enantioselective Domino Reactions Promoted by Bifunctional Organocatalysts (invited), H. Sasai: 3rd International Symposium on Organic Synthesis and Drug Development (ISOSDD2012), Changzhou, China, May 20-23, 2012.
- [3]Enantioselective Intramolecular Rauhut-Currier Reaction (poster), T. M.-N. Nguyen, A. Grossmann, S. Takizawa, D. Enders, H. Sasai: 3rd International Symposium on Organic Synthesis and Drug Development (ISOSDD2012), Changzhou, China, May 20-23, 2012.
- [4]Development of BINOL-Derived Organocatalysts with Dual Activation Mechanism and Their Applications to Enantioselective Friedel-Crafts Type Reaction (poster), Y. Nagata, S. Takizawa, H. Sasai: 3rd International Symposium on Organic Synthesis and Drug Development (ISOSDD2012), Changzhou, China, May 20-23, 2012.
- [5]Development of Enantioselective Carbon-Carbon Bond Forming Reactions Using Multi-functional Organocatalyst (invited), H. Sasai: International Conference on Functional Organic Materials and Related Devices, Hsinchu, Taiwan, June 16-17, 2012.
- [6]Enantioselective Coupling of Phenanthrols Using Vanadium Catalysts (poster), J. Koderä, S. Takizawa, H. Sasai: International Conference on Functional Organic Materials and Related Devices, Hsinchu, Taiwan, June 16-17, 2012.
- [7]Enantioselective Carboxylation via a π -Allyl Pd Intermediate Promoted by Pd-SPRIX Catalyst (poster), K. Takenaka, M. Akita, S. C. Mohanta, S. Takizawa, H. Sasai: International Conference on Functional Organic Materials and Related Devices, Hsinchu, Taiwan, June 16-17, 2012.
- [8]Several Catalytic Enantioselective Reactions Promoted by Vanadium Complexes (oral), S. Takizawa, H. Sasai: Osaka-Bielefeld Symposium on Chiral Synthetic Chemistry, Bielefeld, Germany, July 11, 2012.
- [9]Enantioselective C-C Bond-forming Reactions Catalyzed by Vanadium(V) Complexes (invited), S. Takizawa, H. Sasai, J. Koderä: 8th International Vanadium Symposium Chemistry, Biological Chemistry, & Toxicology (V8), Washington DC, USA, August 15-18, 2012.
- [10]Development of enantioselective carbon-carbon bond forming reactions promoted by bifunctional organocatalysts (oral), H. Sasai, S. Takizawa: 244th ACS National Meeting & Exposition, Philadelphia, PA, United States, August 19-23, 2012.
- [11]Enantioselective Synthesis of α -Alkylidene- γ -Butyrolactones: Intramolecular Rauhut-Currier Reaction Promoted by Acid/Base Organocatalysts (poster), T. M.-N. Nguyen, A. Grossmann, S. Takizawa, D. Enders, H. Sasai: The 6th Takeda Science Foundation Symposium on PharmaSciences, Osaka, Japan, September 13-14, 2012.
- [12]Recent Application of Spiro Bis(isoxazoline) Ligand (SPRIX) for Asymmetric Catalysis (poster), S. C. Mohanta, T. Tsujihara, M. Akita, K. Takenaka, S. Takizawa, H. Sasai: The 6th Takeda Science Foundation Symposium on PharmaSciences, Osaka, Japan, September 13-14, 2012.
- [13]Umpolung Reactivity of Pd Enolate: Cyclative Diacetoxylation of Alkynyl Cyclohexadienones Catalyzed by Pd-SPRIX (invited), K. Takenaka, S. C. Mohanta, S. Takizawa, H. Sasai: The 6th Kansai-CMDS Meeting on OMCOS, 2012, Gangwon-do, Korea, September 21-23, 2012.
- [14]Dual Activation In Asymmetric Organocatalyses (invited), H. Sasai: 17th Malaysian Chemical Congress (17MCC) 2012, Kuala Lumpur, Malaysia, October 15-17, 2012.

- [15]Development of Chiral Spiro Bis(isoxazoline) Ligand “SPRIX” (invited), H. Sasai: Cambodian Malaysian Chemical Conference (CMCC) 2012, Siem Reap, Cambodia, October 19-21, 2012.
- [16]Enantioselective C-C Bond Forming Reactions Using Multi-Functional Organocatalysts (poster), S. Takizawa, K. Matsui, N. Inoue, T. M.-N. Nguyen, H. Sasai: The 12th International Kyoto Conference on New Aspects of Organic Chemistry, Kyoto, Japan, November 12-16, 2012.
- [17]Recent Progress of Enantioselective Catalysis Promoted by Pd-SPRIX (poster), K. Takenaka, M. Akita, S. C. Mohanta, S. Takizawa, H. Sasai: The 12th International Kyoto Conference on New Aspects of Organic Chemistry, Kyoto, Japan, November 12-16, 2012.
- [18]Organocatalyzed Enantioselective Aza-MBH Reaction of Ketimines (poster), S. Takizawa, E. Rémond, F. Arteaga-Arteaga, J. Bayardon, Y. Yoshida, S. Jugé, H. Sasai: The 12th International Kyoto Conference on New Aspects of Organic Chemistry, Kyoto, Japan, November 12-16, 2012.
- [19]Umpolung Reactivity of Pd Enolate (oral), K. Takenaka, S. C. Mohanta, S. Takizawa, H. Sasai: Aachen-Osaka Symposium “Biological and Chemical Methods for Selective Catalysis”, Aachen, Germany, December 3-5, 2012.
- [20]Enantioselective Organocatalyzed Aza-Morita-Baylis-Hillman (Aza-MBH) Reaction of Ketimines (oral), S. Takizawa, F. Arteaga-Arteaga, Y. Yoshida, S. Vellaisamy, E. Rémond, J. Bayardon, S. Jugé, H. Sasai: Aachen-Osaka Symposium “Biological and Chemical Methods for Selective Catalysis”, Aachen, Germany, December 3-5, 2012.
- [21]Design and Synthesis of Organocatalysts Bearing Spiro Backbone (oral), L. Fan, S. Takizawa, H. Sasai: Aachen-Osaka Symposium “Biological and Chemical Methods for Selective Catalysis”, Aachen, Germany, December 3-5, 2012.
- [22]Study on Asymmetric Environment of SPRIX Ligand (oral), X. Lin, K. Takenaka, S. Takizawa, H. Sasai: Aachen-Osaka Symposium “Biological and Chemical Methods for Selective Catalysis”, Aachen, Germany, December 3-5, 2012.
- [23]Enantioselective Organocatalyzed Aza-Morita-Baylis-Hillman (Aza-MBH) Reaction of Ketimines (invited), S. Takizawa, F. Arteaga-Arteaga, Y. Yoshida, S. Vellaisamy, E. Rémond, J. Bayardon, S. Jugé, H. Sasai: First Japan-USA Organocatalytic Symposium, Hawaii, USA, December 15-18, 2012.
- [24]Recent Progress of Enantioselective Catalysis Promoted by Pd-SPRIX (poster), S. C. Mohanta, Y. D.; Dhage, K. Takenaka, S. Takizawa, H. Sasai: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium, Osaka, Japan, January 22-23, 2013.
- [25]Enantioselective Cyclization of 4-Alkenoic Acids via an Oxidative Allylic C-H Esterification (poster), M. Akita, Y. Tanigaki, K. Takenaka, S. Takizawa, H. Sasai: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium, Osaka, Japan, January 22-23, 2013.
- [26]Study on Asymmetric Environment of SPRIX Ligand (poster), X. Lin, K. Takenaka, S. Takizawa, H. Sasai: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium, Osaka, Japan, January 22-23, 2013.
- [27]Pd-catalyzed Direct C-H Arylation of 5-Position of Isoxazole Ring (poster), M. Shigenobu, K. Takenaka, H. Sasai: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium, Osaka, Japan, January 22-23, 2013.
- [28]Copper-catalyzed Enantioselective Construction of Spirobiquinoline Skeleton (poster), M. Sako, K.

Takenaka, H. Sasai: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium, Osaka, Japan, January 22-23, 2013.

[29]Design and Synthesis of Organocatalysts Bearing Spiro Backbone (poster), L. Fan, S. Takizawa, H. Sasai: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium, Osaka, Japan, January 22-23, 2013.

[30]Development of New Efficient Synthesis Method of Spiro Bis(1,2,3-triazole)s and Their Applications (poster), Y. Yoshida, S. Takizawa, H. Sasai: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium, Osaka, Japan, January 22-23, 2013.

[31]Enantioselective Synthesis of α -Methylidene- γ -Butyrolactones: Intramolecular Rauhut-Currier Reaction Promoted by Acid/Base Organocatalysts (poster), T. M.-N. Nguyen, S. Takizawa, A. Grossmann, M. Suzuki, D. Enders, H. Sasai: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium, Osaka, Japan, January 22-23, 2013.

[32]Organocatalyzed Enantioselective Aza-MBH Reaction of Ketimines (poster), S. Takizawa, E. Rémond, F. Arteaga-Arteaga, J. Bayardon, Y. Yoshida, S. Vellaisamy, S. Jugé, H. Sasai: The 16th SANKEN International and The 11th SANKEN Nanotechnology Symposium, Osaka, Japan, January 22-23, 2013.

[33]Enantioselective Pd(II)/Pd(IV) Catalysis Using SPRIX Ligand: Efficient Synthesis of Chiral Tetrahydrofuran Derivatives (oral), K. Takenaka, Y. D. Dhage, S. Takizawa, H. Sasai: Aachen-Osaka Symposium "Biological and Chemical Methods for Selective Catalysis", Osaka, Japan, March 11-13, 2013.

[34]Development of New Efficient Synthesis Method of Spiro Bis(1,2,3-triazole)s and Their Applications (oral), Y. Yoshida, S. Takizawa, H. Sasai: Aachen-Osaka Symposium "Biological and Chemical Methods for Selective Catalysis", Osaka, Japan, March 11-13, 2013.

Books

[1]Direct C–C Bond Formation (Henry, aza-Henry)(H. Yamamoto, E. Carreira) H. Sasai, "Comprehensive Chirality", ELSEVIER, 4 (Chapter 12) (214-242) 2012.

[2](aza) Morita–Baylis–Hillman Reaction(H. Yamamoto, E. Carreira) H. Sasai, S. Takizawa, "Comprehensive Chirality", ELSEVIER, 6 (Chapter 9) (234-263) 2012.

Patents

[1]Chiral Spiro Bis(triazole) Compounds: Synthesis and Application H. Sasai, S. Takizawa, Y. Yosida, JP2012-188387

[2]Preparation of alicyclic N-oxyl compounds J. Ichihara, JP2012-148302

Contributions to International Conferences and Journals

H. SASAI 12th International Kyoto Conference on New Aspect of Organic Chemistry
(Organizing Committee)

H. SASAI The 8th International Vanadium Symposium Chemistry, Biological Chemistry, &
Toxicology (Organizing Committee)

Publications in Domestic Meetings

Annual Meeting of The Chemical Society of Japan	11 papers
Symposium on Molecular Chirality	3 papers
Symposium on Organic Reaction	3 papers
Symposium on Organometallic Chemistry	3 papers
Symposium on Pharmaceutical Science	2 papers

Congress of Heterocyclic Chemistry	1 paper
Annual Meeting of The Pharmaceutical Society of Japan	1 paper
Symposium on Organocatalysis	1 paper

Academic Degrees

Doctor Degree for Science	Synthesis and Application of Chiral Catalysts Bearing Spiro Skeleton	
K. Kiriyaama		
Master Degree for Science	Screening of Thermophilic Alcohol Dehydrogenase for in vitro Butanol Production	
M. O. S. dos Santos		
Master Degree for Science	Enantioselective Couplings of Polycyclic Aromatic Compounds Using Chiral Vanadium(V) Catalysts	
J. Koderia		

Grant-in-Aid for Scientific Research

H. Sasai	Integrated synthesis based on the creation of multifunctional organocatalysts	¥3,380,000
H. Sasai	Development of Catalytic Skeletal Constructing Reactions Utilizing Spiro-type Ligands	¥4,030,000
H. Sasai	Development of Novel Pd(II)/Pd(IV) catalysis	¥900,000
S. Takizawa	Synthesis of chiral multifunctional compounds promoted by acidi-base organocatalysts	¥4,680,000
S. Takizawa	Development of environmentally benign asymmetric catalysts using spiro chirality	¥2,340,000
J. Ichihara	Reaction mechanism of halogen-free epoxidation reaction with environmentally friendly powder reaction	¥2,730,000

Entrusted Research

H. Sasai	Japan Science and Technology Agency	Control of Chirality by Immobilized Ligands Based on Metal-bridging Polymer	¥2,600,000
H. Sasai	Japan Science and Technology Agency	Practical Transformation Based on Catalytic Asymmetric Domino Reactions	¥10,469,000

Contribution to Research

H. Sasai	Nagase & Co., Ltd.	¥1,000,000
H. Sasai	Nissan Chemical Industries, Ltd.	¥400,000
J. Ichihara	Kyodo Printing Co., Ltd.	¥200,000
Y. Kita	Nagase ChemteX Corporation	¥1,000,000

Cooperative Research

J. Ichihara	JX Nippon Oil & Energy Corp.	¥1,040,000
J. Ichihara	T&K Toka Company	¥1,000,000
J. Ichihara	Okawara MFG.CO., LTD.	¥105,000

Other Research Fund

H. Sasai	Japan-German Graduate Externship	¥1,235,000
H. Sasai	University Cooperative Network for Research Equipment	¥1,700,000

Department of Regulatory Bioorganic Chemistry

Original Papers

[1]Structure-activity studies on the fluorescent indicator in the displacement assay for the screening of small molecules binding to RNA, S. Umemoto, S. Im, J. Zhang, M. Hagihara, A. Murata, Y. Harada, T. Fukuzumi, T. Wazaki, S. Sasaoka, K. Nakatani: Chem. Eur. J., 18 (2012) 9999-10008.

[2]Amphiphilic DNA duplex stabilized by hydrophobic zipper, C. Dohno, T. Shibata, M. Okazaki, S. Makishi, K. Nakatani: Eur. J. Org. Chem., 2012 (2012) 5317-5323.

- [3]Competitive allele-specific hairpin primer PCR for extremely high allele discrimination in typing of single nucleotide polymorphism, F. Takei, M. Igarashi, Y. Oka, Y. Koga, K. Nakatani: *ChemBioChem*, 13 (2012) 1409-1412.
- [4]Assembly of a small DNA rectangular parallelepiped block into higher order nanostructures, H. Nakagawa, M. Toda, H. Atsumi, M. Hagihara, M. Hayashi-Nishino, C. Dohno, K. Nakatani: *Chem. Lett.*, 41 (2012) 1550-1552.
- [5]Activation of prokaryotic translation by antisense oligonucleotides binding to coding region of mRNA, G. Hayashi, C. Hong, M. Hagihara, K. Nakatani: *Biochen. Biophys. Res. Commun.*, 429 (2012) 105-110.
- [6]Triethynylmethane: A Molecular Unit Inducing Excimer-Like Emission in Aggregated States of Hydrocarbon Fluorophores, T. Otabe, S. Matsumoto, H. Nakagawa, C. Hong, C. Dohno, K. Nakatani: *Tetrahedron Lett.*, 54 (2013) 143-146.
- [7]Xanthone derivatives as potential inhibitors of miRNA processing by human Dicer: Targeting secondary structures of pre-miRNA by small molecules, A. Murata, T. Fukuzumi, S. Umemoto, K. Nakatani: *Bioorg. Med. Chem. Lett.*, 23 (2013) 252-255.
- [8]A dimeric form of N-Methoxycarbonyl-2-amino-1,8-naphthyridine bound to the A-A mismatch in the CAG/CAG base triad in dsRNA, K. Nakatani, M. Toda, H. He: *Bioorg. Med. Chem. Lett.*, 23 (2013) 558-561.
- [9]Selective recognition of G-G mismatch using the double functional probe with electrochemical active ferrocenyl, H. He, J. Xia, G. Chang, X. Peng, Z. Lou, K. Nakatani, X. Zhou, S. Wang: *Biosens. Bioelectronics*, 42 (2013) 36-40.
- [10]A Novel DANP-Coupled Hairpin RT-PCR for Rapid Detection of Chikungunya Virus, H. Chen, F. Takei, E.S.C. Koay, K. Nakatani, J.J.H. Chu: *J. Mol. Diagn.*, 15 (2013) 227-233.

International Conferences

- [1]High-throughput Screening of Chemical Libraries for the Discovery of RNA-binding Compounds (poster), A. Murata, Y. Harada, T. Fukuzumi, S. Umemoto, S. Im, M. Hagihara, K. Nakatani: *RNA 2012*, the 17th Annual Meeting of the RNA Society, 2012.5.29-6.2, USA.
- [2]Synthesis of Small Molecule Library for pre-miRNA Secondary Structures (poster), T. Fukuzumi, A. Murata, Y. Harada, K. Nakatani: *RNA 2012*, the 17th Annual Meeting of the RNA Society, 2012.5.29-6.2, USA.
- [3]Development of amphiphilic DNA for building of 2D nanostructure at hydrophobic-hydrophilic interface (oral), S. Makishi, T. Shibata, C. Dohno, K. Nakatani: *The 5th edition of the Young Scientist Symposium by the European Institute of Chemistry and Biology (IECB)*, 2012.5.21-22, France.
- [4]Small Molecule Interaction to RNA (invited), K. Nakatani: *A3RONA 2012 Korea*, 2012.5.18-20, Korea.
- [5]Studies on Small Molecules Targeting RNA (invited), K. Nakatani: *2012 Telluride Science Conference on Nucleic Acids Chemistry*, 2012.7.29-8.3, USA.
- [6]Synthesis of Small Molecule Library for pre-miRNA Secondary Structures (poster), T. Fukuzumi, A. Murata, Y. Harada, K. Nakatani: *IKCOC-12*, 2012.11.12-16, Japan.
- [7]Coumarin derivatives as an indicator for interactions between RNA and small molecules (poster), T.

Tsuda, T. Fukuzumi, K. Nakatani: The 7th Asia and Oceania Conference on Photochemistry 2012, 2012.11.12-15, Japan.

[8]High allelic discrimination in typing of single nucleotide polymorphisms using allele-specific hairpin primer PCR (oral), F. Takei, G. Yu, C. Dohno, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[9]Synthesis and application of a new modified DNA having cytosine-bulge binding fluorescent molecule (poster), G. Yu, F. Takei, T. Shibata, C. Dohno, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[10]Synthesis and evaluation of novel naphthyridine derivatives for binding to RNA bulge structure (poster), T. Otabe, G. Yu, F. Takei, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[11]Translation regulation of gene expression by small molecule-induced pseudoknot formation (poster), S. Matsumoto, C. Hong, A. Murata, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[12]Change of photochemical properties of coumarin fluorochrome induced by binding to RNA (poster), T. Tsuda, T. Fukuzumi, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[13]Synthesis and evaluation of hydrophobic G-quadruplex (poster), T. Shibata, S. Makishi, C. Dohno, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[14]Small Organic Molecules Regulating RNA Structure and Function (invited), K. Nakatani: The First International Symposium on Biofunctional Chemistry (ISBC2012), 2012.11.28-30, Japan.

[15]Formation of Ligand-Assisted Complex of Two RNA Hairpin Loops (invited), K. Nakatani: The 7th International Conference on Cutting-Edge Organic Chemistry in Asia (ICCEOCA-7) and The 3rd New Phase International Conference on Cutting-Edge Organic Chemistry in Asia (NICCEOCA-3), 2012.12.11-14, Singapore.

[16]Small Organic Molecules regulating RNA Structure and Function (invited), K. Nakatani: International Symposium on Challenges in Chemical Biology (ISCCB2013), 2013.1.27-29, India.

Review Papers

Discovery study for small molecule ligands targeting RNA, K. Nakatani, Manufacturing & Technology, Association for the Advancement of Manufacturing & Technology, 65[1] (2013), 34-40.

Publications in Domestic Meetings

The 93rd CSJ Annual Meeting 2013	9 papers
The 6th Symposium on Biorelevant Chemistry CSJ	2 papers
The 27th Young Scientists Forum on Biorelevant Chemistry CSJ	1 paper
7th Annual Meeting of Japanese Society for Chemical Biology	1 paper

Academic Degrees

Doctoral Degree for Science T. Shibata	Studies on Membrane-Bound Nucleic Acids
Master Degree for Science J. Song	Studies on RNA binding ligand-mediated regulation of ribozyme activity
Master Degree for Science G. Yu	Novel turn-on type PCR monitoring system using naphthyridine binding primers
Master Degree for Science T. Tsuda	Development of fluorescent RNA-binding molecules with coumarine skeleton

Grant-in-Aid for Scientific Research

K. Nakatani	Riboswitch reengineering using a synthetic 8-substituted purine library	¥15,730,000
K. Nakatani	RNA loop-loop interaction modulated by small molecules	¥4,030,000
F. Takei	The high sensitive virus detection system using hairpin primer PCR method	¥6,760,000
A. Murata	Gene regulation by small molecule-modulated miRNA pathway	¥2,080,000
T. Fukuzumi	Design and synthesis of small molecules that target miR-29a precursor.	¥2,340,000

Entrusted Research

K. Nakatani	National Institute of Biomedical Innovation	Development of Research Basis for accelerating the Drug Discovery targeting Functional ncRNA	¥60,800,000
C. Dohno	Japan Science and Technology Agency, PREST	Biochemical functions emerging from DNA containing hydrophobic regions	¥14,300,000

Contribution to Research

C. Dohno	The Kurata Memorial Hitachi Science and Technology Foundation	¥1,200,000
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Cooperative Research

K. Nakatani	Furukawa Electric Advanced Engineering Co., Ltd.	¥1,573,000
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Department of Organic Fine Chemicals**Original Papers**

[1]Molecular breeding of a fungus producing a precursor diterpene suitable for semi-synthesis by dissection of the biosynthetic machinery, M. Noike, Y. Ono, Y. Araki, R. Tanio, Y. Higuchi, H. Nitta, Y. Hamano, T. Toyomasu, T. Sassa, N. Kato, T. Daiiri: PLoS ONE, 7 (8) (2012) e42090.

[2]A novel fusococcin derivative preferentially targets hypoxic tumor cells and inhibits tumor growth in xenografts, K. Kawakami, M. Hattori, T. Inoue, Y. Maruyama, J. Ohkanda, N. Kato, M. Tongu, T. Yamada, M. Akimoto, K. Takenaga, T. Sassa, J. Suzumiya, Y. Honma: Anticancer Agents Med. Chem., 12 (7) (2012) 791-800.

[3]Synthesis and application of visible light sensitive azobenzene, S. Sawada, N. Kato, K. Kaihatsu: Curr. Pharm. Biotechnol., 13 (14) (2012) 2642-2648.

[4]Label-free single-particle imaging of the influenza virus by objective-type total internal reflection dark-field microscopy, S. Enoki, R. Iino, N. Morone, K. Kaihatsu, S. Sakakihara, N. Kato, H. Noji: PLoS ONE, 7 (11) (2012) e49208.

[5]Inhibition of rapamycin-induced Akt phosphorylation by cotylenin A correlates with their synergistic growth inhibition of cancer cells, T. Kasukabe, J. Okabe-Kado, Y. Haranosono, N. Kato, Y. Honma: Int. J. Oncol., 42 (2) (2013) 767-775.

International Conferences

[1]Diagnosis of influenza viruses by peptide nucleic acid-modified with a novel intercalator (poster), K. Kaihatsu, S. Sawada, T. Kanno, S. Nakamura, T. Nakaya, T. Yasunaga, N. Kato: 25th International Symposium of Antiviral Research, Sapporo, Japan, May 7-13, 2012.

[2]Genome specific diagnosis of influenza virus strains by hairpin-type peptide nucleic acid (poster), Tenko Hayashi, Kunihiro Kaihatsu, Shinjiro Sawada, Shota Nakamura, Takaaki Nakaya, Nobuo Kato: The 10th Annual Meeting of Society of Nano Science and Technology, Osaka, Japan, Jun 14-16, 2012.

- [3]Fusicoccin-based fluorescent probes for detecting 14-3-3 interactions with phosphorylated ligands (invited), J. Ohkanda: The Second Asian Chemical Biology Conference, Okinawa, Japan, Jul 4-7, 2012.
- [4]Natural product-based chemical probes for detecting 14-3-3-phospholigand interactions (invited), J. Ohkanda: The Sixth Peptide Engineering Meeting, Atlanta, Georgia, USA, Oct 2-5, 2012.
- [5]Anticancer, antiviral, and antibacterial activities of Epigallocatechin-3-O-gallate fatty acid derivatives (invited), K. Kaihatsu: 5th Symposium on Recent Trends in Cancer Prevention, Kyung Hee University, Seoul, Korea, Oct. 12, 2012.
- [6]Virus chromatograph: On-chip diagnosis of virus infection from human body fluid (oral), M. Niimi, T. Masuda, K. Kaihatsu, N. Kato, F. Arai: The Sixteenth International Conference on Miniaturized Systems for Chemistry and Life Sciences, Okinawa, Japan, Oct 28-Nov 1, 2012.
- [7]Identification and inhibition of influenza virus genome replication by a peptide nucleic acid (oral), K. Kaihatsu, S. Sawada, T. Kanno, S. Nakamura, N. Goto, T. Nakaya, T. Yasunaga, N. Kato: The 39th International Symposium on Nucleic Acids Chemistry, Nagoya, Japan, Nov 15-17, 2012.
- [8]Toward selective inactivation of K-Ras: bivalent dual inhibitors for disrupting protein-protein interactions of protein prenyltransferases (poster), J. Ohkanda, M. Tsubamoto, S. Machida, N. Kato: The 16th SANKEN International Symposium, Osaka, Japan, Jan 22-23, 2013.
- [9]Production of useful biosynthetic intermediates of fusicoccin by manipulation of biosynthetic genes of the fusicoccin-producing fungus (poster), R. Ishida, H. Nitta, Y. Higuchi, M. Noike, J. Ohkanda, T. Daiiri, N. Kato: The 16th SANKEN International Symposium, Osaka, Japan, Jan 22-23, 2013.
- [10]Effect of chemical modification for peptide nucleic acid on its mismatch discrimination (poster), T. Hayashi, S. Sawada, K. Kaihatsu, N. Kato: The 16th SANKEN International Symposium, Osaka, Japan, Jan 22-23, 2013.

Patents

- [1]Method for producing intermediate for biosynthesis of fusicoccin A, and synthase for use in said method T. Daiiri, N. Kato, M. Noike, Y. Ono, Y. Higuchi, WO2013/031975
- [2]Anti-non-envelope virus agent and its application Y. Kaihatsu, K. Kaihatsu, N. Tanaka, JP2013-070031

Contributions to International Conferences and Journals

J. OHKANDA 2nd Asian Chemical Biology Symposium (Organizing committee)
 K. KAIHATSU J. Antivirals & Antiretrovirals (Editorial Board Member)

Publications in Domestic Meetings

The 93rd CSJ Annual Meeting	5 papers
The 6th Bio-related Chemistry Symposium	3 papers
The 60th Annual Meeting of the Japanese Society for Virology	1 paper
Symposium for Antisense and Gene Delivery 2012	1 paper
The 9th Bio-Optics Workshop	1 paper
Others	4 papers

Academic Degrees

Master Degree for Science	Design and evaluation of guanidyl group containing bivalent enzyme inhibitors for disrupting K-Ras4B protein-protein interactions
M. Tsubamoto	
Master Degree for Science	Mismatch discrimination of intercalator-modified peptide nucleic acids
T. Hayashi	
Master Degree for Science	Stability effects of 3-amino-9-deoxycytlenol on 14-3-3 protein/phosphopeptides

Science	complexes	
T. Yoneyama		
Master Degree for Science	Sequence specificity of peptide nucleic acid containing chemically-modified thiouracyl bases	
Y. Zhou		
Bachelor Degree for Science	Development of chemical modification methods at the 5-position of cytosine	
K. Takagi		
Grant-in-Aid for Scientific Research		
J. Ohkanda	Design of fusococcin-based chemical probes for detecting protein-protein interactions	¥3,510,000
J. Ohkanda	Design of synthetic molecules for disrupting protein-protein interactions	¥1,820,000
K. Kaihatsu	Development of transcription regulation method using photosensitive hairpin-type nucleic acid	¥1,170,000
Entrusted Research		
N. Kato	JST Strategic Basic Research Programs CREST	Design and synthesis of universal inhibitors for bacterial efflux pumps
		¥2,145,000
Contribution to Research		
N. Kato	MBR Co., Ltd.	¥500,000
K. Kaihatsu	TANAKA HOLDINGS Co., Ltd.	¥2,000,000
Cooperative Research		
K. Kaihatsu	Protectea, Ltd.	¥405,000
Other Research Fund		
K. Kaihatsu	Osaka University Office for University-Industry Collaboration	¥2,398,000

Department of Structural Molecular Biology

Original Papers

[1] Isolation and characterization of signermycin B, an antibiotic that targets the dimerization domain of histidine kinase WalK, T. Watanabe, M. Igarashi, T. Okajima, E. Ishii, H. Kino, M. Hatano, R. Sawa, M. Umekita, T. Kimura, S. Okamoto, Y. Eguchi, Y. Akamatsu, and R. Utsumi: Antimicrob. Agents Chemother., 56 (2012) 3657-3663.

[2] Cell wall trapping of autocrine peptides for human G-protein-coupled receptors on the yeast cell surface, J. Ishii, N. Yoshimoto, K. tatematsu, S. Kuroda, C. Ogino, H. Fukuda, and A. Kondo: PLoS One., 7 (5) (2012) e37136.

[3] An automated system for high-throughput single cell-based breeding, N. Yoshimoto, A. Kida, X. Jie, M. Kurokawa, M. Iijima, T. Niimi, A.D. Maturana, I. Nikaïdo, H.R. Ueda, K. Tatematsu, K. Tanizawa, A. Kondo, I. Fujii, and S. Kuroda: Sci Rep., 3 (2013) 1191.

International Conferences

[1] Functional Analysis of Intra-peptide Thioether Forming Enzyme Essential for Biogenesis of Quinohemoprotein Amine Dehydrogenase (poster), H. Ito, T. Nakai, T. Okajima, K. Kobayashi, Y. Takahashi, H. Hori, M. Tsubaki, K. Tanizawa: 16th SANKEN International Symposium, Osaka, Japan, January 22-23, 2013.

Publications in Domestic Meetings

Japanese Biochemical Society	3 papers
Japan Society for Bioscience, Biotechnology and Agrochemistry	2 papers
Japanese Biochemical Society, Kinki Branch Meeting	1 paper
Meeting of Enzyme and Coenzyme Researchs	1 paper

Academic Degrees

Master Degree for Science H. Yamane	Evaluation of Antibody Binding Properties of Proteins G and L Using Bio-nanocapsule	
Master Degree for Frontier Biosciences A. Nagasaki	Improvement of purification and transfection method of anti-inflammatory protein MTI-II for clinical application	
Master Degree for Frontier Biosciences A. Iwai	Functional study for Streptococcus mutans histidine kinase VicK by site-directed mutagenesis	
Grant-in-Aid for Scientific Research		
T. Okajima	Creation of novel bioactive cyclic peptide using Fe-S cluster containing peptide crosslink enzyme	¥1,560,000
T. Nakai	Biogenesis process of quinoxaline protein aminodehydrogenase accompanying multi-step posttranslational modification reactions	¥1,300,000
Entrusted Research		
K. Tanizawa	Bio-oriented Technology Research Advancement Institution	Establishment of Methods for Preparation of Modified Bionanocapsules and Their Mass Production ¥5,900,000
Contribution to Research		
K. Tanizawa	Vitamin B Research Committee	¥190,000

Department of Cell Membrane Biology

Original Papers

- [1] A single-cell drug efflux assay in bacteria by using a directly accessible femtoliter droplet array, R. Iino, K. Hayama, H. Amezawa, S. Sakakihara, S.H. Kim, Y. Matsumono, K. Nishino, A. Yamaguchi, H. Noji: Lab Chip., 12 (20) (2012) 3923-3929.
- [2] The functional roles of S1P in immunity, Y. Hisano, T. Nishi, A. Kawahara: J Biochem., 142 (4) (2012) 305-311.
- [3] Mouse SPNS2 functions as a sphingosine 1-phosphate transporter in vascular endothelial cells, Y. Hisano, N. Kobayashi, A. Yamaguchi, T. Nishi: PLoS One, 7 (6) (2012) e38941, 1-11.
- [4] Antibacterial and antifungal activities of new acylated derivatives of epigallocatechin gallate, Y. Matsumoto, K. Kaihatsu, K. Nishino, M. Ogawa, N. Kato, A. Yamaguchi: Front Microbiol., 3 (53) (2012) article53 1-10.
- [5] Effects of indole on drug resistance and virulence of Salmonella enterica serovar Typhimurium revealed by genome-wide analyses, E. Nikaido, E. Giraud, S. Baucheron, S. Yamasaki, A. Wiedemann, K. Okamoto, T. Takagi, A. Yamaguchi, A. Cloeckert, K. Nishino: Gut Pathog., 4 (5) (2012) 1-13.

International Conferences

- [1] Inhibitor-bound structures of a multidrug exporters AcrB and MexB (invited), A. Yamaguchi: Gordon Research Conference, "Multi-Drug Efflux Systems", CA, U.S.A., March 17-22, 2013.
- [2] The crystal structures of Bacterial multidrug efflux pumps with a specific inhibitor in the common inhibitory narrow pit (poster), K. Hayashi, R. Nakashima, K. Sakurai, S. Yamasaki, C. Nagata, K. Hoshino, Y. Onodera, K. Nishino, A. Yamaguchi: Gordon Research Conference, "Multi-Drug Efflux Systems", CA, U.S.A., March 17-22, 2013.

[3]The crystal structures of Bacterial multidrug efflux pumps with a specific inhibitor in the common inhibitory narrow pit (poster), K. Hayashi, R. Nakashima, K. Sakurai, S. Yamasaki, C. Nagata, K. Hoshino, Y. Onodera, K. Nishino, A. Yamaguchi: The 16th SANKEN International Symposium 2013/The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, Jan. 22-23, 2013.

[4]Structures of AcrB Multidrug Efflux Pump Reveal the Peristaltic Drug Export Mechanism (poster), S. Yamasaki, K. Nishino, R. Nakashima, K. Sakurai, A. Yamaguchi: The 16th SANKEN International Symposium 2013/The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, Jan. 22-23, 2013.

[5]The crystal structure of multidrug resistance regulator RamR reveal the mechanism of multiple drugs recognition (poster), S. Yamasaki, E. Nikaido, R. Nakashima, K. Sakurai, A. Yamaguchi, K. Nishino: The 16th SANKEN International Symposium 2013/The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, Jan. 22-23, 2013.

[6]Structural basis of multidrug efflux transport (invited), A. Yamaguchi: G3 Meeting International, Tokyo, Japan, Oct., 11-12, 2012.

[7]Peristaltic Drug Export Mechanism of the AcrB Multidrug Efflux Pump (poster), S. Yamasaki, K. Nishino, R. Nakashima, K. Sakurai, A. Yamaguchi: ASM American Society for Microbiology 112th General Meeting, San Francisco, U.S.A., June 16–19, 2012.

[8]Analysis of physiological function of the sphingosine 1-phosphate transporter in mice (invited), T. Nishi: Gordon Research Conference, "Glycolipid & Sphingolipid Biology", Lucca (Barga), Italy, April 22-27, 2012.

Review Papers

A microfluidic device for simple and rapid evaluation of multidrug efflux pump inhibitors, R. Iino, K. Nishino, H. Noji, A. Yamaguchi, Y. Matsumoto, Front Microbiol., Frontiers, 3 (2012), article40 1-9.

Structural basis of multidrug recognition, R. Nakashima, A. Yamaguchi, Cell Technology, Gakken Medical Shujunsha Co., Ltd., 31 (2012), 529-534.

Structural basis of multidrug efflux transport, A. Yamaguchi, R. Nakashima, CHEMISTRY, KAGAKUDOJIN, 67 (2012), 74-75.

Publications in Domestic Meetings

The 133th Annual Meeting of the Pharmaceutical Society of Japan	3 papers
The 86th Annual Meeting of Japanese Society for Bacteriology	3 papers
The 85th Annual Meeting of the Japanese Biochemical Society	5 papers
The 68th ISIR academic mreeting	1 paper
The 62th Annual Meeting of the Pharmaceutical Society of Japan, Kinki Branch	1 paper
New Frontiers of Metabolism Research in Biomedical Sciences	1 paper
10th Physical Pharma Forum 2012 - The Next Generation -	1 paper
BIA Symposium 2012	1 paper
The 26th Annual Meeting of Bacterial Adherence & Biofilm	1 paper
The 12th Annual Meeting of the Protein Society of Japan	1 paper
Nano-Macro Materials, Devices and System Research Alliance	1 paper

Academic Degrees

Master Degree for Pharmaceutical Sciences M. Mashita	Analysis of important amino acid sequences for plasma membrane localization of S1P transporter SPNS2.
Master Degree for Pharmaceutical	Studies on an activation mechanism of S1P receptor by the S1P transporter, SPNS2.

Sciences

Y. Matsuyama

Master Degree for Structure and function of multidrug resistance regulator RamR
Pharmaceutical

Sciences

S. Yamasaki

Grant-in-Aid for Scientific Research

T. Nishi Identification of the sphingosine 1-phosphate transporters and ¥1,300,000
its diverse physiological roles

R. Nakashima Crystallographic study of multidrug efflux proteins coupled ¥9,750,000
with outer membrane channel TolC

Entrusted Research

A. Yamaguchi JST Strategic Basic Studies on the structural basis of ¥8,710,000
Research Programs, multidrug efflux transport and the
CREST (H24.10.1~ development of multidrug
H27.3.31) transporter inhibitors

Contribution to Research

T. Nishi The Cell Science Research Foundation ¥3,000,000

Cooperative Research

A. Yamaguchi Fine Co., Ltd ¥0,000

Other Research Fund

R. Nakashima JSPS International Collaborations, Supporting International ¥2,500,000
Joint Research,/Belgium

Department of Biomolecular Science and Engineering

Original Papers

[1] Fluorescence imaging of potassium ions in living cells using a fluorescent probe based on a thrombin binding aptamer-peptide conjugate., Ohtsuka K, Sato S, Sato Y, Sota K, Ohzawa S, Matsuda T, Takemoto K, Takamune N, Juskowiak B, Nagai T, Takenaka S.: Chem Commun (Camb)., 48 (39) (2012) 4740-4742.

[2] Optogenetic activation during detector "dead time" enables compatible real-time fluorescence imaging., Chang YF, Arai Y, Nagai T.: Neurosci Res., 73 (4) (2012) 341-347.

[3] The molecular mechanism of apoptosis upon caspase-8 activation: quantitative experimental validation of a mathematical model., Kominami K, Nakabayashi J, Nagai T, Tsujimura Y, Chiba K, Kimura H, Miyawaki A, Sawasaki T, Yokota H, Manabe N, Sakamaki K.: Biochim Biophys Acta., 1823 (10) (2012) 1825-1840.

[4] Changes in cytosolic ATP levels and intracellular morphology during bacteria-induced hypersensitive cell death as revealed by real-time fluorescence microscopy imaging., Hatsugai N, Perez Koldenkova V, Imamura H, Noji H, Nagai T.: Plant Cell Physiol., 53 (10) (2012) 1768-1875.

[5] Cytoplasmic Ca²⁺ changes dynamically during the interaction of the pollen tube with synergid cells., Iwano M, Ngo QA, Entani T, Shiba H, Nagai T, Miyawaki A, Isogai A, Grossniklaus U, Takayama S.: Development., 139 (22) (2012) 4202-4209.

[6] In vivo imaging of hierarchical spatiotemporal activation of caspase-8 during apoptosis., Kominami K, Nagai T, Sawasaki T, Tsujimura Y, Yashima K, Sunaga Y, Tsuchimochi M, Nishimura J, Chiba K, Nakabayashi J, Koyamada K, Endo Y, Yokota H, Miyawaki A, Manabe N, Sakamaki K.: PLoS One., 7 (11) (2012) e50218.

[7] Luminescent proteins for high-speed single-cell and whole-body imaging., Saito K, Chang YF, Horikawa K, Hatsugai N, Higuchi Y, Hashida M, Yoshida Y, Matsuda T, Arai Y, Nagai T.: Nat Commun.,

3 (2012) 1262.

[8]Local nucleosome dynamics facilitate chromatin accessibility in living mammalian cells., Hihara S, Pack CG, Kaizu K, Tani T, Hanafusa T, Nozaki T, Takemoto S, Yoshimi T, Yokota H, Imamoto N, Sako Y, Kinjo M, Takahashi K, Nagai T, Maeshima K.: *Cell Rep.*, 2 (6) (2012) 1645-1656.

[9]Highlightable Ca²⁺ indicators for live cell imaging., Hoi H, Matsuda T, Nagai T, Campbell RE.: *J Am Chem Soc.*, 135 (1) (2013) 46-49.

[10]Video-rate imaging of luminescent tumour cells in freely moving unshaved mice, Saito K, Higuchi Y, Arai Y, and Nagai T.: *Protocol Exchange*, - (-) (2013)
<http://www.nature.com/protocolexchange/protocols/2621>.

[11]Highlighted Ca²⁺ imaging with a genetically encoded ‘caged’ indicator, Matsuda T, Horikawa K, Saito K, Nagai T.: *Sci Rep.*, 3 (2013) 1398.

[12]Critical roles of type III phosphatidylinositol phosphate kinase in murine embryonic visceral endoderm and adult intestine., Takasuga S, Horie Y, Sasaki J, Sun-Wada GH, Kawamura N, Iizuka R, Mizuno K, Eguchi S, Kofuji S, Kimura H, Yamazaki M, Horie C, Odanaga E, Sato Y, Chida S, Kontani K, Harada A, Katada T, Suzuki A, Wada Y, Ohnishi H, Sasaki T.: *Proc Natl Acad Sci U S A.*, 110 (5) (2013) 1726-1731.

[13]Dynamic visualization of RANKL and Th17-mediated osteoclast function, Kikuta J, Wada Y, Kowada T, Wang Z, Sun-Wada GH, Nishiyama I, Mizukami S, Maiya N, Yasuda H, Kumanogoh A, Kikuchi K, Germain RN, Ishii M.: *J Clin Invest.*, 123 (2) (2013) 866-873.

[14]SNAP-23 regulates phagosome formation and maturation in macrophages., Sakurai C, Hashimoto H, Nakanishi H, Arai S, Wada Y, Sun-Wada GH, Wada I, Hatsuzawa K.: *Mol Biol Cell.*, 23 (24) (2012) 4849-4863.

[15]Delivery of endosomes to lysosomes via microautophagy in the visceral endoderm of mouse embryos., Kawamura N, Sun-Wada GH, Aoyama M, Harada A, Takasuga S, Sasaki T, Wada Y.: *Nat Commun.*, 3 (2012) 1071.

[16]Spatial restriction of bone morphogenetic protein signaling in mouse gastrula through the mVam2-dependent endocytic pathway., Aoyama M, Sun-Wada GH, Yamamoto A, Yamamoto M, Hamada H, Wada Y.: *Dev Cell.*, 22 (6) (2012) 1163-75.

[17]Simultaneous observation of the lever arm and head explains myosin VI dual function., Ikezaki K, Komori T, Sugawa M, Arai Y, Nishikawa S, Iwane AH, Yanagida T.: *Small*, 8 (19) (2012) 3035-3040.

[18]Rapid severing and motility of chloroplast-actin filaments are required for the chloroplast avoidance response in Arabidopsis., Kong SG, Arai Y, Suetsugu N, Yanagida T, Wada M.: *Plant Cell.*, 25 (2) (2013) 572-590.

International Conferences

[1]What do we see with bioimaging? (invited), T. Nagai: Joint Meeting of The 45th Annual Meeting of the Japanese Society of Developmental Biologists & The 64th Annual Meeting of the Japan Society for Cell Biology, Kobe, Japan, May 28-31, 2012.

[2]Genetically-encoded functional probes applicable in conjunction with photo-manipulation technologies (invited), T. Nagai: The 14th International Congress of Histochemistry and Cytochemistry (ICHC 2012), Kyoto, Japan, August 26-29, 2012.

- [3]Genetically-encoded tools for chromophore-assisted light inactivation of biomolecule functions (invited), T. Nagai: The 14th International Congress of Histochemistry and Cytochemistry (ICHC 2012), Kyoto, Japan, August 26-29, 2012.
- [4]Revolutionary bioimaging with super-duper luminescent proteins (poster), T. Nagai: 12th ECS Meeting, Toulouse, France, September 9-12, 2012.
- [5]A genetically encoded photoactivatable Ca²⁺ indicator to visualize Ca²⁺ dynamics in single arbitrary cells (oral), T. Matsuda: 12th ECS Meeting, Toulouse, France, September 9-12, 2012.
- [6]Revolutionary bioimaging with super-duper luminescent proteins (invited), T. Nagai: 4th International Symposium on Photonic Bioimaging 2012, Sapporo, Japan, September 16-17, 2012.
- [7]Genetically-encoded functional probes applicable in conjunction with photomanipulation technologies (oral), T. Nagai: 2012 Paradigm Innovation in Biology: Novel Strategy and Thinking, Taipei, Taiwan, October 16-19, 2012.
- [8]Fast single molecule particle tracking and analysis plugin with Java Native Interface (poster), Y. Arai: ImageJ User and Developer Conference 2012, Mondorf-les-Bains, Luxembourg, October 24-26, 2012.
- [9]Revolutionary bioimaging with super-duper luminescent proteins (invited), T. Nagai: Fluorescent Proteins and Biological Sensors III, Ashburn, USA, November 4-7, 2012.
- [10]Revolutionary Bioimaging with Super-Duper Luminescent Proteins (invited), T. Nagai: International Joint Symposium on Single-Cell Analysis (The 6th International Workshop on Approaches to Single-Cell Analysis & The 8th International Forum on Post-Genome Technologies), Kyoto, Japan, November 27-28, 2012.
- [11]Genetically-encodable functional indicator and manipulator for deciphering biological events (invited), T. Nagai: The 25th Annual and International Meeting of the Japanese Association for Animal Cell Technology (JAACT2012), Nagoya, Japan, November 27-30, 2012.
- [12]Revolutionary bioimaging with super-duper luminescent proteins (poster), T. Nagai: The Thirteenth JAFoS (2012 Japanese-American Kavli Frontiers of Science symposium), Irvine, USA, November 30-December 2, 2012.
- [13]Lossless fluorescence and chemiluminescence imaging with optogenetic activation at real time, Yoshiyuki Arai, Chang Yu-fen and Takeharu Nagai (poster), Y. Arai: The 16th SANKEN International, The 11th SANKEN Nanotechnology Symposium 2013, Ibaraki, Osaka, January 22-23, 2013.
- [14]STRUCTURE ANALYSIS OF ULTRAMARINE FLUORESCENT PROTEIN SIRIUS. Tomoki Matsuda, Nobuo Noda, Fuyuhiko Inagaki, Takeharu Nagai (poster), T. Matsuda: Biophysical Society 57th Annual Meeting, Philadelphia, USA, February 2-6, 2013.
- [15]Revolutionary bioimaging with super-duper luminescent proteins (invited), T. Nagai: The Fourteenth International Membrane Research Forum, Kyoto, Japan, March 15-17, 2013.
- [16]Revolutionary bioimaging with super-duper luminescent proteins (poster), T. Nagai: Focus on Microscopy 2013, Maastricht, The Netherlands, March 24-27, 2013.
- [17]Polarization microscopy with photonic crystal rectifier Y. Arai, S.Y. Kim, T. Tani & T. Nagai (Osaka University, Japan) (poster), Y. Arai: Focus on Microscopy 2013, Maastricht, The Netherlands, March 24-27, 2013.

[18]Delivery of Endosomes to Lysosomes via Microautophagy in the Visceral Endoderm of Mouse Embryos (oral), Wada, Y., Kawamura, N., Sun-Wada, G. H., Harada, A., Takasuga, S., Sasaki, T., and Aoyama, M.: The 6th International Symposium on Autophagy, Okinawa, Japan, October 28- November 1, 2012.

[19]Rab7-Dependent Microautophagy in Gastrulating Mouse Embryo (oral), Wada, Y., Kawamura, N., Sun-Wada, G. H., Harada, A., Takasuga, S., Sasaki, T., and Aoyama, M.: Cold Spring Harbor Asia Conference on Small GTPases at Different Scales: Proteins, Membranes, Cells, Suzhou, China, September 24-28, 2012.

[20]Endosome dynamism during early embryogenesis (poster), Wada, Y: Hong Kong Society for Developmental Biology Symposium: From Embryology to Disease Mechanisms, Hong Kong, November 26–27, 2012.

Review Papers

The Roles of Calcium and Phosphorus in Cardiovascular Diseases. Spatiotemporal regulation of Ca^{2+} dynamics in live cells revealed by Ca^{2+} imaging., Horikawa K., Nagai T., CLINICAL CALCIUM, Iyaku Journal Co., Ltd, 23[4] (2013), 527-533.

Anecdote of fluorescent probe development (No.2) -summer, autumn, winter and spring-, Nagai T., CELL TECHNOLOGY, Shujunsha, 31[12] (2012), 1390-1397.

Vacuoles in mammals: A subcellular structure indispensable for early embryogenesis., Wada Y., Bioarchitecture., Landes Bioscience, 3[1] (2013), 13-19.

Microautophagy in the visceral endoderm is essential for mouse early development., Wada Y, Sun-Wada GH, Kawamura N., Autophagy., Landes Bioscience, 2[2] (2013), 252-254.

Spatial restriction of bone morphogenetic protein signaling in mouse gastrula through the mVam2-dependent endocytic pathway., Wada Y, Sun-Wada GH, Review for newly arrived articles of Life Science, The Database Center for Life Science (DBCLS), - (2012), <http://first.lifesciencedb.jp/archives/5083#more-5083>.

Patents

[1]Microscopy and auto-focusing system for microscopy T. Nagai, Y. Arai, JP2012-257426

[2]confocal microscopy T. Nagai, K. Saito, Y. Arai, K. Saito, Y. Nakamura, J. Ishii, JP2012-197435

Contributions to International Conferences and Journals

T.Nagai Japanese-American Frontiers of Science Symposium (Chief PGM)

T.Nagai 2012 Paradigm Innovation in Biology: Novel Strategy and Thinking (Organizing Committee)

Publications in Domestic Meetings

The 66th Nanoprobe Technology 167 Committee Workshop	1 paper
IMCE Seminar	1 paper
The 1st Meeting of Laser Biomedical Care Committee	1 paper
The 24th Toen Symposium	1 paper
The 52th Summer School of Life Science	1 paper
The 50th Annual Meeting of the Biophysical Society of Japan	1 paper
Summer Workshop of "Imaging Science"	1 paper
The 20th Workshop of Cell Biology	1 paper
The 4th Workshop of Optogenetics	1 paper
Workshop of the National Institute for Physiological Sciences	1 paper
The 33th Annual Meeting of Japan Society for Laser Surgery and Medicine	1 paper

The 35th Annual Meeting of the Molecular Biology Society of Japan	4 papers
The 85th Annual Meeting of the Japanese Biochemical Society	1 paper
The 23rd CDB Meeting	1 paper
The 33th Annual Meeting of The Laser Society of Japan	1 paper
The 4th Techno_Salon "Application Development of Bioscience"	1 paper
Kobe Biomedical academic exchange meeting	1 paper
Symposium of Research Project for Advanced Photonic Bioimaging	1 paper
The 90th Annual Meeting of The Physiological Society of Japan	1 paper
Annual Meeting of the PSJ Kinki-branch	2 papers

Academic Degrees

Bachelor Degree for Development of genetically encodable FRET-based magnesium ion indicators
Engineering

S. Kawakami

Bachelor Degree for Development of genetically-encodable FRET-based membrane voltage indicators
Engineering

S. Inagaki

Grant-in-Aid for Scientific Research

T. Nagai	Spying minority in biological phenomena -Toward bridging dynamics between individual and ensemble processes-	¥14,820,000
T. Nagai	Development of molecular probes and photonic tools for bio-manipulation	¥56,940,000
T. Matsuda	Photoactivatable Ca ²⁺ indicator to visualize biological events in single arbitrary cells within tissues / whole body	¥4,550,000
T. Matsuda	Development of rational design of the bright fluorescent protein based on the 3D-structure	¥3,900,000
Y. Arai	Fluorescence signal enhancement by metal nano-particles for highly-stable single molecule imaging system.	¥2,080,000
K. Saito	Real-time imaging of formation and depletion of synapses by using split RLuc-Venus fusion protein.	¥5,590,000
M. Nakano	Visualization of heat production inside a single cell with genetically-encoded fluorescent temperature indicator	¥2,730,000

Entrusted Research

T. Nagai	Japan Science and Technology Agency	Invention of high performance bright luminescent proteins used as a nanolight source	¥16,380,000
T. Nagai	New Energy and Industrial Technology Development Organization	Development of absorption-enhanced microscopy based on novel principle and its application for bioscience	¥16,510,000
T. Matsuda	Japan Science and Technology Agency	Analysis of Dynamics of Drug Efflux Transporter and Drug	¥2,145,000

Cooperative Research

T. Nasgai	Nikon Instech Co.,Ltd.	¥6,160,000
T. Nasgai	OPTO-LINE, Inc.	¥8,285,000
T. Nasgai	Nikon Co.,Ltd.	¥2,090,000
T. Nasgai	Panasonic Corporation	¥2,090,000
T. Nasgai	Olympus Corporation	¥0,000

Specially Appointed Laboratory

Original Papers

[1]Single-nanoparticle detection using a low-aspect-ratio pore, M. Tsutsui, S. Hongo, Y. He, M. Taniguchi, N. Gemma, T. Kawai.: ACS Nano, 6 (2012) 3499-3505.

[2]Electrical detection of single pollen allergen particles using electrode-embedded microchannels, C.

Kawaguchi, T. Noda, M. Tsutsui, M. Taniguchi, S. Kawano, T. Kawai: J. Physics : Condensed Mater, 24 (2012) 164202(1-6).

[3] Transverse electric field dragging of DNA in a nanochannel, M. Tsutsui, Y. He, M. Furuhashi, S. Rahong, M. Taniguchi, T. Kawai: Scientific Reports, 2 (2012) 394(1-7).

[4] DNA capture in nanopores for genome sequencing: challenges and opportunities, Y. He, M. Tsutsui, M. Taniguchi, T. Kawai: J. Materials Chemistry, 22 (2012) 13423-13427.

[5] Single-molecule electrical random resequencing of DNA and RNA, T. Ohshiro, K. Matsubara, M. Tsutsui, M. Furuhashi, M. Taniguchi, T. Kawai: Scientific Reports, 2 (2012) 501(1-7).

[6] Embedded TiO₂ waveguides for sensing nanofluorophores in a microfluidic channel, M. Furuhashi, M. Fujiwara, T. Ohshiro, K. Matsubara, M. Tsutsui, M. Taniguchi, S. Takeuchi, T. Kawai: Applied Physics Letters, 101 (2012) 153115.

[7] Switching properties of titanium dioxide nanowire memristor, K. Nagashima, T. Yanagida, M. Kanai, K. Oka, A. Klamchuen, S. Rahong, G. Meng, M. Horprathum, B. Xu, F. Zhuge, Y. He, T. Kawai: Japanese J. Applied Physics, 51 (2012) 11PE09(1-4).

[8] Prominent thermodynamical interaction with surroundings on nanoscale memristive switching of metal oxides, K. Nagashima, T. Yanagida, K. Oka, M. Kanai, A. Klamchuen, S. Rahong, G. Meng, M. Horprathum, B. Xu, F. Zhuge, Y. He, B. H. Park, T. Kawai: Nano Letters, 12 (2012) 5684-5690.

[9] Fundamental strategy for creating VLS grown TiO₂ single crystalline nanowires, F. Zhuge, T. Yanagida, K. Nagashima, H. Yoshida, M. Kanai, B. Xu, A. Klamchuen, G. Meng, Y. He, S. Rahong, X. Li, M. Suzuki, S. Kai, S. Takeda, . Kawai: J. Physical Chemistry C, 116 (2012) 24367-24372.

[10] Thermophoretic manipulation of DNA translocation through nanopores, Y. He, M. Tsutsui, R. H. Scheicher, F. Bai, M. Taniguchi, T. Kawai: ACS Nano, 7 (2013) 538-546.

[11] Crystal-plane dependence of critical coccentration for nucleation on hydrothermal ZnO nanowires, Y. He, T. Yanagida, K. Nagashima, F. Zhuge, G. Meng, B. Xu, A. Klamchuen, S. Rahong, M. Kanai, X. Li, M. Suzuki, S. Kai, T. Kawai: J. Physical Chemistry C, 117 (2012) 1197-1203.

[12] Pressure-induced evaporation dynamics of gold nanoparticles on oxide substrate, G. Meng, T. Yanagida, M. Kanai, M. Suzuki, K. Nagashima, B. Xu, F. Zhuge, A. Klamchuen, Y. He, S. Rahong, S. Kai, T. Kawai: Physical Review, 87 (2013) 012405(1-7).

[13] Electron transport properties of air-exposed one-dimensional uneven peanut-shaped C60 polymer films, S. Ryuzaki, M. Nishiyama, J. Onoe: Diamond and Related Materials, 33 (2013) 12-15.

[14] In situ non-destructive impedance spectroscopic study of nanostructured hetero-junction organic photovoltaic cells, S. Ryuzaki, J. Onoe: Japanese J. Applied Physics, in press (2013) in press.

[15] Photo-generated carrier dynamics in the vicinity of the donor/acceptor interface of organic solar cells, S. Ryuzaki, J. Onoe: Electronics and Communications in Japan, in press (2013) in press.

[16] Photo-generated carrier dynamics in the vicinity of the donor/acceptor interface of organic solar cells, S. Ryuzaki, J. Onoe: The transactions of the Institute of Electrical Engineers of Japan. C, 132 (2012) 1291-1296.

International Conferences

[1] Single molecule electrical sequencing of DNA and RNA using integrated gating nanopores (oral), T.

Kawai: NHGRI 2012 Advanced Sequencing Technology Development Meeting.

[2]Impact of controlling transport pathway in VLS grown oxide nanowires (oral), M. Kanai, A. Klamchuen, T. Yanagida, K. Nagashima, K. Oka, M. Gang, S. Rahong, M. Horprathum, B. Xu, F. Zhuge, Y. He, M. Suzuki, Y. Hidaka, S. Kai, T. Kawai: 2012MRS Spring Meeting.

[3]General strategy for impurity doping in VLS growth of semiconductor metal oxide nanowires (invited), A. Klamchuen, T. Yanagida, M. Kanai, K. Nagashima, K. Oka, M. Gang, S. Rahong, M. Horprathum, B. Xu, F. Zhuge, Y. He, M. Suzuki, T. Hidaka, S. Kai, T. Kawai: 2012MRS Spring Meeting.

[4]Single-molecule tunnel-current identification towards a sequencing of oligonucleotides (plenary), T. Ohshiro, M. Taniguchi, T. Kawai: Global Technology Congress, 2nd Next Generation Sequencer Congress.

[5]DNA sequencing by electron tunneling: STM and gated nanopore (oral), T. Kawai: Centre Européen de Calcul Atomique et Moléculaire.

[6]NANOWIRED ReRAM (invited), T. Kawai: International Symposium on Integrated Functionalities.

[7]Gating nanopore and STM for single molecular DNA sequencing (invited), T. Kawai: 16th edition of the International Conference on Solid Films and Surfaces.

[8]Hetero-structured metal oxide nanowires for nanoelectronics (poster), T. Kawai: 7th Annual Multi-Functional Materials Workshop.

[9]Tunnel-current based single-molecule identification of DNA/RNA oligomer by using nano-MCBI (poster), T. Ohshiro, M. Tsutsui, M. Furuhashi, S. Ryuzaki, K. Yokota, M. Taniguchi, T. Kawai: 12th IEEE Nano Conference.

[10]Nano-scale reactive-ion dry-etching with electron-beam-baked resists (oral), T. Ohshiro, M. Furuhashi, S. Ryuzaki, K. Yokota, M. Taniguchi, T. Kawai: 12th IEEE Nano Conference.

[11]Microfabrication processes of defectless TiO₂ waveguides for insertion of a microfluidic channel (oral), M. Furuhashi, T. Ohshiro, M. Taniguchi, T. Kawai: 12th IEEE Nano Conference.

[12]Single-molecule electrical identification towards nucleotide sequencing by using nano-gap devices (plenary), T. Ohshiro, M. Taniguchi, T. Kawai: 2012 International Conference on Solid State Devices and Materials.

[13]Single molecule DNA sequencing by STM and gating nanopore (oral), T. Kawai: 2012 RCAS-TNNA Symposium Recent Development in nanomaterials: Structures, Dynamics & Applications.

[14]Mechanism of bipolar and unipolar resistive switching on metal oxide nanowires (plenary), T. Kawai: 2nd International Workshop on Resistive RAM.

[15]Broader societal implications: long-term scenarios, challenges for humankind (invited), T. Kawai: NBIC2 International Study on Converging Technologies for Societal Benefit U.S.-Korea-Japan Workshop.

[16]Innovative and responsible governance to address grand challenges (oral), T. Kawai: NBIC2 International Study on Converging Technologies for Societal Benefit U.S.-Korea-Japan Workshop.

[17]Innovative nano-biodevices for DNA and related molecules: STM and gating nanopore (oral), T. Kawai: 4th International Conference NANOCON 2012.

- [18]Fabrication of nanofluidics and nanopore using reactive-ion dry-etching with electron-beam baked resists (poster), T. Ohshiro, M. Taniguchi, T. Kawai: Micro TAS 2012.
- [19]Single-molecule tunnel-current based identification of DNA/RNA towards sequencing by using nano-MCJB (invited), T. Ohshiro, M. Taniguchi, T. Kawai: Micro TAS 2012.
- [20]Converging technology for the life innovation: Single molecule DNA sequencing and silicon technology (poster), T. Kawai: 2nd YICT Forum 2012.
- [21]Application of crossed structure of TiO₂ waveguides and microfluidic channels to fluorescence detection system (poster), M. Furuhashi, T. Ohshiro, M. Taniguchi, T. Kawai: 2012 MRS Fall Meeting & Exhibit.
- [22]Nanowire Memristor: Fabrication and memristive properties (oral), : 2012 MRS Fall Meeting & Exhibit.
- [23]Creation of novel metal oxide nanowires (oral), T. Kawai: 2012 MRS Fall Meeting & Exhibit.
- [24]From STM to gating nanopore as the innovative nano-biosensing devices for DNA and related molecules (oral), T. Kawai: 2012 MRS Fall Meeting & Exhibit.
- [25]Tunnel-current based small RNA profiling by using nanogap electrode (plenary), T. Ohshiro, M. Taniguchi, T. Kawai: International Polymer congress 2012.
- [26]Innovative nanobio-devices for the single molecule DNA nanotechnology (poster), T. Kawai: EEWS Distinguished Lecture.
- [27]Single-molecule tunnel-current based identification of DNA/RNA nucleotides by using nano-gap electrode (plenary), T. Ohshiro, M. Furuhashi, S. Ryuzaki, K. Yokota, M. Taniguchi, T. Kawai: The 16th SANKEN International Symposium 2013.
- [28]Integrated gating nanopores for single molecule DNA and RNA electrical sequencing (invited), T. Kawai: "Expanding Frontiers of Genome Science".
- [29]Innovative nano-biodevices for DNA and related molecules: STM and gating nanopore (oral), T. Kawai: PITTCON CONFERENCE & EXPO Symposia.
- [30]A structural analysis method for nanomaterials using a nanopore (oral), S. Ryuzaki: "US through an Exchange Program in Nanotechnology Fields".

Review Papers

In situ Impedance Spectroscopic Study of Built-in Potentials in the Vicinity of the Donor/Acceptor Interface of Organic Solar Cells under Photo-irradiation, S. Ryuzaki, J. Onoe, J. The Surface Science Society of Japan, The Surface Society of Japan, 33 (2012), 93-99.

Patents

- [1]Method of sample analysis T. Kawai, T. Ohshiro, M. Taniguchi, 2012-181104
- [2]Method of control for single molecular dynamics by nanopore devices with a surrounding electrode T. Kawai, S. Ryuzaki, M. Taniguchi, 2012-286115
- [3]Method of control for transverse speed of material, equipment for control, and these application T. Kawai, M. Tsutsui, M. Taniguchi, PCT/JP2013/051913

[4]Method of material distinguishment T. Kawai, M. Tsutsui, M. Taniguchi, 2013-047373

[5]Equipment for single particle analysis and method of analysis S. Hongo, T. Kawai, M. Tsutsui, M. Taniguchi, S. Ryuzaki, PCT/JP2013/056690

Publications in Domestic Meetings

The 73rd JSAP Autumn Meeting, 2012	8 papers
1st symposium on Development of molecular robots equipped with sensors and intelligence: sponsored by Grant-in-Aid for Scientific Research on Innovative Areas)	1 paper
2 nd seminar on nanoscale molecular devices	2 papers
The 60th JSAP Spring Meeting, 2013	5 papers
The 10th Annual Meeting of Society of Nano Science and Technology	3 papers
The Chemical Society of Japan, The 93rd Annual Meeting	1 paper
61st Annual Meeting of the Japan Society for Analytical Chemistry	3 papers

Grant-in-Aid for Scientific Research

M. Furuhashi	Development of integrated optical devices for single particle detection	¥1,950,000
K. Yokota	Development of graphene nanopore devices	¥1,560,000

Laboratory of Microbiology and Infectious Diseases

Original Papers

- [1]Impact of Hfq on the intrinsic drug resistance of *Salmonella enterica* serovar Typhimurium, M. Hayashi-Nishino, A. Fukushima, K. Nishino: *Front. Microbiol.*, 3 (2012) 205.
- [2]Effects of indole on drug resistance and virulence of *Salmonella enterica* serovar Typhimurium revealed by genome-wide analyses, E. Nikaido, E. Giraud, S. Baucheron, S. Yamasaki, A. Wiedemann, K. Okamoto, T. Takagi, A. Yamaguchi, A. Cloeckert, K. Nishino: *Gut Pathog.*, 4 (2012) 5.
- [3]A single-cell drug efflux assay in bacteria by using a directly accessible femtoliter droplet array, R. Iino, K. Hayama, H. Amezawa, S. Sakakihara, S.H. Kim, Y. Matsumono, K. Nishino, A. Yamaguchi, H. Noji: *Lab Chip.*, 12 (2012) 3923-3929.
- [4]Effects of natural mutations in the *ramRA* locus on invasiveness of epidemic fluoroquinolone-resistant *Salmonella enterica* serovar Typhimurium isolates, E. Giraud, S. Baucheron, I. Virlogeux-Payant, K. Nishino, A. Cloeckert: *J. Infect. Dis.*, 207 (2013) 794-802.
- [5]Assembly of a small DNA rectangular parallelepiped block into higher order nanostructures, H. Nakagawa, M. Toda, H. Atsumi, M. Hagihara, M. Hayashi-Nishino, C. Dohno, K. Nakatani: *Chem. Lett.*, 41 (2012) 1550-1552.
- [6]Autophagosomes induced by a bacterial Beclin 1 binding protein facilitate obligatory intracellular infection, H. Niu, Q. Xiong, A. Yamamoto, M. Hayashi-Nishino, Y. Rikihisa: *Proc. Natl. Acad. Sci. USA.*, 109 (2012) 20800-20807.
- [7]Morphological analysis of autophagy, K. Tabata, M. Hayashi-Nishino, T. Noda, A. Yamamoto, T. Yoshimori: *Methods Mol. Biol.*, 931 (2013) 449-466.

International Conferences

- [1]Structural study on inhibitor specificity of bacterial multidrug efflux pumps (poster), K. Hayashi, R. Nakashima, K. Sakurai, S. Yamasaki, C. Nagata, K. Hoshino, Y. Onodera, K. Nishino, A. Yamaguchi: The Gordon Research Conference on Multi-Drug Efflux Systems (Ventura, CA, U.S.A. • 2013.3.17~22).

- [2]Crystal structures of RamR-chemical compounds complexes (oral), S. Yamasaki, E. Nikaido, K. Sakurai, R. Nakashima, K. Nishino: ISIR-INRA project meeting (Nouzilly, France • 2013.3.9) .
- [3]Development of novel therapeutic strategies to tackle multidrug-resistant pathogens (poster), K. Nishino: 16th SANKEN International Symposium / 11th SANKEN Nanotechnology Symposium (Osaka, Japan • 2013.1.22~23).
- [4]The crystal structure of multidrug resistance regulator RamR reveal the mechanism of multiple drugs recognition (poster), S. Yamasaki, E. Nikaido, R. Nakashima, K. Sakurai, K. Nishino: 16th SANKEN International Symposium / 11th SANKEN Nanotechnology Symposium (Osaka, Japan • 2013.1.22~23).
- [5]Structures of AcrB Multidrug Efflux Pump Reveal the Peristaltic Drug Export Mechanism (poster), S. Yamasaki, K. Nishino, R. Nakashima, K. Sakurai, A. Yamaguchi: 16th SANKEN International Symposium / 11th SANKEN Nanotechnology Symposium (Osaka, Japan • 2013.1.22~23).
- [6]The Crystal Structures of Bacterial Multidrug Efflux Pumps with a Specific Inhibitor in the Common Inhibitory Narrow Pit (poster), K. Hayashi, R. Nakashima, K. Sakurai, S. Yamasaki, C. Nagata, K. Hoshino, Y. Onodera, K. Nishino, A. Yamaguchi: 16th SANKEN International Symposium / 11th SANKEN Nanotechnology Symposium (Osaka, Japan • 2013.1.22~23).
- [7]Crystal Structures of Bacterial Multidrug Efflux Pumps with a Specific Inhibitor (poster), K. Hayashi, R. Nakashima, K. Sakurai, S. Yamasaki, C. Nagata, K. Hoshino, Y. Onodera, K. Nishino, A. Yamaguchi: 8th Handai Nanoscience and Nanotechnology International Symposium (Osaka, Japan • 2012.12.10~11).
- [8]Development of novel therapeutic strategies to tackle multidrug-resistant pathogens (poster), K. Nishino, K. Hayashi, S. Yamasaki, S. Yamasaki, Y. Matsumoto, M. Hayashi-Nishino, A. Yamaguchi: New Frontiers of Metabolism Research in Biomedical Sciences (Tokyo, Japan • 2012.9.27).
- [9]Effects of indole on drug resistance and virulence of *Salmonella enterica* serovar Typhimurium revealed by genome-wide analyses (poster), S. Yamasaki, E. Nikaido, A. Yamaguchi, K. Nishino: New Frontiers of Metabolism Research in Biomedical Sciences (Tokyo, Japan • 2012.9.27).
- [10]Structures of the multidrug efflux pump AcrB reveal a proximal multisite drug-binding pocket (poster), S. Yamasaki, K. Nishino, R. Nakashima, K. Sakurai, A. Yamaguchi: New Frontiers of Metabolism Research in Biomedical Sciences (Tokyo, Japan • 2012.9.27).
- [11]Effects of indole on drug resistance and virulence of *Salmonella enterica* serovar Typhimurium revealed by genome-wide analyses (poster), E. Nikaido, E. Giraud, S. Baucheron, S. Yamasaki, A. Wiedemann, K. Okamoto, T. Takagi, A. Yamaguchi, A. Cloeckeaert, K. Nishino: 3rd ASM Conference on Antimicrobial Resistance in Zoonotic Bacteria and Foodborne Pathogens in Animals, Humans, and the Environment (Aix-en-Provence, France • 2012.6.26~29).
- [12]Effects of natural mutations in *ramRA* locus on invasiveness of epidemic fluoroquinolone-resistant *Salmonella typhimurium* isolates (poster), E. Giraud, S. Baucheron, I. Virlogeux-Payant, K. Nishino, A. Cloeckeaert: 3rd ASM Conference on Antimicrobial Resistance in Zoonotic Bacteria and Foodborne Pathogens in Animals, Humans, and the Environment (Aix-en-Provence, France • 2012.6.26~29).
- [13]Up-regulation of multidrug efflux pumps during the bacterial stress response to host physiological conditions (poster), K. Fung, Y. Zhang, K. Nishino, A. Yan: 3rd ASM Conference on Antimicrobial Resistance in Zoonotic Bacteria and Foodborne Pathogens in Animals, Humans, and the Environment (Aix-en-Provence, France • 2012.6.26~29).
- [14]Peristaltic drug export mechanism of the AcrB multidrug efflux pump (poster), S. Yamasaki, K. Nishino, R. Nakashima, K. Sakurai, A. Yamaguchi.: ASM American Society for Microbiology 112th

General Meeting (San Francisco, U. S. A. • 2012.616~19).

[15]MDR efflux pumps and bacterial virulence. Workshop on MDR Efflux Pumps and Salmonella (invited), K. Nishino: Workshop on MDR Efflux Pumps and Salmonella (Ghent, Belgium • 2013.3.5).

[16]Regulatory networks of bacterial multidrug resistance (oral), K. Nishino: Oxford University Special Workshop on Bio-Nanomaterials Devices (Osaka • 2012.12.21) .

Review Papers

The foundation of an electron microscope, and the application - "3D analysis of the cell organelle by electron beam tomography.", M. Hayashi-Nishino, Tissue cell chemistry technical protocol Leap in the challenge - clinical applied research of tissue cell chemistry -, Japan Society Histochemistry and Cytochemistry, 2012 (2012), 213-217.

Physiological functions of drug efflux pumps, K. Nishino, Advances in Pharmaceutical Sciences, Research Foundation for Pharmaceutical Sciences, 29 (2013), 27-31.

Regulation and function of drug efflux transporters, K. Nishino, Antibiotics & Chemotherapy, Iyaku (Medicine and Drug) Journal Co., Ltd., 29 (2013), 81-89.

Books

[1]Analysis of autophagy using an electron microscope(N. Mizushima, T. Yoshimori) M. Hayashi-Nishino, "Autophagy Autolysis system of the cell.", Kagakudojin, 14 (14) 2012.

[2]Multidrug efflux pumps and development of therapeutic strategies to control infectious diseases(Masakatsu Shibasaki, Masamitsu Iino, Hiroyuki Osada) K. Nishino, "Chembiomolecular Science", Springer, 3 (269-279) 2013.

Contributions to International Conferences and Journals

K. NISHINO	Frontiers in Microbiology (Antimicrobials, Resistance and Chemotherapy) (Associate Editor)
K. NISHINO	3rd ASM Conference on Antimicrobial Resistance (Program Advisory Committee)
K. NISHINO	Frontiers in Microbiology (Reviewer)
K. NISHINO	FEMS Microbiology Letters (Ad-Hoc Reviewer)
K. NISHINO	BMC Systems Biology (Ad-Hoc Reviewer)
K. NISHINO	PLoS One (Ad-Hoc Reviewer)
K. NISHINO	Journal of Antimicrobial Chemotherapy (Ad-Hoc Reviewer)
K. NISHINO	Molecular Microbiology (Ad-Hoc Reviewer)
K. NISHINO	Microbiology and Immunology (Ad-Hoc Reviewer)
K. NISHINO	Journal of Biochemistry (Ad-Hoc Reviewer)
S. YAMASAKI	Journal of Antimicrobial Chemotherapy (Ad-Hoc Reviewer)
K. NISHINO	Wellcome Trust (Reviewer of Research Fellowship)

Publications in Domestic Meetings

Science Café, Osaka University	1 paper
SANKEN Techno-Salon	1 paper
Academic lecture meeting of the Institute of Scientific and Industrial Research, Osaka University	2 papers
37th Lecture Meeting of the Society for Tissue Cell Chemistry	1 paper
The 133rd Annual Meeting of the Pharmaceutical Society of Japan	2 papers
86th General Meeting of Japanese Society for Bacteriology	2 papers
85th Annual Meeting of Japanese Biochemical Society	1 paper
Crystallographic Society of Japan annual convention in the Heisei 24 fiscal year, and a general meeting	1 paper
41th Research Meeting of Society for Bacterial Drug Resistance	1 paper

62nd Annural Meeting of Kinki Branch of the Pharmaceutical Society of Japan	1 paper
50th Annural Meeting of the Biophysical Society of Japan	1 paper
10th Physical Pharma Forum 2012	1 paper
BIA Symposium 2012	1 paper

Academic Degrees

Master Degree for Function and structural analysis of the bacteria drug-resistance regulator RamR
Pharmaceutical
Science
S. Yamasaki

Grant-in-Aid for Scientific Research

K. Nishino	Roles of drug efflux pumps in bacterial multidrug resistance · virulence and development of novel therapeutic strategies	¥47,190,000
M. Nishino	Inhibitor development and the functional elucidation of the drug efflux transporter which participates in multidrug resistance and pathogenic revelation	¥2,080,000

Entrusted Research

Y. Matsumoto	Result-of-research Development of the new rapid and deployment enterprise easy method to determine The result-of-research antibiotic susceptibility using a optimal deployment novel microfluidic device support program Feasibility study [FS] stage Search type	¥1,040,000
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Contribution to Research

K. Nishino	Mishima Kaiun Memorial Foundation	¥1,000,000
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Cooperative Research

K. Nishino	Axel Cloeckaert (INRA, France)	¥0,000
K. Nishino	Aixin Yan (University of Hong Kong)	¥400,000
K. Nishino	Daiichi-Sankyo	¥0,000
K. Nishino	Fine	¥5,000,000
K. Nishino	Filip Van Immerseel (Ghent University)	¥0,000
K. Nishino	Corinna Kehrenberg (Tierärztliche Hochschule Hannover)	¥0,000
M. Nishino	Yasuko Rikihisa (Ohio State University)	¥0,000
K. Nishino	Takeshi Noda, Tamotsu Yoshimori (Osaka University)	¥0,000
K. Nishino	Masaya Yamaguchi, Yutaka Terao, Shigetada Kawabata (大阪大学)	¥0,000
K. Nishino	Daiichi-Sankyo	¥0,000
K. Nishino	Toshiki Itoh (Kobe University)	¥100,000
K. Nishino	Ayano Satoh (Okayama University)	¥100,000

Other Research Fund

M. Nishino	Japan Society for the Promotion of Science, Bilateral Programs, Joint Research () (2012-2014)	¥2,500,000
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Laboratory of Atomic Scale Materials Processing

Original Papers

[1]Facile and scalable patterning of sublithographic scale uniform nanowires by ultra-thin AAO free-standing membrane, G. Meng, T. Yanagida, K. Nagashima, M. Kanai, S. Rahong, F. W. Zhuge, Y. He, T. Kawai: RSC Adv., 2 (2012) 10618-10623.

[2]Prominent Thermodynamical Interaction with Surroundings on Nanoscale Memristive Switching of Metal Oxides, K. Nagashima, T. Yanagida, M. Kanai, S. Rahong, G. Meng, F. W. Zhuge, Y. He, T. Kawai: Nano Lett., 12 (2012) 5684-5690.

[3]Switching Properties of Titanium Dioxide Nanowire Memristor, K. Nagashima, T. Yanagida, M. Kanai,

S. Rahong, G. Meng, F. W. Zhuge, Y. He, T. Kawai: Jpn. J. Appl. Phys., 51 (2012) 11PE09.

[4]Fundamental Strategy for Creating VLS Grown TiO₂ Single Crystalline Nanowires, F. W. Zhuge, T. Yanagida, K. Nagashima, H. Yoshida, M. Kanai, G. Meng, Y. He, S. Rahong, S. Takeda, T. Kawai: J. Phys. Chem. C, 116 (2012) 24367-24372.

[5]Crystal-Plane Dependence of Critical Concentration for Nucleation on Hydrothermal ZnO Nanowires, Y. He, T. Yanagida, K. Nagashima, F. W. Zhuge, G. Meng, S. Rahong, M. Kanai, T. Kawai: J. Phys. Chem. C, 117 (2013) 1197-1203.

[6]Pressure induced evaporation dynamics of gold nanoparticles on oxide substrate, G. Meng, T. Yanagida, M. Kanai, K. Nagashima, F. W. Zhuge, Y. He, S. Rahong, T. Kawai: Phys. Rev. E, 87 (2013) 012405.

International Conferences

[1]Spatially Controlled Uniform Oxide Nanowire Arrays by Ultra-thin AAO Membrane Mask (poster), G. Meng, T. Yanagida, M. Kanai, K. Nagashima, S. Rahong, T. Kawai: Material Research Society Spring Meeting 2012, San Francisco, USA, 2012.4.9-4.13.

[2]General Strategy for Impurity Doping in VLS Growth of Semiconductor Metal Oxide Nanowires (poster), T. Yanagida, M. Kanai, K. Nagashima, G. Meng, S. Rahong, F. W. Zhuge, Y. He, T. Kawai: Material Research Society Spring Meeting 2012, San Francisco, USA, 2012.4.9-4.13.

[3]Impact of Controlling Transport Pathway in VLS Grown Oxide Nanowires (poster), M. Kanai, T. Yanagida, K. Nagashima, G. Meng, S. Rahong, F. W. Zhuge, Y. He, T. Kawai: Material Research Society Spring Meeting 2012, San Francisco, USA, 2012.4.9-4.13.

[4]Identification of Nanoscale Memristive Switching Using a Single Oxide Nanowire (oral), K. Nagashima, T. Yanagida, M. Kanai, T. Kawai: Material Research Society Spring Meeting 2012, San Francisco, USA, 2012.4.9-4.13.

[5]Microfluidic Devices Integrated with VLS Grown Oxide Nanowires for Controlling Dynamics of Long DNA Molecules (poster), S. Rahong, T. Yanagida, M. Kanai, G. Meng, K. Nagashima, T. Kawai: Material Research Society Spring Meeting 2012, San Francisco, USA, 2012.4.9-4.13.

[6]Surrounding Effects on Nanoscale Memristive Switching Behaviors (oral), K. Nagashima, T. Yanagida, M. Kanai, S. Rahong, M. Gang, F. W. Zhuge, Y. He, T. Kawai: 19th International Workshop on Oxide Electronics, Apeldoorn, Netherland, 2012.9.30-10.3.

[7]Scaling Effect on Unipolar and Bipolar Resistive Switching (poster), T. Yanagida, K. Nagashima, M. Kanai, T. Kawai: 19th International Workshop on Oxide Electronics, Apeldoorn, Netherland, 2012.9.30-10.3.

[8]Intrinsic Redox Balancing of Nanoscale Memristive Oxides (poster), K. Nagashima, T. Yanagida, M. Kanai, T. Kawai: 5th International Symposium on Atomically Controlled Fabrication Technology, Osaka, Japan, 2012.10.22-10.24.

[9]Surrounding Effects on Nanoscale Memristive Switching Behaviors (oral), K. Nagashima, T. Yanagida, M. Kanai, T. Kawai: 25th International Microprocesses and Nanotechnology Conference, Hyogo, Japan, 2012.10.30-11.2.

[10]Crucial Role of Ambient Pressure on Thermal Shrinking of Au Nanodot Array (oral), G. Meng, T. Yanagida, K. Nagashima, M. Kanai, F. W. Zhuge, S. Rahong, Y. He, T. Kawai: 25th International Microprocesses and Nanotechnology Conference, Hyogo, Japan, 2012.10.30-11.2.

- [11]Oxide Nanowires DNA Chip for Long DNA Molecules Manipulation (oral), S. Rahong, T. Yanagida, M. Kanai, G. Meng, K. Nagashima, T. Kawai: 25th International Microprocesses and Nanotechnology Conference, Hyogo, Japan, 2012.10.30-11.2.
- [12]Creation of Novel Metal Oxide Nanowires (oral), T. Kawai, K. Nagashima, M. Kanai, T. Yanagida: Material Research Society Fall Meeting 2012, Boston, USA, 2012.11.26-30.
- [13]Nanowire Memristor: Fabrication and Memristive Properties (oral), T. Yanagida, K. Nagashima, M. Kanai, T. Kawai: Material Research Society Fall Meeting 2012, Boston, USA, 2012.11.26-30.
- [14]Impact of Crystal Plane Dependence of Saturated Concentration on Hydrothermal Growth of ZnO Nanowires (poster), Y. He, T. Yanagida, K. Nagashima, F. W. Zhuge, G. Meng, S. Rahong, M. Kanai, T. Kawai: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, 2012.12.10-11.
- [15]Photoassisted Atomic Switch Using ITO Nanowire Electrodes (poster), H. Tanaka, T. Tanaka, G. Meng, S. Rahong, K. Nagashima, M. Kanai, T. Yanagida, T. Kawai, T. Ogawa: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, 2012.12.10-11.
- [16]Novel Design Rule of Nanoscale Memristive Switching (poster), K. Nagashima, T. Yanagida, M. Kanai, S. Rahong, G. Meng, F. W. Zhuge, Y. He, T. Kawai: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, 2012.12.10-11.
- [17]Fundamental Strategy Toward VLS Grown TiO₂ Nanowires (poster), F. W. Zhuge, T. Yanagida, K. Nagashima, H. Yoshida, M. Kanai, G. Meng, Y. He, S. Rahong, T. Kawai: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, 2012.12.10-11.
- [18]Crucial Role of Surrounding Pressure on Thermal Shrinking of Au Nanoparticle Arrays (poster), G. Meng, T. Yanagida, K. Nagashima, M. Kanai, F. W. Zhuge, S. Rahong, Y. He, T. Kawai: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, 2012.12.10-11.
- [19]Oxide Nanowires DNA chip for Long DNA Molecules Manipulation (poster), S. Rahong, T. Yanagida, M. Kanai, G. Meng, K. Nagashima, T. Kawai: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, 2012.12.10-11.
- [20]Novel Design Rule Toward Nanoscale Memristive Switching (poster), K. Nagashima, T. Yanagida, M. Kanai, S. Rahong, G. Meng, F. W. Zhuge, Y. He, T. Kawai: The 16th SANKEN International Symposium 2013, The 11th SANKEN Nanotechnology Symposium, Sustainable Society -After the Nuclear Power Plant Accident-, Osaka, Japan, 2013.1.22-23.
- [21]Exquisite Size Control of Au Nanoparticle Arrays by Thermal Shrinking (poster), G. Meng, T. Yanagida, K. Nagashima, M. Kanai, F. W. Zhuge, S. Rahong, Y. He, T. Kawai: The 16th SANKEN International Symposium 2013, The 11th SANKEN Nanotechnology Symposium, Sustainable Society -After the Nuclear Power Plant Accident-, Osaka, Japan, 2013.1.22-23.
- [22]Crystal Plane Dependence of Critical Concentration for Nucleation on Hydrothermal ZnO Nanowires (poster), Y. He, T. Yanagida, K. Nagashima, F. W. Zhuge, G. Meng, S. Rahong, M. Kanai, T. Kawai: The 16th SANKEN International Symposium 2013, The 11th SANKEN Nanotechnology Symposium, Sustainable Society -After the Nuclear Power Plant Accident-, Osaka, Japan, 2013.1.22-23.
- [23]Fundamental strategy for VLS grown TiO₂ nanowires (poster), F. W. Zhuge, T. Yanagida, K. Nagashima, H. Yoshida, M. Kanai, G. Meng, Y. He, S. Rahong, S. Takeda, T. Kawai: The 16th SANKEN International Symposium 2013, The 11th SANKEN Nanotechnology Symposium, Sustainable Society -After the Nuclear Power Plant Accident-, Osaka, Japan, 2013.1.22-23.

[24]Photoassisted Atomic Switch using ITO Nanowire Electrodes (poster), H. Tanaka, D. Tanaka, G. Meng, S. Rahong, K. Nagashima, M. Kanai, T. Yanagida, T. Kawai, T. Ogawa: The 16th SANKEN International Symposium 2013, The 11th SANKEN Nanotechnology Symposium, Sustainable Society -After the Nuclear Power Plant Accident-, Osaka, Japan, 2013.1.22-23.

Publications in Domestic Meetings

The Japan Society of Applied Physics	7 papers
The Society of Chemical Engineers, Japan	2 papers
Scientific Research in Innovative Areas 'Emergence in Chemistry' Symposium	1 paper

Grant-in-Aid for Scientific Research

T.Yanagida	Green innovation by oxide nanowire based nanodevices	¥48,750,000
K.Nagashima	Synthesis of redox based switching nanodevice using oxide nanowire	¥780,000

Contribution to Research

T.Yanagida	Support Center for Advanced Telecommunications Technology Research, Foundation	¥1,000,000
T.Yanagida	Kato Foundation for Promotion of Science.	¥1,500,000

Cooperative Research

T.Yanagida	Panasonic Co.	¥2,500,000
T.Yanagida	Panasonic Co.	¥578,000

Laboratory of Cellulose Nanofiber Materials

Original Papers

[1]Ag nanowires: large-scale synthesis via a trace-salt-assisted solvothermal process and application in transparent electrodes, Jinting Jiu, Tohru Sugahara, Masaya Nogi, Katsuaki Suganuma: Journal of Nanoparticle Research, 15 (2013) 1588.

[2]Low-Temperature Pressure-Less Silver Direct Bonding, Teppei Kunimune, Masafumi Kuramoto, Satoru Ogawa, Masaya Nogi, and Katsuaki Suganuma: IEEE Transactions on Components, Packaging and Manufacturing Technology, 3 (3) (2013) 363-369.

[3]Transparent, Conductive, and Printable Composites Consisting of TEMPO-Oxidized Nanocellulose and Carbon Nanotube, Hiroataka Koga, Tsuguyuki Saito, Takuya Kitaoka, Masaya Nogi, Katsuaki Suganuma, Akira Isogai: Biomacromolecules, 14 (4) (2013) 1160-1165.

[4]Effect of Void Volume and Silver Loading on Strain Response of Electrical Resistance in Silver Flakes/Polyurethane Composite for Stretchable Conductors, Teppei Araki, Tohru Sugahara, Masaya Nogi, and Katsuaki Suganuma: Jpn. J. Appl. Phys., 51 (2012) 11PD01.

[5]Ag/TiO₂ core-shell nanocables prepared with a one-step polyol process, Jinting Jiu, Masaya Nogi, Tohru Sugahara, Katsuaki Suganuma, Masahiko Tsujimoto, Seiji Isoda: Journal of Nanoparticle Research, 14 (2012) 1241.

[6]Highly sensitive antenna using inkjet overprinting with particle-free conductive inks, INatsuki Komoda, Masaya Nogi, Katsuaki Suganuma, and Kanji Otsuka: ACS Appl. Mater. Interfaces, 4 (11) (2012) 5732-5736.

[7]Strongly adhesive and flexible transparent silver nanowire conductive film fabricated with high-intensity pulsed light technique, Jinting Jiu, Masaya Nogi, Tohru Sugahara, Takehiro Tokuno, Teppei Araki, Natsuki Komoda, Katsuaki Suganuma, Hiroshi Uchida and Kenji Shinozaki: Journal of Materials Chemistry, 22 (2012) 23561-23567.

[8]Absorption layers of ink vehicles for inkjet-printed lines with low electrical resistance, Changjae Kim,

Masaya Nogi, Katsuaki Suganuma, Yukie Saitou, Jun Shirakami: RSC Advances, 2 (2012) 8447-8451.

[9]Interfaces in Cross-Linked and Grafted Bacterial Cellulose/Poly(Lactic Acid) Resin Composites, IFranck Quero, Stephen J. Eichhorn, Masaya Nogi, Hiroyuki Yano, Koon-Yang Lee, Alexander Bismarck: Journal of Polymers and the Environment, 20 (2012) 916-925.

[10]Synthesis and application of Ag nanowires via a trace salt assisted hydrothermal process, Jinting Jiu, Takehiro Tokuno, Masaya Nogi, Katsuaki Suganuma: J Nanopart Res, 14 (2012) 975.

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Symposium on maicro-nano fabrication	1 paper

Grant-in-Aid for Scientific Research

M. Nogi	Environmentally-Friendly and Low-Temperature Printed Electronics by Using Bionanofibers	¥55,900,000
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Contribution to Research

M. Nogi	Chuetsu Pulp & Paper Co., Ltd.	¥1,200,000
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Cooperative Research

M. Nogi	ALBION Co. Ltd.	¥550,000
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[10]Alpha1,6 fucosyltransferase, Fut8 is implicated in sensitivity to emphysema in mice and a possible predictive marker for disease progression and exacerbations in chronic obstructive pulmonary disease (COPD). (invited), N. Taniguchi: RIKEN-Academia Sinica Joint Conference on Chemical Biology, Taipei, Taiwan, March 1-3, 2013.

Review Papers

Integrated approach toward the discovery of glyco-biomarkers of inflammation-related diseases., T. Angata, R. Fujinawa, A. Kurimoto, K. Nakajima, M. Kato, S. Takamatsu, H. Korekane, CX. Gao, K. Ohtsubo, S. Kitazume and N. Taniguchi, Ann. NY Acad. Sci., Wiley-Blackwell, 1253 (2012), 159-169.

Biological functions of branched N-glycans related to physiology and pathology of extracellular matrix., C. Gao, K. Ohtsubo, J. Gu and N. Taniguchi, Extracellular Matrix: Pathobiology and Signaling, De Gruyter, (2012), 119-132.

Contributions to International Conferences and Journals

N. TANIGUCHI	Glycobiology (Editorial Board)
N. TANIGUCHI	IUBMB life (Editorial Board)
N. TANIGUCHI	IUBMB Biochemistry and Molecular Biology Education (Editorial Board)
N. TANIGUCHI	Journal of Biological Chemistry (Editorial Board)
N. TANIGUCHI	Nitric Oxide (Editorial Board)
N. TANIGUCHI	Protein Expression and Purification (Editorial Board)
N. TANIGUCHI	Biochemical and Biophysical Research Communications (Editor)
N. TANIGUCHI	International Journal of Oncology (Editor)
N. TANIGUCHI	Glycoconjugate Journal (Review Editor)
N. TANIGUCHI	Proteomics/ Proteomics-Clinical Applications (Senior Editor)
N. TANIGUCHI	GlycoT (Scientific Advisory Board)
N. TANIGUCHI	Cellular and Molecular Life Sciences (Editorial Board)
N. TANIGUCHI	Journal of Proteome Research (Editorial Advisory Board)

N. TANIGUCHI Clinical Proteomics (Editorial Board)
 N. TANIGUCHI Antioxidants and Redox Signaling (Editorial Board)

Publications in Domestic Meetings

The 13th Forum and Annual Meeting for Kansai Glycoscientists 2012	1 paper
The 4th Joint Symposium for Okayama University and RIKEN	1 paper
Annual Meeting of Hokkaido University Medical School Alumni Association Kanagawa-Frate	1 paper
2012 Annual Meeting of Japanese Proteomics Society/The 10th JHUPO Conference	1 paper
The 5th Symphony	1 paper
The 31st Annual Meeting of the Japanese Society of Carbohydrate Research	2 papers
The 85th Annual Meeting of the Japanese Biochemical Society	3 papers

Grant-in-Aid for Scientific Research

K. Ohtsubo	Development of novel antidiabetes drugs by targeting an antidiabetic factor "GnT-Iva".	¥4,550,000
C. Gao	Molecular mechanism of early-onset Chronic Obstructive Pulmonary Disease caused by genetic mutation for Fut8.	¥5,200,000

Department of Functional Nanomaterials and Nanodevices

Original Papers

- [1]In-Plane Oblique Pulsed-Laser Deposition and Its Application to the Fabrication of Metal Oxide Nanoconstrictions, T. Kushizaki, K. Fujiwara, Y. Fujiwara, A. N. Hattori, and H. Tanaka: Appl. Phys. Express, 6 (2013) 035201(1-3).
- [2]Electric-field breakdown of the insulating charge-ordered state in LuFe₂O₄ thin films, K. Fujiwara, T. Hori, and H. Tanaka: J. Phys. D: Appl. Phys., 46 (2013) 155108(1-4).
- [3]Epitaxial inversion on ferromagnetic (Fe,Zn)₃O₄/ferroelectric BiFeO₃ core-shell nanodot arrays using three dimensional nano-seeding assembly, T. Sakamoto, K. Okada, A. N. Hattori, T. Kanki, A. S. Borowiak, B. Gautier, B. Vilquin, and H. Tanaka: J. Appl. Phys., 113 (2013) 104302(1-5).
- [4]Compositionally tunable three-dimensional nano-seeding assembly in Fe-LaSrFeO₄ nanostructure, K. Okada and H. Tanaka: J. Appl. Phys., 113 (2013) 064317(1-5).
- [5]Increase in initial permeability due to substitution of high spin cations in nanocrystalline Ni-Mg ferrites, A. K. M. A. Hossain, M. R. Amin, and H. Tanaka: J. Magn. Magn. Mater., 334 (2013) 124-129.
- [6]Nanowall shaped MgO substrate with flat (100) sidesurface: A new route to three-dimensional functional oxide nanostructured electronics, Y. Fujiwara, A. N. Hattori, K. Fujiwara and H. Tanaka: Jpn. J. Appl. Phys., 52 (2012) 015001(1-5).
- [7]Multistate Memory Devices based on Free-standing VO₂/TiO₂ Microstructures Driven by Joule Self-heating, Luca Pellegrino, Nicola Manca, Teruo Kanki, Hidekazu Tanaka, Michele Biasotti, Emilio Bellingeri, Antonio Sergio Siri, and Daniele Marre: Adv. Mater., 24 (2012) 2929-2934.
- [8]Tuning metal-insulator transition by one dimensional alignment of giant electronic domains in artificially size-controlled epitaxial VO₂ wires, Hidefumi Takami, Kenichi Kawatani, Hiroki Ueda, Kohei Fujiwara, Teruo Kanki, and Hidekazu Tanaka: Appl. Phys. Lett., 101 (2012) 263111(1-4).
- [9]Direct observation of giant metallic domain evolution driven by electric bias in VO₂ thin films on TiO₂(001) substrate, Teruo Kanki, Kenichi Kawatani, Hidefumi Takami, and Hidekazu Tanaka: Appl. Phys. Lett., 101 (2012) 243118(1-3).
- [10]Metal-insulator transition with multiple micro-scaled avalanches in VO₂ thin film on TiO₂(001) substrates, Kenichi Kawatani, Hidefumi Takami, Teruo Kanki, and Hidekazu Tanaka: Appl. Phys. Lett.,

100 (2012) 173112(1-3).

[11] Filling-controlled Mott Transition in W-doped VO₂, Hidefumi Takami, Teruo Kanki, Shigenori Ueda, Keisuke Kobayashi, and Hidekazu Tanaka: Phys. Rev. B, 85 (2012) 205111(1-4).

[12] ZnO nanobox luminescent source fabricated by three-dimensional nanotemplate pulsed-laser deposition, A. N. Hattori, M. Ichimiya, M. Ashida and H. Tanaka: Appl. Phys. Express, 5 (2012) 125203(1-3).

[13] Controlled fabrication of artificial ferromagnetic (Fe,Mn)₃O₄ nanowall-wires by a three-dimensional nanotemplate pulsed laser deposition method, T. Kushizaki, K. Fujiwara, A. N. Hattori, T. Kanki, and H. Tanaka: Nanotechnology, 23 (2012) 485308(1-5).

[14] Position-controlled functional oxide lateral heterostructures consisting of artificially-aligned (Fe,Zn)₃O₄ nanodots and BiFeO₃ matrix, T. Sakamoto, K. Okada, A. N. Hattori, T. Kanki, and H. Tanaka: Nanotechnology, 23 (2012) 335302(1-6).

[15] 3D nano-seeding assembly of ferromagnetic Fe/LaSrFeO₄ nano-hetero dot array, K. Okada, T. Sakamoto, K. Fujiwara, A. N. Hattori, T. Kanki, and H. Tanaka: J. Appl. Phys., 112 (2012) 024320(1-7).

International Conferences

[1] Correlated Nano-Oxide Materials for Electronic Phase Change Electronics (oral), H. Tanaka, T. Kanki, A. Hattori, K. Fujiwara: The 16th SANKEN International Symposium 2013, The 11th SANKEN Nanotechnology Symposium, Osaka, Japan.

[2] 3 Dimensional Oxide Nano-structures: – A tool to rule strongly correlated electrons – (invited), H. Tanaka: The 13th RIES-Hokudai International Symposium, Sapporo, Hokkaido 律[ritsu] Joined with The 1st International Symposium of Nano-Macro Materials, Devices, and System Research Alliance Project.

[3] Functional Oxide Semiconductor Nano-wall and Box-structures Fabricated by Three-Dimensional Nanotemplate Pulsed-Laser Deposition (poster), Hidekazu Tanaka, Azusa N. Hattori, Masayoshi Ichimiya, and Masaaki Ashida: 2012 MRS Fall Meeting & Exhibit, Boston, MA, USA.

[4] 3D Nano-seeding Assembly of Well Ordered Ferromagnetic Fe/LaSrFeO₄ Nano-hetero Dot Array (poster), Hidekazu Tanaka, Koichi Okada, Takuya Sakamoto, Kohei Fujiwara, Azusa N. Hattori, and Teruo Kanki: 2012 MRS Fall Meeting & Exhibit, Boston, MA, USA.

[5] Sustainable Spintronic Fe Oxides and Their Nano-device Application (invited), Hidekazu Tanaka: 2012 International Symposium on Magnetic Materials and their applications, Ningbo, China.

[6] Nano-confinement steep magnetoresistance in extremely small (La,Pr,Ca)MnO₃ epitaxial nanowall wire by 3D nano-template PLD (oral), Hidekazu Tanaka: Workshop on Oxide Electronics 19 (WOE19), Apeldoorn, Netherland.

[7] Fabrication of Multi-dimensional Oxide Nanostructures and its Physical Properties (invited), Hidekazu Tanaka: 2012 MRS Spring Meeting, San Francisco, California, USA.

[8] Fabrication of Metal Oxide Nanoconstrictions by In-Plane Oblique Deposition (poster), Kohei Fujiwara, Takayoshi Kushizaki, Yasushi Fujiwara, Azusa N. Hattori, and Hidekazu Tanaka: The 16th SANKEN International Symposium 2013, The 11th SANKEN Nanotechnology Symposium, Osaka, Japan.

[9] Fabrication of free-standing microstructures in vanadium dioxide thin films and their transport

properties (poster), S. Yamasaki, T. Kanki, L. Pellegrino, N. Manca, A. S. Siri, D. Marré, and H. Tanaka: The 16th SANKEN International Symposium 2013, The 11th SANKEN Nanotechnology Symposium, Osaka, Japan.

[10]Investigation of digital metal-insulator transition for tailor-made VO₂ nanowires on Al₂O₃ (0001) substrates (poster), Hidefumi Takami, Kenichi Kawatani, Hiroki Ueda, Kohei Fujiwara, Teruo Kanki, and Hidekazu Tanaka: The 13th Japan-Korea-Taiwan Symposium on Strongly Correlated Electron Systems, Toyonaka, Osaka, Japan.

[11]Electronic structure of the (La,Pr,Ca)MnO₃ nanobox structures fabricated by 3D nanotemplate PLD technique (poster), N. T. V. Anh, A. N. Hattori, Y. Fujiwara, S. Ueda, and H. Tanaka: The 13th Japan-Korea-Taiwan Symposium on Strongly Correlated Electron Systems, Toyonaka, Osaka, Japan.

[12]Drastic magnetoresistance change originated from the single electronic phase dynamics in (La,Pr,Ca)MnO₃ nanowall wire structures (poster), Yasushi Fujiwara, Azusa N. Hattori, Kohei Fujiwara, and Hidekazu Tanaka: The 13th Japan-Korea-Taiwan Symposium on Strongly Correlated Electron Systems, Toyonaka, Osaka, Japan.

[13]Dimension-control of giant metal-insulator domain patterns in VO₂ thin films and their electronic properties (poster), Hiroki Ueda, Hidefumi Takami, Kenichi Kawatani, Teruo Kanki, and Hidekazu Tanaka: 8th Handai Nanoscience and Nanotechnology International Symposium, Suita, Osaka, Japan.

[14]Fabrication of the (La,Pr,Ca)MnO₃ nanobox structures by 3D nanotemplate PLD technique and investigation of their electronic structure (poster), N. T. V. Anh, A. N. Hattori, Y. Fujiwara, S. Ueda, and H. Tanaka: 8th Handai Nanoscience and Nanotechnology International Symposium, Suita, Osaka, Japan.

[15]Investigation of nano-confinement effect on magnetoresistance in (La,Pr,Ca)MnO₃ epitaxial nanowall wire structures (poster), Yasushi Fujiwara, Azusa N. Hattori, Kohei Fujiwara, and Hidekazu Tanaka: 8th Handai Nanoscience and Nanotechnology International Symposium, Suita, Osaka, Japan.

[16]Controlled fabrication of (Fe, Mn)₃O₄ nanowall-wires and constrictions by a three-dimensional nanotemplate pulsed laser deposition method (poster), Takayoshi Kushizaki, Kohei Fujiwara, Azusa N. Hattori, Teruo Kanki, and Hidekazu Tanaka: 8th Handai Nanoscience and Nanotechnology International Symposium, Suita, Osaka, Japan.

[17]Dimension control of electronic phase configuration consisting of metal-insulator domains in VO₂ wires on TiO₂ (001) substrates (poster), Hidefumi Takami, Kenichi Kawatani, Hiroki Ueda, Kohei Fujiwara, Teruo Kanki, and Hidekazu Tanaka: 2012 MRS Fall Meeting & Exhibit, Boston, MA, USA.

[18]Tailor-made VO₂ nanowires on Al₂O₃ (0001) substrates for digitized metal-insulator transition (poster), Hidefumi Takami, Kenichi Kawatani, Hiroki Ueda, Kohei Fujiwara, Teruo Kanki, and Hidekazu Tanaka: 2012 MRS Fall Meeting & Exhibit, Boston, MA, USA.

[19]Field-effect transistor based on ferromagnetic (Fe,Zn)₃O₄ epitaxial thin film: towards electrical control of magnetism for dissipationless electronics (poster), T. Ichimura, K. Fujiwara, T. Kushizaki, T. Kanki, and H. Tanaka: The 6th International Workshop on ADVANCED MATERIALS SCIENCE AND NANOTECHNOLOGY - IWAMSN 2012 Ha Long City, Vietnam.

[20]Extremely small luminescent ZnO nanobox structure fabricated by three-dimensional nanotemplate pulsed-laser deposition (oral), Azusa N. Hattori: Workshop on Oxide Electronics 19 (WOE19), Apeldoorn, Netherland.

[21]Studying multifunctional oxide thin films by all-oxide microcantilevers (oral), L. Pellegrino, M. Biasotti, N. Manca, E. Bellingeri, C. Bernini, A.S. Siri, D. Marré, T. Kanki, and H. Tanaka: Workshop on

Oxide Electronics 19 (WOE19), Apeldoorn, Netherland.

[22]One dimensional alignment of metal-insulator domains in size-controlled VO₂ wires and their electronic properties (poster), Teruo Kanki, Hidefumi Takami, Kenichi Kawatani, Hiroki Ueda, Kohei Fujiwara, and Hidekazu Tanaka: Workshop on Oxide Electronics 19 (WOE19), Apeldoorn, Netherland.

[23]Electronic phase engineering: One dimensional organization of metal-insulator domains in size-controlled VO₂ nano-wires (invited), : Seminar at Genova University.

[24]Noise-driven signal transmitter using nonlinear effect of functional oxide thin films (invited), Teruo Kanki: BIT's 1st Annual World Congress of Advanced Materials-2012 (WCAM-2012), Beijing, China.

[25]Exotic signal transmission driven by noise using functional oxides (invited), Teruo Kanki: Seminar in Chinese Academy of Sciences (CAS) at Ningbo Institute of Material Technology and Engineering, Ningbo, China.

[26]3D Nano-Seeding Self-Assembly of Ferromagnetic Fe Dot Array-LaSrFeO₄ Nano-Heterostructure (invited), Koichi Okada, Takuya Sakamoto, Kohei Fujiwara, Azusa N.Hattori, Teruo Kanki, and Hidekazu Tanaka: The Twentieth Annual International Conference on Composites/Nano Engineering (ICCE-20), Beijing, China.

Patents

[1]Semiconductor Light Emitting diode Hidekazu Tanaka, Tomoji Kawai, Patent 5209417

Contributions to International Conferences and Journals

H. Tanaka CIMTEC 2014 (13th International Ceramics Congress) CIMTEC 2014 13th International Ceramics Congress (Organizing Committee)

Publications in Domestic Meetings

The 60th JSAP Spring Meeting,2013	6 papers
The 32nd annual meeting of the Surface Science Society of Japan	2 papers
The 56th Japan Congress on Materials Research	1 paper
The 72th JSAP Autumn Meeting,2012	7 papers

Academic Degrees

Master Degree for Engineering Y. Fujiwara	Creation of Strongly Correlated Electron Oxide Nanowall-Wire and Investigation of Digital Magnetoresistance
Master Degree for Engineering T. Kushizaki	Creation of the Magnetoresistive Device Using an Oxide Nanowall Constriction -Toward the Large Magnetoresistance Effect-
Master Degree for Engineering A. Ono	Physical property evaluation of (La,Pr,Ca)MnO ₃ nanowall wire created on 3D nanotemplate SrTiO ₃ substrate

Grant-in-Aid for Scientific Research

H. Tanaka	Nano-spintronics based on self-organized oxide nanostructures	¥5,590,000
H. Tanaka	Novel Nano-electronics based on Strongly Correlated Oxides	¥14,560,000
T. Kanki	Electronic material development for new concept signal transmitter driven by noise	¥1,950,000
K. Fujiwara	Mechanism of electric-field-induced resistive switching in binary transition metal oxides	¥780,000

Entrusted Research

H. Tanaka	Nanotechnology Platform	Molecular & Material Synthesis Platform	¥35,000,000
H. Tanaka	New Energy and Industrial Technology Development	Development of Spintronics devices using High temperature sustainable Fe oxide ferromagnetic	¥21,320,000

	Organization	semiconductor	
Cooperative Research			
H. Tanaka	Naturetechnology Co. Ltd.		¥660,000
Other Research Fund			
H. Tanaka	International Collaborations(India)		¥1,000,000

Department of Advanced Nanofabrication

Original Papers

- [1]Radiation-induced radicals in hydrated magnesium sulfate, A. Tani, N. Hasegawa, K. Norizawa, T. Yada, M. Ikeya: Radiat. Meas., 47 (2012) 890-893.
- [2]Development of double-decker pulse radiolysis, K. Kan, T. Kondoh, J. Yang, A. Ogata, K. Norizawa, Y. Yoshida: Rev. Sci. Instrum., 83 (2012) 073302.
- [3]Femtosecond pulse radiolysis study of geminate ion recombination in biphenyl-dodecane solution, T. Kondoh, J. Yang, K. Norizawa, K. Kan, T. Kozawa, A. Ogata, S. Tagawa, Y. Yoshida: Radiat. Phys. Chem., 84 (2012) 30-34.

International Conferences

- [1]Femtosecond Electron Guns for Ultrafast Electron Diffraction (invited), J. Yang: International Particle Accelerator Conference (IPAC'12), USA.
- [2]Femtosecond Pulse Radiolysis for Radiation Chemistry (invited), T. Kondoh, J. Yang, K. Norizawa, K. Kan, H Kobayashi, A Ogata, S. Tagawa, Y. Yoshida: 3rd World Class Institute Symposium (WCI-Symposium 2012), Korea.
- [3]THz-wave generation using femtosecond electron beam (invited), K. Kan, J. Yang, A. Ogata, T. Kondoh, K. Norizawa, Y. Yoshida, M. Hangyo: 3rd World Class Institute Symposium (WCI-Symposium 2012), Korea.
- [4]Recent Progress of Femtosecond Pulse Radiolysis (invited), Y. Yoshida: 4th Asia Pacific Symposium on Radiation Chemistry (APSRC-2012), China.
- [5]Development of Femtosecond time-resolved MeV Electron Microscopy (invited), J. Yang: Workshop on Ultrafast Electron Sources for Diffraction and Microscopy Applications, USA.
- [6]MeV Electron Diffraction and Microscopy in Osaka University (invited), J. Yang: The 3ed Banff Meeting on Structural Dynamics: Ultrafast Dynamics with X-rays and Electrons, Canada.
- [7]Ultrafast MeV Electron Diffraction and Microscopy (invited), J. Yang: 4th Asian Forum for Accelerators and Detectors (AFAD-2013), Russia.
- [8]Femtosecond pulse radiolysis studied on primary process of radiation chemistry (invited), Y. Yoshida: the 28th Miller Conference on Radiation Chemistry, Israel.
- [9]Femtosecond Pulse Radiolysis Study on Solvation Process of Electrons in Neat Alcohols (poster), K. Norizawa, T. Kondoh, K. Kan, J. Yang, T. Kozawa, Y. Yoshida: Sci-Mix in Kanazawa 2012, Japan.
- [10]Inverse Cherenkov Radiation based on Smith-Purcell Effect (poster), K. Kan, T. Kondoh, K. Norizawa, A. Ogata, J. Yang, Y. Yoshida, M. Hangyo: International Particle Accelerator Conference (IPAC'12), USA.
- [11]High-intensity Monochromatic Cherenkov Radiation in THz Range by Femtosecond Electron Bunches in Impurity-doped Semiconductor Tube (poster), A. Ogata, K. Kan, T. Kondoh, K. Norizawa, J.

Yang, Y. Yoshida: International Particle Accelerator Conference (IPAC'12), USA.

[12]Progress of the Equivalent Velocity Spectroscopy Method for Femtosecond Pulse Radiolysis by Pulse Rotation and Pulse Compression (poster), T. Kondoh, K. Kan, K. Norizawa, A. Ogata, S. Tagawa, J. Yang, Y. Yoshida, H. Kobayashi: International Particle Accelerator Conference (IPAC'12), USA.

[13]Development of Femtosecond Pulse Radiolysis (poster), Y. Yoshida, T. Kondoh, J. Yang, K. Norizawa, K. Kan, H. Kobayashi, A. Ogata, S. Tagawa: The Radiation Chemistry Gordon Research Conference (GRC), USA.

[14]Geminate Ion Recombination and Ultrafast Charge Transfer in n-Dodecane Studied by Femtosecond Pulse Radiolysis (poster), T. Kondoh, J. Yang, K. Norizawa, K. Kan, H. Kobayashi, A. Ogata, S. Tagawa, Y. Yoshida: The Radiation Chemistry Gordon Research Conference (GRC), USA.

[15]Solvation Kinetics of Electrons in Neat Alcohols studied by Femtosecond Pulse Radiolysis (oral), K. Norizawa, T. Kondoh, K. Kan, J. Yang, T. Kozawa, Y. Yoshida: The Radiation Chemistry Gordon Research Conference (GRC), USA.

[16]Terahertz-wave generation using metamaterial and femtosecond electron bunch (oral), K. Kan, J. Yang, A. Ogata, T. Kondoh, K. Norizawa, Y. Yoshida, M. Hangyo: International Conference on Infrared, Millimeter and Terahertz Waves (IRMMW-THz 2012), Australia.

[17]Geminate Ion Recombination and Ultrafast Charge Transfer In N-dodecane Studied by Femtosecond Pulse Radiolysis (oral), T. Kondoh: 4th Asia Pacific Symposium on Radiation Chemistry (APSRC-2012), China.

[18]Pulse Radiolysis Study of Solvated Electron in Alcohol at Low Temperature (oral), K. Norizawa: 4th Asia Pacific Symposium on Radiation Chemistry (APSRC-2012), China.

[19]Pulse Radiolysis Based on Double-decker Electron Beams (poster), K. Kan: 4th Asia Pacific Symposium on Radiation Chemistry (APSRC-2012), China.

[20]Ultrafast Electron Diffraction for Radiation Chemistry (poster), J. Yang: 4th Asia Pacific Symposium on Radiation Chemistry (APSRC-2012), China.

[21]ESR Studies on Mn²⁺ Signal in Epsomite Prepared in Different Synthetic Conditions (poster), A. Tani, N. Hasegawa, K. Norizawa, T. Yada: 3rd Asia Pacific Conference on Luminescence and Electron Spin Resonance dating (3rd APLED), Japan.

[22]Smith-Purcell Radiation Based on Femtosecond Electron Beam (poster), K. Kan, J. Yang, A. Ogata, T. Kondoh, K. Norizawa, H. Kobayashi, Y. Yoshida, M. Hangyo: International Symposium on Frontiers in THz Technology (FTT2012), Japan.

[23]The Equivalent Velocity Spectroscopy Pulse Radiolysis by Using the Transverse and Longitudinal Modulation of Electron Beam (poster), T. Kondoh, K. Kan, J. Yang, T. Toigawa, K. Norizawa, H. Kobayashi, A. Ogata, Y. Yoshida: 8th Handai Nanoscience and Nanotechnology International Symposium, Japan.

[24]Development of Femtosecond Time-resolved MeV Electron Microscopy (poster), J. Yang, T. Kondoh, K. Kan, N. Naruse, Y. Yoshida, K. Tanimura: 8th Handai Nanoscience and Nanotechnology International Symposium, Japan.

[25]Formation Process of Solvated Electron in Alcohol (poster), K. Norizawa, T. Kondoh, K. Kan, J. Yang, Yoichi Yoshida: 8th Handai Nanoscience and Nanotechnology International Symposium, Japan.

- [26]Femtosecond Pulse Radiolysis Study of Solvation Process of Electrons in Neat Alcohol (poster), K. Norizawa, T. Kondoh, K. Kan, J. Yang, T. Kozawa, A. Ogata, Y. Yoshida: 8th Handai Nanoscience and Nanotechnology International Symposium, Japan.
- [27]Terahertz-wave Generation Using Metamaterial and Femtosecond Electron Beam (poster), K. Kan, J. Yang, A. Ogata, T. Kondoh, K. Norizawa, Y. Yoshida, M. Hangyo: 8th Handai Nanoscience and Nanotechnology International Symposium, Japan.
- [28]Attosecond and femtosecond radiation-induced phenomena (oral), Y. Yoshida: 16th SANKEN International Symposium and 11th SANKEN Nanotechnology Symposium, Japan.
- [29]Femtosecond Time-resolved Electron Microscopy (oral), J. Yang: 16th SANKEN International Symposium and 11th SANKEN Nanotechnology Symposium, Japan.
- [30]Equivalent Velocity Spectroscopy for Femtosecond Pulse Radiolysis and Initial Process of Radiation Chemistry (poster), T. Kondoh, K. Kan, J. Yang, K. Norizawa, H. Kobayashi, A. Ogata, S. Tagawa, Y. Yoshida: 16th SANKEN International Symposium and 11th SANKEN Nanotechnology Symposium, Japan.
- [31]Generation of THz-wave using ultrashort electron beam (poster), K. Kan, J. Yang, A. Ogata, T. Kondoh, K. Norizawa, Y. Yoshida, M. Hangyo: 16th SANKEN International Symposium and 11th SANKEN Nanotechnology Symposium, Japan.
- [32]Femtosecond Pulse Radiolysis Study of Solvation Process of Electrons in Neat Alcohol (poster), K. Norizawa, T. Kondoh, K. Kan, J. Yang, T. Kozawa, A. Ogata, Y. Yoshida: 16th SANKEN International Symposium and 11th SANKEN Nanotechnology Symposium, Japan.
- [33]Formation Process of Solvated Electron in Alcohol at Low Temperature (poster), K. Norizawa, T. Kondoh, K. Kan, J. Yang, Y. Yoshida: 16th SANKEN International Symposium and 11th SANKEN Nanotechnology Symposium, Japan.
- [34]First observation of formation and geminate recombination of hydrated electron in femtosecond radiolysis (poster), Jinfeng Yang, Takafumi Kondoh, Kimihiro Norizawa, Yoichi Yoshida: the 28th Miller Conference on Radiation Chemistry, Israel.
- [35]Femtosecond pulse radiolysis study of dodecane radical cation (poster), Takafumi Kondoh, Jinfeng Yang, Kimihiro Norizawa, Koichi Kan, Hitoshi Kobayashi, Atsushi Ogata, Seiichi Tagawa: the 28th Miller Conference on Radiation Chemistry, Israel.
- [36]Temperature dependence of solvation process of excess electron in alcohol (poster), Kimihiro Norizawa, Takafumi Kondoh, Koichi Kan, Jinfeng Yang, Yoichi Yoshida: the 28th Miller Conference on Radiation Chemistry, Israel.
- [37]Femtosecond pulse radiolysis study on the spectral shift during solvation process of electrons in neat alcohols (poster), Kimihiro Norizawa, Takafumi Kondoh, Koichi Kan, Jinfeng Yang, Takahiro Kozawa, Atsushi Ogata, Yoichi Yoshida: the 28th Miller Conference on Radiation Chemistry, Israel.

Review Papers

Ultrashort-bunch Electron RF Gun, J. Vacuum Society of Japan, The Vacuum Society of Japan, 55 (2012), 42-49.

Femtosecond Time-resolved MeV Electron Microscope, 放射線化学, Japanese Society of Radiation Chemistry, 94 (2012), 3-12.

High Intensity Monochromatic Cherenkov Radiation in Terahertz Range by Femtosecond Electron Bunches in Impurity-Doped Semiconductor Tube, JOURNAL OF PLASMA AND FUSION RESEARCH, The Japan Society of Plasma Science and Nuclear Fusion Research, 88 (2012), 599-602.

Multidirectional Radiation of Terahertz Waves using Smith-Purcell Effect, JOURNAL OF PLASMA AND FUSION RESEARCH, The Japan Society of Plasma Science and Nuclear Fusion Research, 88 (2012), 603-607.

Publications in Domestic Meetings

Workshop of quantum beam using laser and accelerator	1 paper
Meeting of Particle Accelerator Society of Japan	7 papers
Meeting of Japan Society of Applied Physics	1 paper
Meeting of Atomic Energy Society of Japan	14 papers
Meeting of Japanese Society of Radiation Chemistry	6 papers
Symposium of application using quantum beam in Takasaki	1 paper
Workshop of beam physics	1 paper
Workshop of high blightness/rf electron gun	3 papers
Nano tech	2 papers
Meeting of Chemical Society of Japan	3 papers

Academic Degrees

Master Degree for Engineering T. Toigawa	Solvation process of electrons in Neat alcohols studied by femtosecond pulse radiolysis	
Bachelor of Engineering T. Nakanishi	Development of femtosecond time-resolved ultra-high voltage electron microscopy	
Bachelor of Engineering T. Igahara	Study of direct ionization in polymeric resists using femtosecond pulse radiolysis	
Bachelor of Engineering I. Nozawa	Generation and measurement of attosecond electron beams	

Grant-in-Aid for Scientific Research

Y. Yoshida	Attosecond and femtosecond pulse radiolysis study	¥32,760,000
J. Yang	Study of femtosecond time-resolved electron microscopy	¥13,520,000
T. Kondoh	Radiation-induced ultra-fast electron transfer in condensed matter	¥2,860,000
K. Kan	Inverse Cherenkov radiation using terahertz-metamaterial and femtosecond electron beam	¥2,860,000

Contribution to Research

K. Kan	The Murata Science Foundation	¥200,000
K. Kan	The Sumitomo Foundation	¥1,200,000

Cooperative Research

Y. Yoshida	Japan Atomic Energy Agency	¥0,000
Y. Yoshida	Japan Atomic Energy Agency	¥0,000
Y. Yoshida	Hiroshima International University	¥0,000
Y. Yoshida	Kanazawa University	¥0,000

Department of Nanocharacterization for Nanostructures and Functions

Original Papers

[1]Intrinsic catalytic structure of gold nanoparticles supported on TiO₂, Y. Kuwauchi, H. Yoshida, T. Akita, M. Haruta and S. Takeda: Angew. Chem. Int. Ed., 51 (2012) 7729-7733.

- [2]Theoretical study of atomic oxygen on gold surface by Hückel theory and DFT calculations, K. Sun, M. Kohyama, S. Tanaka and S. Takeda: *J. Phys. Chem. A*, 116 (2012) 9568–9573.
- [3]Fundamental strategy for creating VLS grown TiO₂ single crystalline nanowires, F. Zhuge, T. Yanagida, K. Nagashima, H. Yoshida, M. Kanai, B. Xu, A. Klamchuen, G. Meng, Y. He, S. Rahong, X. Li, M. Suzuki, S. Kai, S. Takeda and T. Kawai: *J. Phys. Chem. C*, 116 (2012) 24367-24372.
- [4]In situ structural analysis of crystalline Fe-Mo-C nanoparticle catalysts during the growth of carbon nanotubes, H. Yoshida, H. Kohno and S. Takeda: *Micron*, 43 (2012) 1176-1180.
- [5]Atomic-resolution environmental TEM for quantitative in-situ microscopy in materials science, S. Takeda and H. Yoshida: *Microscopy*, 62 (2013) 193-203.
- [6]Catalysis and in-situ studies of Rh₁/Co₃O₄ nanorods in reduction of NO with H₂, L. Wang, S. Zhang, Y. Zhu, A. Patlolla, J. Shan, H. Yoshida, S. Takeda, A. Frenkel and Franklin Feng Tao: *ACS Catal.*, 3 (2013) 1011-1019.
- [7]Read/write characteristics of a new type of bit-patterned-media using nano-patterned glassy alloy, K. Takenaka, N. Saidoh, N. Nishiyama, M. Ishimaru, M. Futamoto, A. Inoue: *J. Magn. Magn. Mater.*, 324 (2012) 1444-1448.
- [8]Electron diffraction study on chemical short-range order in covalent amorphous solids, M. Ishimaru, A. Hirata, M. Naito: *Nucl. Instrum. Methods Phys. Res. B*, 277 (2012) 70-76.
- [9]High-temperature thermoelectric properties of Cu₂In₄Te₇, T. Plirdpring, K. Kurosaki, A. Kosuga, M. Ishimaru, Y. Ohishi, H. Muta, S. Yamanaka: *phys. stat. solidi (RRL)*, 6 (2012) 154-156.
- [10]Fabrication of nickel/organic-molecule/nickel nanoscale junctions utilizing thin-film edges and their structural and electrical properties, H. Kaiju, K. Kondo, N. Basheer, N. Kawaguchi, S. White, A. Hirata, M. Ishimaru, Y. Hirotsu, A. Ishibashi: *Jpn. J. Appl. Phys.*, 51 (2012) 065202(1)-065202(8).
- [11]Effect of the amount of vacancies on the thermoelectric properties of Cu-Ga-Te ternary compounds, T. Plirdpring, K. Kurosaki, A. Kosuga, M. Ishimaru, A. Harnwungmoung, T. Sugahara, Y. Ohishi, H. Muta, S. Yamanaka: *Mater. Trans.*, 53 (2012) 1212-1215.
- [12]Enhancement of thermoelectric properties of CoSb₃-based skutterudites by double filling of Tl and In, A. Harnwungmoung, K. Kurosaki, A. Kosuga, M. Ishimaru, T. Plirdpring, R. Yimnirun, J. Jutimoosik, S. Rujirawat, Y. Ohishi, H. Muta, S. Yamanaka: *J. Appl. Phys.*, 112 (2012) 043509(1)-043509(6).
- [13]Surface and cross sectional nano-structure of prototype BPM prepared using imprinted glassy alloy thin film, N. Saidoh, K. Takenaka, N. Nishiyama, M. Ishimaru, A. Inoue: *Intermetallics*, 30 (2012) 48-50.
- [14]Novel soft-magnetic underlayer of a bit-patterned media using CoFe-based amorphous alloy thin film, K. Takenaka, N. Saidoh, N. Nishiyama, M. Ishimaru, A. Inoue: *Intermetallics*, 30 (2012) 100-103.
- [15]Strong atomic ordering in Gd-doped GaN, M. Ishimaru, K. Higashi, S. Hasegawa, H. Asahi, K. Sato, T. J. Konno: *Appl. Phys. Lett.*, 101 (2012) 101912(1)-101912(4).
- [16]Nanoscale engineering of radiation tolerant silicon carbide, Y. Zhang, M. Ishimaru, T. Varga, T. Oda, C. Hardiman, H. Xue, Y. Katoh, S. Shannon, W. J. Weber: *Phys. Chem. Chem. Phys.*, 14 (2012) 13429-13436.
- [17]Direct imaging of atomic clusters in an amorphous matrix: a Co-C granular thin film, K. Sato, M. Mizuguchi, R. Tang, J.-G. Kang, M. Ishimaru, K. Takanashi, T. J. Konno: *Appl. Phys. Lett.*, 101 (2012)

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[18] Coherent growth of GaGdN layers with high Gd concentration on GaN(0001), K. Higashi, S. Hasegawa, D. Abe, Y. Mitsuno, S. Komori, F. Ishikawa, M. Ishimaru, H. Asahi: Appl. Phys. Lett., 101 (2012) 221902(1)-221902(4).

International Conferences

[1] In situ ETEM characterization of the growth of carbon nanotubes from nanoparticle catalysts (invited), S. Takeda, Y. Kohigashi, H. Yoshida and H. Kohno: 2012MRS Spring Meeting, San Francisco, USA, April 9-13, 2012.

[2] Structural analysis of fluctuating crystalline Fe-Mo-C nanoparticle catalysts during the growth of carbon nanotubes (poster), S. Takeda, Y. Kohigashi, H. Yoshida and H. Kohno: 2012MRS Spring Meeting, San Francisco, USA, April 9-13, 2012.

[3] Operando Structural Study of Metal Nanoparticle Catalysts by Environmental TEM (invited), S. Takeda: imec • Handai International Symposium, Osaka, Japan, June 4-5, 2012.

[4] In situ observation of carbon nanotube growth from catalyst nanoparticles by environmental TEM (invited), H. Yoshida: The 6th International Conference on the Science and Technology for Advanced Ceramics (STAC-6), Yokohama, Japan, June 26-28, 2012.

[5] In-situ structure analysis of gold nanoparticulate catalysts during CO oxidation (oral), S. Takeda, H. Yoshida, Y. Kuwauchi, K. Sun, M. Koyhama, M. Haruta, T. Akita: 15th International Congress on Catalysis, Munich, Germany, July 1-6, 2012.

[6] Operando Structural Study of Supported Gold Nanoparticulate Catalysts by Quantitative Environmental Transmission Electron Microscopy (invited), S. Takeda, H. Yoshida, Y. Kuwauchi, K. Sun, M. Kohyama, M. Haruta, T. Akita, T. Uchiyama: Microscopy & Microanalysis 2012 Meeting, Phoenix, USA, July 29-August 8, 2012.

[7] Operando Structure of Supported Gold Nanoparticulate Catalysts Studied by Environmental Transmission Electron Microscopy (oral), S. Takeda, H. Yoshida, Y. Kuwauchi, K. Sun, M. Kohyama, M. Haruta, T. Akita, T. Uchiyama: The 6th International Conference on GOLD 2012, Tokyo, Japan, September 5-8, 2012.

[8] Environmental Transmission Electron Microscopy of Au/TiO₂ Catalysts under Reaction Conditions (poster), Y. Kuwauchi, H. Yoshida, T. Akita, and S. Takeda: The 6th International Conference on GOLD 2012, Tokyo, Japan, September 5-8, 2012.

[9] Operando Structural Study of Nanoparticle Catalysts by High Resolution Environmental Transmission Electron Microscopy (invited), S. Takeda, H. Yoshida: International Union of Materials Research Societies - International conference on Electronic Materials 2012 (IUMRS-ICEM2012), Yokohama, Japan, September 23-28, 2012.

[10] Application of Hückel theory to locate the active sites for O₂ activation on gold/oxide catalysts (oral), K. Sun, M. Kohyama, S. Tanaka and S. Takeda: International Union of Materials Research Societies - International conference on Electronic Materials 2012 (IUMRS-ICEM2012), Yokohama, Japan, September 23-28, 2012.

[11] Operando Structural Study of Au/CeO₂ and Au/TiO₂ Nanoparticulate Catalysts: Quantitative Environmental TEM as a Methodology for Chemical Imaging (oral), S. Takeda, H. Yoshida, Y. Kuwauchi, K. Sun, M. Kohyama, M. Haruta, T. Akita: 2012 MRS Fall Meeting & Exhibit, Boston, USA, November 25-30, 2012.

- [12]Intrinsic Structure of Au/TiO₂ Catalysts under Reaction Conditions (oral), Y. Kuwauchi, H. Yoshida, T. Akita, M. Haruta, S. Takeda: 2012 MRS Fall Meeting & Exhibit, Boston, USA, November 25-30, 2012.
- [13]Atomic-scale imaging of surface reconstruction of gold nanoparticles induced by adsorbed CO molecules at reaction conditions (poster), H. Yoshida, Y. Kuwauchi, M. Haruta, S. Takeda: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka University, Japan, December 10-11, 2012.
- [14]Atomic-scale observation of gold nanoparticle catalysts at reaction conditions by aberration-corrected environmental transmission electron microscopy (poster), H. Yoshida, Y. Kuwauchi, M. Haruta, S. Takeda: The 16th SANKEN International Symposium, Osaka University, Japan, January 22-23, 2013.
- [15]Transmission electron microscopy study on radiation-induced structures in GaN (invited), M. Ishimaru: 2012 International Conference on Defects in Insulating Materials, Santa Fe, New Mexico, USA (June 24-29, 2012).
- [16]Electron diffraction study on radiation-induced chemical disorder in covalent materials (invited), M. Ishimaru: 9th Polish-Japanese Joint Seminar on Micro and Nano Analysis, Sieniawa, Poland (September 10-13, 2012).
- [17]Defect-induced nanoscale phase separation in epitaxially-grown III-V semiconductor alloys (oral), M. Ishimaru: European Materials Research Society 2012 Fall Meeting “Session: Defect-induced Effects in Nanomaterials”, Warsaw, Poland (September 17-21, 2012).
- [18]Thermoelectric properties of CoSb₃-based skutterudites filled by group 13 elements (oral), K. Kurosaki, A. Harnwungmoung, A. Kosuga, M. Ishimaru, Y. Ohishi, H. Muta, S. Yamanaka: Powder Metallurgy World Congress 2012, Yokohama, Kanagawa (October 14-18, 2012).
- [19]Radiation tolerant nanocrystalline silicon carbide (invited), Y. Zhang, M. Ishimaru, T. Varga, C. Hardiman, S. Shannon, W. J. Weber: The Nuclear Materials Conference 2012, Osaka (October 21-25, 2012).
- [20]Radiation tolerant nanocrystalline silicon carbide (oral), Y. Zhang, M. Ishimaru, T. Varga, T. Oda, C. Hardiman, H. Xue, S. Shannon, W. J. Weber: Materials Research Society 2011 Fall Meeting, Boston, Massachusetts, USA (November 25-30, 2012).

Books

- [1]VLS growth of Si nanowires(T. Fukui) S. Takeda, “Nanowires : Fundamentals and Applications”, CMC Publishing Co.,Ltd., (Part I, Chapter 2) 2013.

Publications in Domestic Meetings

The Japanese Society of Microscopy 2012	3 papers
The 19th Fuel Cell Symposium	1 paper
73th Autumn Meeting of the Japan Society of Applied Physics	2 papers
Catalysis Society of Japan	1 paper
The 5th Symposium on New Electrode Catalysts	1 paper

Academic Degrees

Master Degree for Engineering Y. Isozaki	Environmental TEM observation of the shape change in Au nanorods
Master Degree for Engineering	In situ electron energy loss spectroscopy of CO oxidation catalysts under reaction condition

S. Nakamura

Grant-in-Aid for Scientific Research

M. Ishimaru	Spontaneous nano-scale phase separation and synthesis of low-dimensional nanomaterials	¥1,040,000
H. Yoshida	Structural determination of nanoparticulate catalysts during the synthesis of carbon nanomaterials by aberration-corrected environmental transmission electron microscopy	¥2,990,000

Entrusted Research

S. Takeda	Japan Science and Technology Agency	Development of dynamic imaging technology of the diffusion of ions across the micro-interface in Li ion battery	¥48,750,000
M. Ishimaru	Supporting Industry Project	Development of die production technology for low adhesion of the drug during tablet making	¥1,071,000

Contribution to Research

S. Takeda	UBE Scientific Analysis Laboratory, Inc	¥2,000,000
S. Takeda	DENKI KAGAKU KOGYO KABUSHIKI KAISHA	¥950,000

Department of Theoretical Nanotechnology

Original Papers

[1]First-Principles Study on the Structural and Magnetic Properties of Iron Hydride, T. Tsumuraya, Y. Matsuura, T. Shishidou and T. Oguchi: J. Phys. Soc. Jpn., 81 (2012) 064707/1-6.

[2]Structure and intermolecular bonding in $\text{NaBH}_4 \cdot 2\text{H}_2\text{O}$: A density functional theory study, I. Hamada, K. Yamauchi and T. Oguchi: Phys. Rev. B, 85 (2012) 214119/1-4.

[3]First-principles calculations for pressure-induced structural transition of Sr_2CuO_3 , M. Kodera and T. Oguchi: J. Phys. Soc. Jpn., 81 (2012) 094701/1-4.

[4]Hydrogen-induced modification of the electronic structure and magnetic states in Fe, Co, and Ni monohydrides, N. Ishimatsu, T. Shichijo, Y. Matsushima, H. Maruyama, Y. Matsuura, T. Tsumuraya, T. Shishidou, T. Oguchi, N. Kawamura, M. Mizumaki, T. Matsuoka and K. Takemura: Phys. Rev. B, 86 (2012) 104430/1-9.

[5]Orbital states of V trimers in $\text{BaV}_{10}\text{O}_{15}$ detected by resonant x-ray scattering, K. Takubo, T. Kanzaki, Y. Yamasaki, H. Nakao, Y. Murakami, T. Oguchi and T. Katsufuji: Phys. Rev. B, 86 (2012) 085141/1-8.

[6]High-resolution angle-resolved photoemission study of electronic structure and electron self-energy in palladium, H. Hayashi, K. Shimada, J. Jiang, H. Iwasawa, Y. Aiura, T. Oguchi, H. Namatame and M. Taniguchi: Phys. Rev. B, 87 (2013) 035140/1-8.

[7]Fermi-surface reconstruction involving two van Hove singularities across the antiferromagnetic transition in BaFe_2As_2 , Y. Nakashima, A. Ino, S. Nagato, H. Anzai, H. Iwasawa, Y. Utsumi, H. Sato, M. Arita, H. Namatame, M. Taniguchi, T. Oguchi, Y. Aiura, I. Hase, K. Kihou, C.H. Lee, A. Iyo and H. Eisaki: Solid State Commun., 157 (2013) 16-20.

[8]Stress Formulation in the All-Electron Full-Potential Linearized Augmented Plane Wave Method: II. Accuracy Check in the Generalized Gradient Approximation, N. Nagasako and T. Oguchi: J. Phys. Soc. Jpn., 82 (2013) 044802/1-10.

[9]Why does a metal get an insulator? -- Consequences of unfilled bands on boron crystals -, K. Shirai and N. Uemura: Solid State Sciences, 14 (2012) 1609-1616.

[10]The effect of mass transfer on the temperature gradient of a crystal growing from melt, K. Shirai and T. Abe: J. Cryst. Growth, 351 (2012) 141-148.

[11]Mechanism behind the high thermoelectric power factor of SrTiO_3 by calculating the transport coefficients, K. Shirai and K. Yamanaka: J. Appl. Phys., 113 (2013) 53705 (11p).

[12]Theoretical Prediction of Multiferroicity in $\text{SmBaMn}_2\text{O}_6$, K. Yamauchi: Journal of the Physical Society of Japan, 82 (2013) 043702/1-4.

[13]Effects of strain on ferroelectric polarization and magnetism in orthorhombic HoMnO_3 , D. Iușan, K. Yamauchi, P. Barone, B. Sanyal, O. Eriksson, G. Profeta and S. Picozzi: Physical Review B, 87 (2013) 014403/1-4.

[14]Beyond standard local density approximation in the study of magnetoelectric effects in Fe/BaTiO_3 and Co/BaTiO_3 interfaces, D. Di Sante, K. Yamauchi and Silvia Picozzi: Journal of Physics: Condensed Matter, 25 (2012) 066001/1-6.

[15]Experimental dispersion of the third order optical susceptibility of Ag nanoparticles, R. Sato, H. Momida, M. Ohnuma, M. Sasase, T. Ohno, N. Kishimoto and Y. Takeda: J. Opt. Soc. Am. B, 29 (2012) 2410-2413.

International Conferences

[1]Bonding nature in crystalline ammonia borane and amidoboranes: A first-principles study (invited), T. Oguchi: International Symposium on Metal-Hydrogen Systems -- Fundamentals and Applications -- (MH2012), Kyoto, Japan, October 21-26, 2012.

[2]A-site Ordered Perovskite Oxides: A Playground for Novel Electronic Phases (invited), T. Oguchi: 4th APCTP-IACS Joint Conference on Physics of Novel and Emerging Materials, Pohang, Korea, October 29-31, 2012.

[3]First-Principles Study of X-ray Absorption Spectroscopy (invited), T. Oguchi: International Symposium On Computational Science 2013, Kanazawa University, Japan, February 18-21, 2013.

[4]First-Principles Calculation of the A-Site Ordered Perovskite $\text{CaCu}_3\text{Fe}_4\text{O}_{12}$ (oral), T. Ueda, M. Kodera, K. Yamauchi, T. Oguchi: International Conference of Magnetism, Busan, Korea, July 9-13, 2012.

[5]The effect of mass transfer on the temperature gradient of a crystal growing from melt (oral), Koun Shirai, Takao Abe: E-MRS 2012 Spring Meeting, Strasbourg, France, May 14-18, 2012.

[6]Thermoelectric Properties of SrTiO_3 (oral), Koun Shirai, Kazunori Yamanaka: E-MRS 2012 Spring Meeting, Strasbourg, France, May 14-18, 2012.

[7]Prediction of Phase Diagrams for Hard Materials - application to boron crystals - (oral), Koun Shirai: Eighteenth Symposium on Thermophysical Properties, Colorado, USA, June 24-29, 2012.

[8]Dynamical Properties of Vacancy in Si (poster), Koun Shirai, Jun Ishisada: 31th International Conference on the Physics of Semiconductors 2012, Zurich, Switzerland, July 29 - August 3, 2012.

[9]Metallization mechanism and superconductivity of boron at high pressures (oral), K. Shirai, H. Dekura, Y. Mori, H. Hyodo, K. Kimura: 15-th International Conference on High Pressure Semiconductor Physics, Montpellier, France, July 25-27, 2012.

[10]Theoretical study on the thermoelectric Properties of SrTiO_3 (oral), Koun Shirai, Kazunori Yamanaka: IUMRS-International Conference on Electronic Materials (IUMRS-ICEM 2012), Yokohama,

Japan, September 23-28, 2012.

[11]Stability arrangement of impurities of copper in silicon (oral), T. Fujimura, K. Shirai: Conference on Computational Physics (CCP2012), Kobe, Japan, October 14-18, 2012.

[12]First-principles study of a-tetragonal boron (oral), N. Uemura, K. Shirai: Conference on Computational Physics (CCP2012), Kobe, Japan, October 14-18, 2012.

[13]Material research through prediction of phase diagram (oral), K. Shirai: Japan-France Joint Seminar 2012 "Physics and Control of Clustering Solids", Awaji Island, Hyogo, Japan, November 5-7, 2012.

[14]Electronic Structures of Boron Crystals (invited), K. Shirai: 37th International Conference and Exposition on Advanced Ceramics and Composites, Florida, USA, January 27 - February 1, 2013.

[15]Charge-order-induced multiferroicity in transition-metal oxides (invited), K. Yamauchi: ISSP-CMSI international workshop/symposium on MAterial Simulation in Petaflops era (MASP2012), ISSP Tokyo Univ., Japan, July 2, 2012.

[16]Electronic state calculation in electronic ferroelectricity (invited), K. Yamauchi: CMRC Workshop "Novel dielectric property in correlated electron system - Electron and Structure-", Tsukuba, Japan, November 19-20, 2012.

[17]Electronic structure and magnetoelectric effect in magnetite (poster), K. Yamauchi, S. Picozzi: Psi-k Research Conference on Computational Oxide Spintronics, Cheshire, UK, May 7-10, 2012.

[18]First-Principles Calculation of Multiferroic Bilayer Manganite (oral), K. Yamauchi, S. Picozzi: ICM SCES 2012, Busan, Korea, July 8-13, 2012.

[19]Optical responses of dye/TiO₂ interfaces by time-dependent density functional theory calculations (poster), H. Momida, T. Ohno: Psi-k Workshop 2012 "Functional Molecules on Surfaces: New Building Blocks for Nano-Spintronics", Bonn, Germany, October 2-4, 2012.

[20]Optical absorption spectra of dye/TiO₂ interfaces: First-principles electron dynamics simulations (poster), H. Momida, T. Ohno: "The 13th RIES-Hokudai International Symposium RITSU" joined with "The 1st International Symposium of Nano-Macro Materials, Devices, and System Research Alliance Project", Sapporo, Japan, December 13-14, 2012.

Review Papers

Review of new book "Physics of Defects", K. Shirai, Butsuri, Physical Society of Japan, 67 (2012), 206.

Cluster solids of boron and high pressure, K. Shirai, High Pressure and Technology, Japanese Society of High Pressure, 22 (2012), 33-44.

Books

[1]Band Theory of Transition Metals(-) T. Oguchi, "Band Theory of Transition Metals", Uchida Rokakuho, - (-) 2012.

Contributions to International Conferences and Journals

- | | |
|-----------|--|
| T. Oguchi | International Symposium on Metal-Hydrogen Systems -- Fundamentals and Applications -- (MH2012) (Organizing Committee) |
| T. Oguchi | 15th Asian Workshop on First-Principles Electronic Structure Calculations (International Program Committee) |
| K. Shirai | Japan-France Joint Seminar, "Physics and Control of Cluster Solids" (Organization Committee of Japan-France Joint Seminar) |

Publications in Domestic Meetings

The Physical Society of Japan	16 papers
The Japan Society of Applied Physics	6 papers

Academic Degrees

Master Degree for Science	First-Principles Calculations of X-ray Absorption Spectra of A-site Ordered Perovskite $\text{CaCu}_3\text{Fe}_4\text{O}_{12}$
T. Ueda	

Grant-in-Aid for Scientific Research

K. Yamauchi	Theoretical study on multiferroics based on manganites	¥3,380,000
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Entrusted Research

T. Oguchi	CREST Basic Research Program "Creation of Innovative Functions of Intelligent Materials on the Basis of Element Strategy" (1 April 2012-31 March 2013)	Exploring for New Functional Materials with Unusual Ionic States and Coordinations "Electronic Structure Analysis by First-principles Calculations"	¥9,880,000
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Cooperative Research

T. Oguchi	SHARP CORPORATION	¥920,000
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Other Research Fund

K. Shirai	Japanese-France bilateral seminar	¥1,300,000
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Department of Soft Nanomaterials**Original Papers**

[1]Functional Oligothiophenes toward Molecular Wires in Single-Molecular Electronics, Y. Ie, M. Endou, A. Han, R. Yamada, H. Tada, Y. Aso: Pure Appl. Chem., 84 (4) (2012) 931–943.

[2]Synthesis, Properties, and Photovoltaic Performances of Donor–Acceptor Copolymers Having Dioxocycloalkene-Annulated Thiophenes As Acceptor Monomer Units, Y. Ie, J. Huang, Y. Uetani, M. Karakawa, Y. Aso: Macromolecules, 45 (11) (2012) 4564–4571.

[3]Air-Stable n-Type Organic Field-Effect Transistors Based on 4,9-Dihydro-s-indaceno[1,2-b:5,6-b']dithiazole-4,9-dione Unit, Y. Ie, M. Ueta, M. Nitani, N. Tohnai, M. Miyata, H. Tada, Y. Aso: Chem. Mater., 24 (16) (2012) 3285–3293.

[4]Short Synthesis of Alkyl-Substituted Acenes Using Carbonyl-Directed C–H and C–O Functionalization, D. Matsumura, K. Kitazawa, S. Terai, T. Kochi, Y. Ie, M. Nitani, Y. Aso, F. Kakiuchi: Org. Lett., 14 (15) (2012) 3882–3885.

[5] π -Extended Thiadiazoles Fused with Thienopyrrole or Indole Moieties: Synthesis, Structures, and Properties, S.-i. Kato, T. Furuya, A. Kobayashi, M. Nitani, Y. Ie, Y. Aso, T. Yoshihara, S. Tobita, Y. Nakamura: J. Org. Chem., 77 (17) (2012) 7595–7606.

[6]Buckminsterfullerene Derivatives Bearing a Fluoroalkyl Group for Use in Organic Photovoltaic Cells, M. Karakawa, T. Nagai, T. Irita, K. Adachi, Y. Ie, Y. Aso: J. Fluorine Chem., 144 (2012) 51–58.

[7]Synthesis, Properties, and Photovoltaic Performance of Copolymers Based on Difluorodioxocyclopentene-Annulated Thiophene, Y. Ie, J. Huang, Y. Uetani, M. Karakawa, Y. Aso: Jpn. J. Appl. Phys., 51 (2012) 10NC08-1-3.

[8]Energy Level Modulation of HOMO, LUMO, and Band-Gap in Conjugated Polymers for Organic Photovoltaic Applications, B.-G. Kim, X. Ma, C. Chen, Y. Ie, E. W. Coir, H. Hashemi, Y. Aso, P. F. Green, J. Kieffer, J. Kim: Adv. Funct. Mater., 23 (4) (2013) 439–445.

[9]Self-Assembling Ary-Naphthalendiimide Derivatives with Nitroxide Radical, S. Nakatsuji, K. Aoki, A. Kojoh, H. Akutsu, J. Yamada, M. Karakawa, Y. Aso: Asian J. Org. Chem., 2 (2) (2013) 164-168.

International Conferences

[1]Insulated Molecular Wires for Molecular Electronics (invited), Yutaka Ie, Masaru Endou, Aihong Han, See Kei Lee, Ryo Yamada, Hirokazu Tada, Yoshio Aso: The 16th SANKEN International The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, January 22-23, 2013.

[2]Synthesis Properties, and Photovoltaic Cells Characteristics of D–A Copolymer based on Dioxocycloalkene-annelated Thiophenes (poster), Jianming Huang, Y. Ie, M. Karakawa, Y. Aso: The 16th SANKEN International The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, January 22-23, 2013.

[3]Synthesis, Properties, and Photovoltaic Performances of Donor-Acceptor Copolymers Having Dioxocycloalkene-annelated Thiophenes as Acceptor Unit (poster), Jianming Huang, Yutaka. Ie, Makoto Karakawa, Yoshio Aso: The 9th SPSJ International Polymer Conference (IPC2012), Kobe Japan, December 11-14, 2012.

[4]Development of New pi-Conjugated Systems for Organic Electronic Materials (invited), Yutaka Ie, Yoshio Aso: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, December 10-11, 2012.

[5]Synthesis of Donor–Acceptor Copolymers Based on Dioxocycloalkene-annelated Thiophenes for Photovoltaic Cells (poster), Jianming Huang, Yutaka. Ie, Makoto Karakawa, Yoshio Aso: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, December 10-11, 2012.

[6]Air-Stable n-Type Organic Field-Effect Transistors Based on Multi-Ring-Fused System Containing Carbonyl-Bridged Thiazole (oral), Yutaka Ie, Masashi Ueta, Masashi Nitani, Norimitsu Tohnai, Mikiji Miyata, Hirokazu Tada, Yoshio Aso: 2012 MRS Fall Meeting, Boston, Massachusetts USA, November 25-30, 2012.

[7]4,9-Dihydro-s-indaceno[1,2-b:5,6-b']dithiazole-4,9-dione : A New Electronegative Unit for an Air-Stable n-Type Organic Field-Effect Transistor (oral), Yutaka Ie, Masashi Ueta, Masashi Nitani, Yoshio Aso: The Twelfth International Kyoto Conference on New Aspects of Organic Chemistry, Kyoto, Japan, November 12-16, 2012.

[8]Carbonyl-Bridged Thiazole-Based Conjugation Systems: Air-Stable n-Type Organic Field-Effect Transistors (invited), Yutaka Ie,: International Symposium on Organic Electronics 2012, Okinawa, Japan, October 2-5, 2012.

[9]Synthesis, Properties, and Photovoltaic Performances of Polythiophenes Containing Fluoroalkyl-Ether Substituents (poster), Aya Kojima, Makoto Karakawa, Yutaka Ie, Takabumi Nagai, Yoshio Aso: International Union of Materials Research Societies – International Conference on Electronic Materials 2012, Yokohama, Japan, 23-28 September, 2012.

[10]Development of n-Type Organic Semiconductors Based on Fluoroalkyl-Substituted Conjugation Systems (plenary), Y.Aso: The 20th International Symposium on Fluorine Chemistry, Kyoto, Japan, 22-27 July 2012.

[11]Synthesis and Properties of Polythiophenes Containing Fluoro or Fluoroalkyl-ether Substituents (poster), Aya Kojima, Makoto Karakawa, Yutaka Ie, Takabumi Nagai, Yoshio Aso: International Conference on Science and Technology of Synthetic Metals 2012, Atlanta USA, 8-13 July, 2012.

[12]Development of Solution-Processible n-Type OFFT Materials Based on Carbonyl-Bridged Bithiazole

Unit (poster), Masashi Nitani, Yutaka Ie, Yoshio Aso: The 7th Molecular and Bio Electronics, Fukuoka, Japan, March 17-19, 2013.

[13]Development of Oligomers Based on Carbonyl-Bridged Bithiazole Unit for Solution-Processible n-Type OFFTs (poster), Masashi Nitani, Yutaka Ie, Yoshio Aso: The 16th SANKEN International The 11th SANKEN Nanotechnology Symposium 2013, Osaka, Japan, January 22-23, 2013.

[14]Development of Conjugated Oligomers Based on Carbonyl-Bridged Bithiazole Unit toward Solution-Processable n-Type OFFTs (poster), Masashi Nitani, Yutaka Ie, Yoshio Aso: 8th Handai Nanoscience and Nanotechnology International Symposium, Osaka, Japan, December 10-11, 2012.

[15]Development of Oligomers Based on Carbonyl-Bridged Bithiazole for Solution-Processible n-Type OFFT Materials (poster), Masashi Nitani, Yutaka Ie, Yoshio Aso: 2012 International Conference on Flexible and Printed Electronics, Tokyo, Japan, September 6-8, 2012.

[16]Development of Oligomers Based on Carbonyl-Bridged Bithiazole for Solution-Processible n-Type Organic Field-Effect Transistors (poster), Masashi Nitani, Yutaka Ie, Yoshio Aso: International Conference on Science and Technology of Synthetic Metals 2012, Atlanta USA, 8-13 July, 2012.

[17]Printable Transparent Silver nanowire networks for Organic Photovoltaic Cell electrodes (poster), Makoto Karakawa, T. Tokuno, M. Nogi, Y. Aso and K. Suganuma: KJF International Conference on Organic Materials for Electronics and Photonics, Sendai, Japan, August 29- September 1, 2012.

[18]Effects of Perfluoroalkyl Chain Lengths Introduced to Buckminsterfullerene Derivatives on Their Field-Effect Transistor Performances (poster), Makoto Karakawa, Takabumi Nagai, Kenji Adachi, Yutaka Ie, and Yoshio Aso: The 7th Solid State Device and Materials, Kyoto, Japan, September 24-26, 2012.

[19]Organic Solar Cell using Transparent Paper Substrate (poster), Makoto Karakawa, Masaya Nogi, Thi Thi Nge, Yoshio Aso, Katsuaki Suganuma,: The 2nd Organic Photovoltaics workshop, Kanazawa, Japan, January 10-11, 2013.

[20]Synthesis and Characterization of New Red-NIR Absorption Materials Containing Thienopyrrolidone for Organic Photovoltaics (oral), Makoto Karakawa, Yoshio Aso: The 7th Molecular and Bio Electronics, Fukuoka, Japan, March 17-19, 2013.

Review Papers

Development of new pi-conjugated compounds towards organic/molecular electronics, Y. Ie, Y. Aso, Expected materials for the Future, NTS, 12[6] (2012), 8-14.

Emergence of Highly Elaborated π -Space and Its Function, M. Yamada, Y. Aso, H. Isobe, T. Akasaka, Expected materials for the Future, NTS, 12[9] (2012), 59-65.

Books

[1]Functions of Highly Elaborated π -Space Based on the Synthesis of Extended π -Electron Systems and Application to Electronics(T. Akasaka, A. Osuka, S. Fukuzumi, H. Kandori) Y. Aso, "Emergence of Highly Elaborated π -Space and Its Function", CMC Publishing Co.,Ltd., (10-15) 2013.

[2]Organic electronic materials and their characteristics(M. Oshima) Y. Ie, "Printed electronics", NIKKO Green MOOK, (50-54) 2012.

Patents

[1]Polymer, organic thin film comprising the polymer, and organic thin-film element including same Y. Ie, J. Huang, Y. Aso, M. Karakawa, M. Ueda, 2012-196331

[2]Compound, organic thin film comprising the compound, and organic thin-film element including same
Y. Ie, S. Jinnai, Y. Aso, H. Terai, 2012-193416

[3]Compound and polymer, organic thin film comprising these, and organic thin-film element including same
Y. Ie, S. Jinnai, Y. Aso, H. Terai, 2012-193516

Contributions to International Conferences and Journals

Y. ASO	The 10th International Conference on Heteroatom Chemistry (Organizing Committee)
Y. ASO	2012 International Conference on Flexible and Printed Electronics (Session Organizer, Chair)

Publications in Domestic Meetings

The Chemical Society of Japan	8 papers
Symposium on Main Element Chemistry	2 papers
Symposium on Fundamental Organic Chemistry	3 papers
Symposium on Organic pi-Systems	1 paper
The Society of Polymer Science	1 paper
The Cellulose Society of Japan	1 paper

Academic Degrees

Master Degree for Engineering S. Jinnai	Development of Novel Conjugated Compounds Bearing Electron Withdrawing End Groups for Acceptor Materials in Organic Photovoltaics
Master Degree for Engineering K. Tanaka	Development of Photovoltaic Molecules and Traipodal Anchor Molecules for Single-molecule Electronics

Grant-in-Aid for Scientific Research

Y. Aso	Functions of Highly Elaborated π -Space Based on the Synthesis of Extended π -Electron Systems and Application to Electronics	¥5,850,000
Y. Aso	Emergence of Highly Elaborated π -Space and Its Function	¥6,370,000
Y. Aso	Development of Molecular Electronics on the Basis of the Synthesis of Precisely Designed Molecular Wires	¥10,790,000
Y.Ie	Development of functional pi-conjugated systems for single-molecular photovoltaics	¥1,170,000
Y.Ie	Development of functional pi-conjugated systems toward elucidation of charge-transporting mechanism in single-molecular devices	¥5,850,000
M.Karakawa	Relationship between p-n property and terminal structure on organic semiconductor materials	¥1,560,000
M. Nitani	Development of n-type semiconducting polymers applicable for organic transistors	¥1,560,000

Entrusted Research

Y. Ie	JST Strategic Basic Research Programs PRESTO	Development of n-type organic semiconductor materials towards bulk heterojunction solar cells	¥6,006,000
Y. Ie	Advanced Catalytic Transformation Program for Carbon Utilization	Evaluation of organic field-effect transistor devices	¥3,900,000

Contribution to Research

M. Karakawa	Japan Association for Chemical Innovation	¥1,000,000
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Cooperative Research

Y. Aso	Daikin Industries, Ltd	¥2,200,000
Y. Aso	Sumitomo Chemical Co., Ltd.	¥1,012,000

Department of Bio-Nanotechnology

Original Papers

- [1]Vibrational Spectroscopy of Single-molecule Junctions by Direct Current Measurements, Makusu Tsutsui and Masateru Taniguchi: Journal of Applied Physics, 113 (2013) 084301(1-6).
- [2]Fluctuated atom-sized junctions in a liquid environment, Makusu Tsutsui, Masateru Taniguchi: Journal of Applied Physics, 113 (2) (2013) 024303(1-5).
- [3]Thermophoretic Manipulation of DNA Translocation through Nanopores, Yuhui He, Makusu Tsutsui, Ralph H.Scheicher, Fan Bai, Masateru Taniguchi, Tomoji Kawai: ACS Nano, 7 (1) (2013) 538-546.
- [4]Single Molecule Electronics and Devices, Makusu Tsutsui and Masateru Taniguchi: Sensors, 12 (6) (2012) 7259-7298.
- [5]Embedded TiO₂ waveguides for sensing nanofluorophores in a microfluidic channel, Masayuki Furuhashi, Masazumi Fujiwara, Takahito Ohshiro, Kazuki Matsubara, Makusu Tsutsui, Masateru Taniguchi, Shigeki Takeuchi, Tomoji Kawai: Applied Physics Letters, 101 (15) (2012) 153115(1-4).
- [6]Transverse electric field dragging of DNA in a nanochannel, Makusu Tsutsui, Yuhui He, Masayuki Furuhashi, Sakon Rahong, Masateru Taniguchi, Tomoji Kawai: Scientific Reports, 2 (2012) 394(1-7).
- [7]Single-Molecule Electrical Random Resequencing of DNA and RNA, Takahito Ohshiro, Kazuki Matsubara, Makusu Tsutsui, Masayuki Furuhashi, Masateru Taniguchi, Tomoji Kawai: Scientific Reports, 2 (2012) 501(1-7).
- [8]Electrical detection of single pollen allergen particles using electrode-embedded microchannels, Chihiro Kawaguchi, Tetsuya Noda, Makusu Tsutsui, Masateru Taniguchi, Satoyuki Kawano, Tomoji Kawai: Journal of Physics, 24 (16) (2012) 164202(1-6).
- [9]Single-Nanoparticle Detection Using a Low-Aspect-Ratio Pore, Makusu Tsutsui, Sadato Hongo, Yuhui He, Masateru Taniguchi, Nobuhiro Gemma, Tomoji Kawai: ACS Nano, 6 (4) (2012) 3499-3505.
- [10]Unsymmetrical hot electron heating in quasi-ballistic nanocontacts, Makusu Tsutsui, Tomoji Kawai, Masateru Taniguchi: Scientific Reports, 2 (2012) 217(1-7).
- [11]DNA capture in nanopores for genome sequencing: challenges and opportunities, Yuhui He, Makusu Tsutsui, Masateru Taniguchi, Tomoji Kawai: Journal of Materials Chemistry, 22 (27) (2012) 13423-13427.

International Conferences

- [1]Preparation of Graphene Substrate for DNA Sequencing (invited), Hiro. Tanaka: 20th International Colloquium on Scanning Probe Microscopy, Naha, Okinawa, Japan, 2012 Dec. 17-19.
- [2]dI/dV Spectroscopy of Ferrocene-Bridged Trisporphyrin on Au(111) (oral), Hiro. Tanaka: 20th International Colloquium on Scanning Probe Microscopy, Naha, Okinawa, Japan, 2012 Dec. 17-19.
- [3]Single-Molecule Electrical Sequencing Using Gating Nanopores (invited), Masateru Taniguchi: 2nd Next Generation Sequencing.
- [4]Next-next Generation DNA Sequencing System for Single Molecules (oral), Masateru Taniguchi: imec • Handai International Symposium 2012.
- [5]Quantum-fluctuation-induced inelastic noise in single molecule junctions (invited), Masateru Taniguchi: 14th International Conference on Vibrations at Surfaces (VAS).

[6]Heat dissipation in quasiballistic nanocontacts (poster), Makusu Tsutsui, Masateru Taniguchi: 14th International Conference on Vibrations at Surfaces (VAS).

[7]tunneling nanopore / nanochannel for next generation DNA (invited), Masateru Taniguchi: Pioneer Workshop on Nanopore.

[8]Single Molecule Electrical Sequencing of DNA and RNA (invited), Masateru Taniguchi: APS March Meeting 2013.

[9]Electrode-embedded in-plane Nanopore for DNA Sequencing by Tunneling Current (oral), Makusu Tsutsui, Masateru Taniguchi, Tomoji Kawai: 2012 MRS Fall Meeting & Exhibit.

Publications in Domestic Meetings

The Japan Society of Applied Physics	10 papers
The Surface Science Society of Japan	2 papers
The Chemical Society of Japan	5 papers
The Physical Society of Japan	5 papers
Others	5 papers

Grant-in-Aid for Scientific Research

M.Taniguchi	Development of methods to control the translocation speed of single molecules using gating nanopores	¥6,240,000
H.Tanaka	Nanopore processing of graphene using SPM	¥3,250,000
M.Tsutsui	Development of electrophoresis device with integrated single-molecule sensing electrodes	¥14,170,000

Entrusted Research

M.Taniguchi	Nanofabrication Platform Participating Institute	Nanofabrication Platform	¥38,000,000
M.Tsutsui	SCOPE	Development of organic thermoelectric devices	¥2,887,000

Contribution to Research

M.Tsutsui	Foundation Advanced Technology Institute	¥500,000
M.Tsutsui	The Thermal & Electric Energy Technology Foundation	¥1,000,000
M.Tsutsui	Kansai Research Foundation for Technology Promotion	¥920,000
M.Tsutsui	Yazaki Memorial Foundation for Science and technology	¥1,000,000

Cooperative Research

M.Taniguchi	Gluon Lab LLC	¥312,000
M.Taniguchi	Tech Concierge Kumamoto	¥330,000

Department of Nanotechnology for Environmental and Energy Applications

Original Papers

[1]Fermi level tuning and a large activation gap achieved in the topological insulator $\text{Bi}_2\text{Te}_2\text{Se}$ by Sn doping, Zhi Ren, A. A. Taskin, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Physical Review B, 85 (15) (2012) 155301/1-6.

[2]Landau level spectroscopy of surface states in the topological insulator $\text{Bi}_{0.91}\text{Sb}_{0.09}$ via magneto-optics, A. A. Schafgans, K. W. Post, A. A. Taskin, Yoichi Ando, Xiao-Liang Qi, B. C. Chapler, and D. N. Basov: Physical Review B, 85 (19) (2012) 195440/1-6.

[3]Manifestation of Topological Protection in Transport Properties of Epitaxial Bi_2Se_3 Thin Films, A. A. Taskin, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Physical Review Letters, 109 (6) (2012) 066803/1-5.

[4]Ambipolar transport in bulk crystals of a topological insulator by gating with ionic liquid, Kouji Segawa, Zhi Ren, Satoshi Sasaki, Tetsuya Tsuda, Susumu Kuwabata, and Yoichi Ando: Physical Review

B, 86 (7) (2012) 075306/1-7.

[5] Spin Polarization of Gapped Dirac Surface States Near the Topological Phase Transition in $\text{TiBi}(\text{S}_{1-x}\text{Se}_x)_2$, S. Souma, M. Komatsu, M. Nomura, T. Sato, A. Takayama, T. Takahashi, K. Eto, Kouji Segawa, and Yoichi Ando: Physical Review Letters, 109 (18) (2012) 186804/1-5.

[6] Achieving Surface Quantum Oscillations in Topological Insulator Thin Films of Bi_2Se_3 , A. A. Taskin, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Advanced Materials, 24 (41) (2012) 5581-5585.

[7] Experimental realization of a topological crystalline insulator in SnTe , Y. Tanaka, Zhi Ren, T. Sato, K. Nakayama, S. Souma, T. Takahashi, Kouji Segawa, and Yoichi Ando: Nature Physics, 8 (11) (2012) 800-803.

[8] Anomalous suppression of the superfluid density in the $\text{Cu}_x\text{Bi}_2\text{Se}_3$ superconductor upon progressive Cu intercalation, M. Kriener, Kouji Segawa, Satoshi Sasaki, and Yoichi Ando: Physical Review B, 86 (18) (2012) 180505/1-5.

[9] Structural study of $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$ exfoliated nanocrystals, A. Lupascu, Renfei Feng, L. J. Sandilands, Zixin Nie, V. Baydina, Genda Gu, Shimpei Ono, Yoichi Ando, D. C. Kwok, N. Lee, S.-W. Cheong, K. S. Burch, and Young-June Kim: Applied physics letters, 101 (22) (2012) 223106/1-4.

[10] Odd-Parity Pairing and Topological Superconductivity in a Strongly Spin-Orbit Coupled Semiconductor, Satoshi Sasaki, Zhi Ren, A. A. Taskin, Kouji Segawa, Liang Fu, and Yoichi Ando: Physical Review Letters, 109 (21) (2012) 217004/1-5.

[11] Manipulation of Topological States and the Bulk Band Gap Using Natural Heterostructures of a Topological Insulator, K. Nakayama, K. Eto, Y. Tanaka, T. Sato, S. Souma, T. Takahashi, Kouji Segawa, and Yoichi Ando: Physical Review Letters, 109 (23) (2012) 236804/1-5.

[12] Checkerboard to stripe charge ordering transition in $\text{TbBaFe}_2\text{O}_5$, D. K. Pratt, S. Chang, W. Tian, A. A. Taskin, Yoichi Ando, J. L. Zarestky, A. Kreyssig, A. I. Goldman, and R. J. McQueeney: Physical Review B, 87 (4) (2013) 045127/1-5.

[13] Anomalous metallic state above the upper critical field of the conventional three-dimensional superconductor AgSnSe_2 with strong intrinsic disorder, Zhi Ren, M. Kriener, A. A. Taskin, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Physical Review B, 87 (6) (2013) 064512/1-6.

International Conferences

[1] Topological Insulators and Superconductors: Materials Frontier (plenary), Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[2] ^{77}Se NMR study of possible topological superconductors $\text{Cu}_x\text{Bi}_2\text{Se}_3$ (poster), F. Iwase, G.-q. Zheng, Y. S. Hor, M. Kriener, K. Segawa, Z. Ren, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[3] Gating with ionic liquid on bulk single crystals of a topological insulator (poster), K. Segawa, Z. Ren, S. Sasaki, T. Tsuda, S. Kuwabata, and Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

[4] Soft point-contact spectroscopy of $\text{Cu}_x\text{Bi}_2\text{Se}_3$ (poster), S. Sasaki, M. Kriener, K. Segawa, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.

- [5]Molecular Beam Epitaxial Growth of Topological Insulators on Insulating Substrates (poster), A. Taskin, S. Sasaki, K. Segawa, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.
- [6]Small superfluid density in $\text{Cu}_x\text{Bi}_2\text{Se}_3$ (poster), M. Kriener, S. Segawa, S. Sasaki, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.
- [7]Optimizing the $\text{Bi}_{2-x}\text{Sb}_x\text{Te}_{3-y}\text{Se}_y$ solid solutions to approach the intrinsic topological insulator regime (poster), Z. Ren, A. A. Taskin, S. Sasaki, K. Segawa, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.
- [8]Transport Properties of Topological Insulators with Cobalt Films Deposited on their Surface (poster), K. Eto, S. Sasaki, Z. Ren, K. Segawa, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2012), Nagoya University, Japan, May 16-20, 2012.
- [9]Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: Colloquium, Physics Section, EPFL, Lausanne, May 21, 2012.
- [10]Transport Studies of the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: International Workshop on Strongly Correlated Electron Systems in High Magnetic Fields (SCEF), Les Houches, France, May 21-25, 2012.
- [11]Progress in Topological Insulator Materials for 2D Devices (invited), Y. Ando: NSF/AFOSR Workshop on 2D Materials and Devices Beyond Graphene, Arlington, VA, May 30-31, 2012.
- [12]Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: Seminar, Air Force Research Laboratory, Dayton, OH, June 1, 2012.
- [13]Probing the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: Advanced Research Workshop on Non-equilibrium and Coherent Phenomena at Nanoscale (Meso-2012), Landau Institute, Chernogolovka, Russia, June 17-23, 2012.
- [14]Soft point-contact spectroscopy of $\text{Cu}_x\text{Bi}_2\text{Se}_3$ (poster), S. Sasaki, M. Kriener, K. Segawa, K. Yada, Y. Tanaka, M. Sato, and Y. Ando: Gordon Research Conference the 2012 correlated electron systems, South Hadley, U.S.A., June 24-29, 2012.
- [15]Probing the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: The 19th International Conference on Magnetism (ICM 2012), Busan, Korea, July 8-13, 2012.
- [16]Optimizing the $\text{Bi}_{2-x}\text{Sb}_x\text{Te}_{3-y}\text{Se}_y$ solid solutions to approach the intrinsic topological insulator regime (poster), Z. Ren, A. A. Taskin, S. Sasaki, K. Segawa, Y. Ando: The 19th International Conference on Magnetism (ICM 2012), Busan, Korea, July 8-13, 2012.
- [17]Probing the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: Japanese-German Symposium 2012, Shuzenji, Japan, July 14-17, 2012.
- [18]Experiments Toward Identifying a Topological Superconductor (plenary), Y. Ando: International Conference on Materials & Mechanisms of Superconductivity (M²S 2012), Washington DC, July 29-August 3, 2012.
- [19]Topological Insulators: A New Materials Frontier (invited), Y. Ando: Super-PIRE 2nd Workshop, Hyatt Regency Bethesda, Maryland, August 3, 2012.

[20] Probing the Exotic Surface States in Topological Insulators and Superconductors (invited), Y. Ando: CECAM workshop on Topological Materials, Bremen, Germany, August 13-17, 2012.

[21] Experimental study of three-dimensional topological insulators/superconductors (invited), Kouji Segawa: APCTP Focus Program on Quantum Condensation (QC12), APCTP Headquarters, Pohang, Korea, August 13-24, 2012.

[22] Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: Special Seminar, Department of Electrical Engineering, UCLA, September 10, 2012.

[23] Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: GLAM Special Seminar, Geball Laboratory for Advanced Materials, Stanford University, September 13, 2012.

[24] Topological Insulators and Superconductors: Materials Frontier (invited), Y. Ando: Colloquium, Department of Physics, Harvard University, November 9, 2012.

[25] Exploring Topological Insulator and Superconductor Materials (invited), Y. Ando: International Symposium Nanoscience and Quantum Physics (nanoPHYS'12), International House of Japan, Roppongi, Tokyo, December 17-19, 2012.

[26] Exploring Topological Insulator and Superconductor Materials (invited), Y. Ando: QS²C Theory Forum: International Symposium on Strongly Correlated Quantum Science, University of Tokyo, January 26-29, 2013.

[27] Search for topological superconductivity in superconducting topological insulators (invited), S. Sasaki: American Physical Society March Meeting, Baltimore, U.S.A., March 18-22, 2013.

[28] Manifestation of topological protection in transport properties of epitaxial Bi₂Se₃ thin films (invited), A. Taskin: American Physical Society March Meeting, Baltimore, U.S.A., March 18-22, 2013.

Review Papers

Topological superconductors and Majorana particles, Y. Ando, Forum of superconductivity science and technology news, The Society of Non-Traditional Technology, 133 (2012), 6-8.

Introduction to topological insulator, Y. Ando, , The Japan Society of Applied Physics, 81[12] (2012), 1020-1023.

Contributions to International Conferences and Journals

Y. Ando Europhysics Letters (EPL) (Co-Editor)

Y. Ando the 7th International Conference "Science and Engineering of Novel Superconductors" of the Forum on New Materials (International Advisory Board)

Publications in Domestic Meetings

8th Intensive-Interactive meeting "Topology of Cold Atom Gases" of Topological Quantum Phenomena in Condensed Matter with Broken Symmetries 1 paper

Meeting 2012 for G1 working group of five-institute alliance 1 paper

Fall meeting of the physical society of Japan 2012 12 papers

10th Intensive-Interactive meeting "Topological Superconductivity/Superfluidity" of Topological Quantum Phenomena in Condensed Matter with Broken Symmetries 1 paper

68th annual meeting of the physical society of Japan 9 papers

Academic Degrees

Ph. D. Synthesis and Characterization of Topological Insulators and Related Materials

K. Eto

Master Degree of Science Single-Crystal Growth of Candidate Materials for Topological Superconductor Sn_{1-x}In_xTe and Pb_{1-x}Tl_xTe

T. Ueyama
Master Degree of Science Efforts toward Obtaining Single-Phase Topological Superconductor $\text{Cu}_x\text{Bi}_2\text{Se}_3$

K. Kinoshita

Grant-in-Aid for Scientific Research

Y. Ando	Creation of Innovative Devices Based on Topological Insulators	¥40,950,000
K. Segawa	Precise control of physical properties of topological insulators/superconductors with electrochemical technique	¥2,210,000
S. Sasaki	Elucidation of the symmetry of superconducting gap of topological superconductor $\text{Cu}_x\text{Bi}_2\text{Se}_3$ and other novel materials	¥2,730,000
K. Segawa	Novel phenomena in the electron fluids with broken inversion symmetry	¥9,100,000
K. Eto	Magnetic transport studies about candidate materials of pyrochlore oxide	¥700,000
Contribution to Research		
Y. Ando	Niki Glass Co.Ltd., Kouichi Nishio, the manager at Osaka office	¥1,200,000

Department of Nano-Intelligent Systems

Original Papers

[1] Learning a Common Substructure of Multiple Graphical Gaussian Models, S. Hara, T. Washio: Neural Networks, 38 (2012) 23-38.

[2] Separation of stationary and non-stationary sources with a generalized eigenvalue problem, H. Hara, Y. Kawahara, T. Washio, P. von Bunau, T. Tokunaga, K. Yumoto: Neural Networks, 33 (2012) 7-20.

International Conferences

[1] Enhancing the Analysis of Large Multimedia Applications Execution Traces with FrameMiner, C. K. Kengne, L. C. Fopa, N. Ibrahim, A. Termier, M. Rousset, T. Washio: Proc. PTDM: Workshop on Practical Theories of Data Mining, ICDM 2012. The IEEE International Conference on Data Mining, 2012 (2012) 595-602.

[2] Anomalous Neighborhood Selection, S. Hara, T. Washio: Proc. OEDM: Workshop on Optimization Based Techniques for Emerging Data Mining, ICDM 2012. The IEEE International Conference on Data Mining, 2012 (2012) 474-480.

[3] Group Sparse Inverse Covariance Selection with a Dual Augmented Lagrangian Method, S. Hara, T. Washio: Neural Information Processing, Lecture Notes in Computer Science, 7665 (2012) 108-115.

Publications in Domestic Meetings

The 26th Annual Conference of The Japanese Society for Artificial Intelligence	1 paper
Information-Based Inductive Sciences and Machine Learning (IBISML2012)	1 paper

Academic Degrees

Doctor Degree for Engineering Study on Learning Invariant Patterns with Second Order Statistics
S. Hara

Department of Nanodevices for Medical Applications

Original Papers

[1] Competitive allele-specific hairpin primer PCR for extremely high allele discrimination in typing of single nucleotide polymorphism, F. Takei, M. Igarashi, Y. Oka, Y. Koga, K. Nakatani: ChemBioChem, 13 (2012) 1409-1412.

[2] Assembly of a small DNA rectangular parallelepiped block into higher order nanostructures, H.

Nakagawa, M. Toda, H. Atsumi, M. Hagihara, M. Hayashi-Nishino, C. Dohno, K. Nakatani: Chem. Lett., 41 (2012) 1550-1552.

[3] A Novel DANP-Coupled Hairpin RT-PCR for Rapid Detection of Chikungunya Virus, H. Chen, F. Takei, E.S.C. Koay, K. Nakatani, J.J.H. Chu: J. Mol. Diagn., 15 (2013) 227-233.

International Conferences

[1] Small Molecule Interaction to RNA (invited), K. Nakatani: A3RONA 2012 Korea, 2012.5.18-20, Korea.

[2] Studies on Small Molecules Targeting RNA (invited), K. Nakatani: 2012 Telluride Science Conference on Nucleic Acids Chemistry, 2012.7.29-8.3, USA.

[3] High allelic discrimination in typing of single nucleotide polymorphisms using allele-specific hairpin primer PCR (oral), F. Takei, G. Yu, C. Dohno, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[4] Synthesis and application of a new modified DNA having cytosine-bulge binding fluorescent molecule (poster), G. Yu, F. Takei, T. Shibata, C. Dohno, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[5] Synthesis and evaluation of novel naphthyridine derivatives for binding to RNA bulge structure (poster), T. Otabe, G. Yu, F. Takei, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[6] Change of photochemical properties of coumarin fluorochrome induced by binding to RNA (poster), T. Tsuda, T. Fukuzumi, K. Nakatani: ISNAC2012, 2012.11.15-17, Japan.

[7] Small Organic Molecules Regulating RNA Structure and Function (invited), K. Nakatani: The First International Symposium on Biofunctional Chemistry (ISBC2012), 2012.11.28-30, Japan.

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K. Nakatani	Riboswitch reengineering using a synthetic 8-substituted purine library	¥15,730,000
K. Nakatani	RNA loop-loop interaction modulated by small molecules	¥4,030,000
F. Takei	The high sensitive virus detection system using hairpin primer PCR method	¥6,760,000

Cooperative Research

K. Nakatani	FURUKAWA ELECTRIC ADVANCED ENGINEERING CO.,LTD.	¥1,573,000
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Comprehensive Analysis Center

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Annual meeting of Japan Chemical Society	1 paper

Grant-in-Aid for Scientific Research

T. Suzuki	Development of novel organic reaction based on hydrogen autotransfer process	¥1,430,000
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Contribution to Research

T. Suzuki	J S R	¥500,000
T. Suzuki	Nitto Kasei Corp	¥500,000
T. Suzuki	Q INVERSE	¥500,000
T. Suzuki	KRI	¥500,000

Cooperative Research

T. Suzuki	Panasonic	¥500,000
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Cooperative Research

Y. Honda	Panasonic Corporation	¥105,000
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