ISIR
OSAKA UNIVERSITY

MEMOIRS OF

The Institute of Scientific and Industrial Research

ISSN 0339-0369
VOLUME 73, 2016

Contents

Foreword

Kazuhiko Nakatani
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 LCLS (Former 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, LCLS 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.

【Organization】

Divisions	Departments
Division 1	
Information & Quantum Sciences	Quantum System Electronics
	Semiconductor Electronics
	Advanced Electron Devices
	Intelligent Media
	Reasoning for Intelligence
	Knowledge Science
	Architecture for Intelligence
Divison 2	
Advanced Materials &	Quantum Functional Materials
Beam Science	Semiconductor Materials and Processes
	Advanced Hard Materials
	Advanced Interconnection Materials
	Excited Solid-State Dynamics
	Accelerator Science
	Beam Materials Science
Division 3	
Biological & Molecular Sciences	Molecular Excitation Chemistry
	Synthetic Organic Chemistry
	Regulatory Bioorganic Chemistry
	Organic Fine Chemicals
	Biomolecular Science and Research
	Biomolecular Science and Regulation
	Biomolecular Science and Engineering
Next Industry Generation	New Industrial Projection
	New Industry Generation Systems
	Intellectual Property Research
Specially Appointed Laboratory	Innovative Nanobiodevice based on Single Molecule Analysis
Special Projects	
Laboratories of 1st Project	
Laboratories of 2nd Project	Laboratory of Cellulose Nanofiber Materials
Laboratories of 3rd Project	Laboratory of Cell Membrane Structural Biology

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-Inteligent 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

Nanotechnology Open Facilities

Comprehensive Analysis Center
Research Laboratory for Quantum Beam Science
Center for Research Education and Training
International Collaborative Research 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
Academia Industry Relations Office
Office of Information Network
Public Relations Office
Library
Planning Office
Facilities Management Office

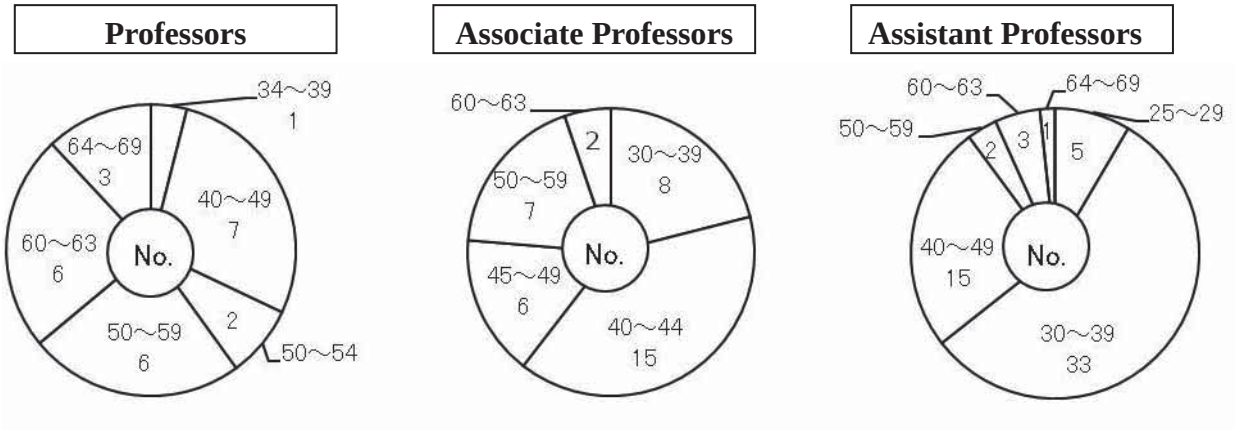
Technical

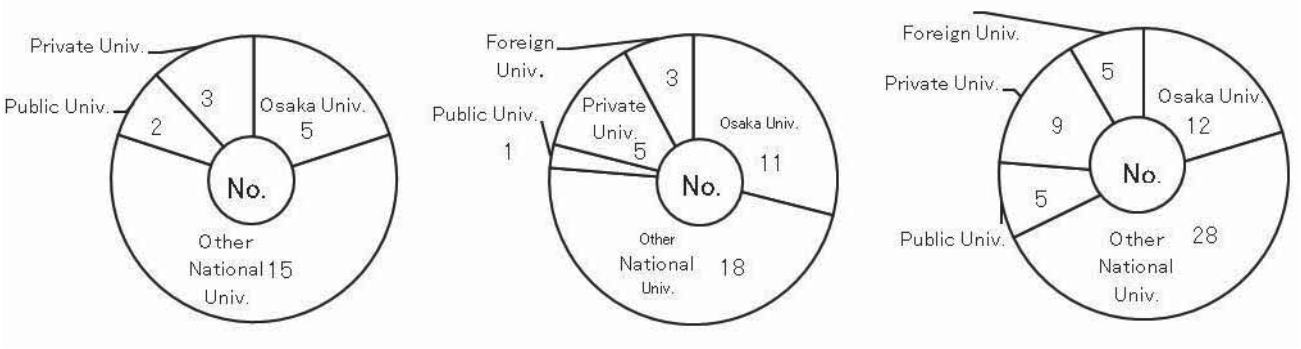
Machine Group
Measurement Group

Administrative Office

General Affairs Division
Research Cooperation Division

Staffs' Age (years old) –As of 3.31.2016





2) Administration

Administration and management of ISIR are conducted by the Director selected from 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.

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.

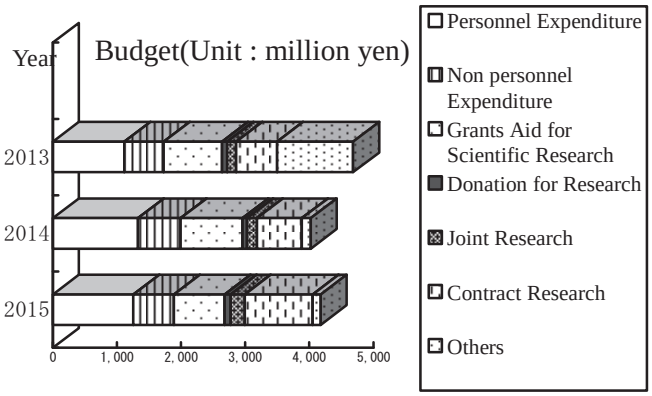
The new organization was highly evaluated, but with change of their structure to National University Agencies in April 2004, our management system needs reshaping. A Board of Directors under the Director has been formed, and Advisory Board has been set up to introduce opinions from outside into the Institute.

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 2015 is 791,957,000yen.

・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
2015	42,265 (15)	23,565 (22)	20,650 (15)	7,740 (6)

Division / Year	Special Projects	Others	Total
2015	0 (0)	600 (2)	95,120 (60)

・Cooperative Researches and Contract Researches in the fiscal year 2015 are as follows: Cooperative Researches are carried out with 69 organizations and the budget for the fiscal year 2015 is 220,562,000 yen. The number of Contract Researches is 44 and the budget for the fiscal year 2015 is 1,058,379,000 yen.

4) International Research

Semiconductor Electronics	Purdue University	USA	Novel graphene device fabrication
Advanced Electron Devices	Imperial Colloge Londo	UK	Manufacturing of Oxide TFTs and integrations
Intelligent Media	Peking University	China	Computer Vision

Intelligent Media	Microsoft Research Asia	China	Computer Vision
	Drexel University	USA	Computer Vision
	University of Rajshahi	**Bangladesh**	Computer Vision
	University of Picardie Jules Verne	France	Computer Vision
Reasoning for Intelligence	Federation University Australia	Australia	Development of Machine Learning Methods Based on Data Mass
	Universite Joseph Fourier	France	Data Block Minng Method and Its application to Log Analysis
	Universite Joseph Fourier	France	Extension to Sequential Test of Statistical Hypotheses Mining
	University of Washington	USA	Development of submodular optimization algorithms for machine learning
	Peking University	China	Application of machine learning to computer vision with brain images
	Nanyang Technological University	Singapore	Application of machine learning to video analysis of crowded scenes
	ETH Zürich	Swiss	Development of optimization algorithms for gene data analysis with machine learning
	ETH Zürich	Swiss	Development of Significant Pattern Mining Methods
	University of Copenhagen	Denmark	Development of Significant Pattern Mining Methods
	University of North Carolina at Chapel Hill	USA	Estimation of causal direction in the presence of latent common causes
	University College London	UK	Estimation of causal direction in the presence of latent common causes for time series data
Knowledge Science	LOA, ISTC-CNR; TU Delft; The John Paul II Catholic University of Lublin;	Italy, The Netherlands, Poland	Definition of artifacts and Unifying definition of functions

Architecture for Intelligence	Chulalongkorn University	Thailand	Machine Learning
	De La Salle University-Manila	Philippines	Empathic Computing
	University of Porto	Portugal	Data mining
	University of Leuven	Belgium	Machine Learning
	Imec	Belgium	Brain signal analysis
	University of Bamberg	Germany	Database Systems
	Telecom Paris Tech	France	Embodied Agent
	Univeisity of Auckland	New Zealand	Information recommendation
	Carnegie Mellon University	USA	Information recommendation
Quantum Functional Materials	University Hasselt	Belgium	Development of n-type organic semiconductors
Semiconductor Materials and Processes	Innver Mongolian Normal University	China	Improvement of semiconductor device characteristics by use of nitric acid oxidation method
	Slovakia Academy of Science	Slovakia	Improvement of crystalline Si solar cell characteristics by use of surface structure chemical transfer method
Advanced Hard Materials	Sunmoon University	Korea	Development of Multifunctional Nanomaterials and Processing Technology for Eco-friendly Applications
	Hanyang University	Korea	Academic Exchange in the field of Nanochemical Engineered New Functional Materials
Advanced Interconnection Materials	Holst Centre	The Netherlands	Stretchable conductive wiring
	imec UGent CMST	Belgium	Stretchable bonding
Excited Solid-State Dynamics	University College London	UK	Mechanisms of photoinduced phase transitions in solids
Accelerator Science	The Advanced Radiation Technology Institute, Korea Atomic	Korea	Auantum Beam Science Research

	Energy Research Institute		
Beam Materials Science	University of Sherbrooke	Canada	Monte-Carlo simulation study on radiolysis of polar liquids at extreme conditions
	University of Paris-sud	France	Ultrafast pulse radiolysis study on polar liquids at extreme conditions
	University of Notre Dame	USA	Theoretical study on electron thermalization process in water
	Université Paris-Sud	France	Radiation-induced synthesis of metal nanoparticles in ethers THF and PGMEA
	University of Birmingham	UK	Study on Combination of Top-down and Bottom-up Nano-fabrication
	University of Qeeensland	Australia	Synthesis of novel block copolymers for lithographic applications
Molecular Excitation Chemistry	National Taiwan University	Taiwan	Photochemistry of supramolecules
	POSTECH	Korea	Photocatalytic reaction mechanism
Synthetic Organic Chemistry	Bielefeld University	Germany	Development of Novel Dual Catalysis based on Biocatalyst and Chemocatalyst
	Paris Sud University	France	Development of Novel Environmentally Benign Process
Regulatory Bioorganic Chemistry	The Hospital for Sick Children	Canada	suppression of trinucleotide repeat expansion by small organic molecules
	Macau University of Science and Technology	China	Analysis of CUG repeat binding molecules by mass spectra
Organic Fine Chemicals	Eindhoven University of Technology	The Netherlands	Modulation of functions of 14-3-3 proteins
	Kyunghee University	Korea	An EGCG derivative effectively induces apoptosis via SHP-1-mediated suppression of BCR-ABL and STAT3 signalling in chronic myelogenous leukaemia

Biomolecular Science and Research	Palacký University	Czech Republic	Reaction mechanism of radical SAM enzyme
Biomolecular Science and Regulation	University of Hong Kong	China	Mechanism of bacterial homeostasis mediated by transporters and development of new therapeutic strategies to control infectious diseases
	National Institute of Agronomic Research (INRA)	France	Bile-mediated activation of the multidrug efflux genes in Salmonella enterica
	Ghent University	Belgium	Uncovering the molecular basis of multidrug efflux pumps involved in resistance of Salmonella Enteritidis against Ovotransferrin and its peptide
	University of Veterinary Medicine Hannover	Germany	Salmonella Typhimurium Multidrug Efflux Pumps and Triclosan Resistance
	Martin Luther University of Halle-Wittenberg	Germany	Structural and functional analysis on bacterial multidrug efflux systems
Biomolecular Science and Engineering	Indian Institute of Technology Madras	India	Spatiotemporal Ca2+ imaging during cellular slime mold development: A study with ultrasensitive genetically encoded indicators
	Weatherall Institute of Molecular Medicine, University of Oxford	UK	The versatility of optical super-resolution microscopy
	Department of Chemistry, University of Alberta	USA	Molecular engineering to build new tools to probe cellular physiology
	Technische Universität Darmstadt	Germany	Single molecule microscopy in mammalian 3D cell cultures and plants -Same challenge. Same solution?

Biomolecular Science and Engineering	Academia Sinica	Taiwan	Lattice light sheet microscopy captures life in action
	EMBL(European Molecular Biology Laboratory)	Germany	Tools for Manipulating Cell Biology
Functional Nanomaterials and Nanodevices	IBM Research Laboratory	Swiss	Obsevation of scanning thermal microscope for oxide nanostucutres
	Indian Institue of Technology, Hyderabard	India	Sn oxide-based gas sensors
	Ehwa Woman University	Korea	Obsevation of nano-doman by Kervn force microscopy
	Genova University	Italia	Functional Oxide-MEMS
Advanced Nanofabrication	Bhabha Atomic Research Centre	India	Investigation of microheterogeneity and initial process of radiation chemistry in materials using ultrafast pulse radiolysis
	Institute of Physics of the Academy of Sciences of the Czech Republic Na Slovance	Czech Republic	Development of dosimeter for X-ray beam line
	University of Notre Dame	USA	Radiation chemistry of water
Nanocharacterization for Nanostructures and Functions	University of Kentucky	USA	ETEM observation of nanomaterials under catalytic reaction conditions
	Utrecht University	The Netherlands	Structural transformation of gold nanorods in gases
	Lawrence Berkeley National Laboratory	USA	High resolution TEM observations of Au nanoparticles supported on metal oxides catalysts
	FEI Company	USA	Development of a high resolution envirionmental TEM
Theoretical Nanotechnology	Korea Institute of Ceramic Engineering	Korea	Mechanical properties of hard ceramics materials

	and Technology		
Soft Nanomaterials	Indian Institute of Chemical Biology	India	Chemical Biology Applications of Organic Electron Acceptors
	Interuniversity Microelectronics Centre (imec)	Belgium	Development of high-performance n-type organic field-effect transistors
Bio-Nanotechnology	Uppsala University	Sweden	Theoretical studies on DNA manipulations
	Rutgers University	USA	Theoretical studies on DNA manipulations
Intellectual Property Research	College of Forestry, Northwest F&A University	China	Effect of natural organic polymers for destaining of Eucommia Leaf Tea
Comprehensive Analysis Center	Carnnegie Institution of Washington	USA	electron density analysis of SrTiO3
Research Laboratory for Quantum Beam Science	Korea Atomic Energy Research Institute	Korea	Quantum Beam Science

5) Symposia, Seminars, Workshops and Lectures

2015/4/3	Workshop on the Advanced Ceramics and Metal Materials
2015/5/15	1st SANKEN Techno Salon
2015/5/25-5/27	Workshop on "Topological Magnets"
2015/5/30-5/31	Workshop on prospect of radiation chemistry
2015/7/27-8/9	The 2ndt Spying minority in biological phenomena Training Courses
2015/7/31	2nd SANKEN Techno Salon
2015/8/5	Lecture on computer vision
2015/8/7	98th Meeting on Foundations and Principles in Aritificial Intelligence
2015/9/5	Material state analysis seminar
2015/9/9	The 3rd Spying minority in biological Phenomena Workshop
2015/9/11-9/12	Spying minority in biological Phenomena Alliance Workshop
2015/9/14-9/15	Juelich–Osaka discussion meeting on Computational Materials Design
2015/9/15	Symposium at The 53rd Annual Meeting of the Biophysical Society of Japan, Biological events operated by small number of biomolecules

2016/9/26	Symposium on Chemistry Chanllenge on Trinucleotide Repeat Diseases
2015/10/1	Lecture on computer vision
2015/10/16-10/17	The 1st Pusan-Osaka Meeting on Advanced Matter Physics,
2015/10/22-10/23	CREST Joint Meeting
2015/11/6	3rd SANKEN Techno Salon
2015/11/24	The 71st SANKEN Workshop
2015/12/2	Workshop at BMB2015, Behavior of the countable number of molecular elements, which governs biological systems.
2015/12/4	3rd Intl Japan-Korea Seminar on Multifunctional NanoStructured Ceramics
2015/12/7-12/9	The 19th SANKEN International Symposium,The 14th SANKEN Nanotechnology International Symposium,3rd KANSAI Nanoscience and Nanotechnology International Symposium, 11th Handai Nanoscience and Nanotechnology International Symposium
2015/12/15-16	WBG-i symposium on Power Electronics
2015/12/19-12/20	Symposium at PacifiChem2015, Life at Small Copy Numbers
2016/1/8-1/9	ISIR Inter-University Collaboration Meeting
2016/1/9	The Japan Society of Applied Physics (JSAP), Kansai-Branch seminer
2016/1/13-1/14	Fluorescent microscopy Imaging
2016/1/21-1/22	99th Meeting on Foundations and Principles in Aritificial Intelligence
2016/1/25～1/26	Research Meeting for "Empathic Computing System through interactive knowledge emergence based on massive data processing"
2016/1/28-1/29	Workshop on Frontier Materials Research
2016/2/5	4th SANKEN Techno Salon
2016/2/14-2/16	Spying minority in biological Phenomena Workshop 2016
2016/2/23	Symposium on membrane transporters and drug resistance
2016/2/29-3/4	28th Computational Materials Design Workshop
2016/3/7	Research Meeting between IIS of University Tokyo and ISIR of Osaka University
2016/3/15	Meeting on Spying minority in biological Phenomena
2016/3/25-3/26	Workshop on Computational Nano-Materials Design and Realization for Energy-Saving and Energy-Creation Materials
2016/3/27-3/28	100th Meeting on Foundations and Principles in Aritificial Intelligence

Other Lectures and Seminars

2015/6/16	Takanari Inoue	Johns Hopkins University	Principal Investigator	一次繊毛内の情報伝達の可視化および操作について

2015/7/27	Ryohei Yasuda	Max Planck Florida Institute	Director	Illuminating signal transduction in single dendritic spines
2015/9/16	Chunhai FAN	Chinese Academy of Sciences	Professor	DNA nanotechnology-enabled organization at the nano-bio interfaces
2015/9/16	Peilin CHEN	Academia Sinica	Research Fellow	Nanomaterials for Biomedical Applications
2016/11/20	Makoto Hashimoto	Hokkaido University	asociate professor	application of stable isotope for the photoaffinity labelling
2016/11/20	Masaya Takahashi	Texas University	asociate professor	Recent progress of molecular, metabolic information using MRI
2016/12/10	Hisashi Doi	Riken	team leader	Chemical synthesis of short-life PET molecular probe
2016/12/10	Kumi Yoshida	Nagoya University	professor	Elucidation of blue flower pigment by chemical analysis
2015/12/4	Myoungpyo Chun	Korea Institute of Ceramic Engineering and Technology（KICET）	Chief Researcher	Synthesis and Characterization of Rod-Shaped Ni-Zn Ferrite
2015/12/4	Jiwon Bang	Korea Institute of Ceramic Engineering and Technology（KICET）	Senior Researcher	Development Fluorescent Quantum Dot Switches and Quantum Dot Based Light Emitting Devices
2015/12/4	Sangil Hyun	Korea Institute of Ceramic Engineering and Technology（KICET）	Principal Researcher	Recent Computational Studies on Nanostructured Materials
2016/2/3	Hee Soo Lee	Pusan National University	Prof.	Design, Development and Standarization of Oxide Electrode for Solid-Oxide Fuel Cells
2016/2/26	Soo Wohn Lee	Sun Moon University	Prof.	Development of Environmental Friendly Nanoceramics
2015/5/22	Jai Pal Mittal	National Academy of Sciences , India	Distinguished Professor	Antioxidents-a Hype or the Myth-some pulse radiolysis and other studies
2015/6/1	Dipak K. Palit	Bhabha Atomic Research Centre	Professor	Ultrafast spectroscopy & dynamics in organics nanoparticles/nano aggregates, ionic liquids and excited

				states of molecules
2015/7/31	Dianne L. Poster	National Institute of Standards and Technology	Special Assistant Associate Director for Laboratory Programs	Radiation Chemistry Activities at NIST and the Development of Advanced Materials
2015/9/29	Yoshinori Kobayashi	Saitama University	Associate Professor	Development of Interaction Systems based on Automatic Measurement of Human Behaviors and Sociological Analysis of Communication
2015/9/29	Shogo Okada	Tokyo Institute of Technology	Assistant Professor	Understanding Actions in Conversation by Multi-modal Sensing
2015/7/16	Prabeer Barpanda	Faraday Materials Laboratory, Materials Research Centre, Indian Institute of Science	Assistant Professor	High-Voltage Polyanionic Cathodes for Li-ion and Na-ion Batteries
2015/11/20	Weinert, Mike	University of Wisconsin-Milwaukee	Professor	International Meeting on First-Principle Calculations
2016/2/5	Tanusri Saha-Dasgupta	S. N. Bose. National Center for Basic Sciences	Senior Professor & Associate Dean Faculty	Mini-Workshop on Novel Materials Physics and Chemistry
2015/6/11	Nirattaya Khamsemanan	Thammasat University	Associate Professor	Managing Data with Mathematics
2015/5/14	Aixin Yan	University of Hong Kong	Associate Professor	Exploring the regulation and physiological functions of drug efflux pumps using transcriptome database
2015/6/23	Aixin Yan	University of Hong Kong	Associate Professor	Regulation and physiological roles of bacterial multi-drug efflux pumps: Understanding their presence in bacterial genomes

2016/3/30	Jingjing Sun	University of Hong Kong	Graduate Student	Exploring the regulation and physiological roles of multidrug efflux pumps in Salmonella enterica serovar Typhimurium during its anaerobic adaptation
2015/7/9	John E. Moore	Belfast City Hospital	Professor	What's new in Infective Endocarditis?
2016/2/3	BUERKLE Marius Ernst	AIST	Researcher	Chemical control of the thermoelectric transport through single molecule devices – Insight from first principle calculations
2015/9/29	Takayoshi Suzuki	Kyoto Prefectural University of Medicine	Professor	エピジェネティクス制御化合物の創製と応用
2015/11/30	Mako Kamiya	The University of Tokyo	Assistant professor	化学プローブを精密にデザインして癌を光らせる
2015/7/27	Nicola Manca	Delft University of Technology	Researcher	Free-standing electromecanical devices using VO2
2015/7/27	Luca Pellegrino	CNR-SPIN and University of Genova	Researcher	Overview of the activities on oxide MEMS at SPIN-Genova: results and perspectives
2015/7/31	Xiaomin Li	Shanghai Institute of Ceramics Chinese Academy of Sciences	Professor	Multiferroic oxide heterostrucure
2016.1.25	Jong Hyun Song	Chungnam National University	Professor	Exotic phenomena at oxide LaAlO3/SrTiO3 hetero-interface and their applications
2015/7/16	Kai Ming Ting	Federation University Australia	Professor	Isolation Forest and recent development of isolation techniques for anomaly detection

7) Public Information Activity

Public information activity of ISIR in 2015 is as follows:

- Bulletin of ISIR 2015 (in both Japanese and English)

- Memoirs of the Institute of Scientific and Industrial Research, Osaka University Vol.72 2015 (in English)
- Annual Report of ISIR (in Japanese)
- SANKEN News Letters(in Japanese)
- Report on SANKEN Techno Salon 2015 (in Japanese)
- WWW home-page (http://www.sanken.osaka-u.ac.jp/)

8) Research Reports

The number of scientific and technological papers published in 2015 is 397. The details are described in the part of activity of divisions and facilities.

9) Scientific Awards

Y.TAKEUCHI	136th Annual Meeting of the Pharmaceutical Society of Japan, Excellent Poster Award	2016/3/31
Y.MAKIHARA	The 2nd IEEE Int. Conf. on Identity, Security and Behavior AnalysisBest Reviewers Award	2016/3/1
W.FUJITA	ICAART Program Best Student Paper Award	2016/2/26
H.SASAI	Synthetic Organic Chemistry Award, Japan	2016/2/18
M.NOGI	Printable Electronics Award 2016 Business Model Award	2016/1/28
T.SEKITANI	IDW'15 Best Paper Award	2015/12/28
T.UEMURA	IDW'15 Best Paper Award	2015/12/28
T.SEKINO	2015 Paper Award	2015/12/19
T.SEKITANI	The 12th JSPS Prize	2015/12/18
S.IKEMOTO	GCAD Award	2015/12/18
K.TAKENAKA	The Society of Synthetic Organic Chemistry, Japan, The 13th Kansai Branch Award	2015/12/4
Danaipat Sodkomkham	The 3rd Prize from an Online Machine Learning/Data Science Competition	2015/12/3
H.TANAKA	PCOS2015 Best Paper Award	2015/11/27
T.SEKINO	The 70th (2015) Ceramic Society of Japan Awards For Academic Achievements	2015/11/26
Y.YAGI	SBRA2015 Poster presentation award	2015/11/13
Y.MAKIHARA	SBRA2015 Poster presentation award	2015/11/13
D.MURAMATSU	SBRA2015 Poster presentation award	2015/11/13

K.KOZAKI	The 5th Joint International Semantic Technology Conference (JIST2015), Best In-Use Paper	2015/11/12
T.SEKINO	IUMRS-ICAM2015 Best Poster Award	2015/10/29
K.FUJII	IUMRS-ICAM2015 Best Poster Award	2015/10/29
N.YOSHIMOTO	Award for Researches on Chemical and Biological Materials in 2015	2015/10/14
T.YOSHIDA	Japanese Society of Radiation Chemistry,Young Scientist Best Poster Award	2015/10/1
M.TANE	Grant-in-Aid for Scientific Research on Innovative Areas Materials Science on Synchronized LPSO Structure -Innovative Development to Next-generation Lightweight-structural Materials-,Best Presentation Award	2015/9/29
K.FUJII	The 28th Fall Meeting, Best Presentation Award	2015/9/18
M.FUJITSUKA	The Japanese Photochemistry Association Award	2015/9/10
Y.MUROYA	Indian Nuclea Society ,Best Postre Award	2015/9/4
S.YAMASAKI	27th SYMPOSIUM ON MICROBIAL SCIENCE Best Abstract Award	2015/9/4
H.KOGA	Best Presentation Award in the 82nd Meeting of Japan Technical Association of the Pulp and Paper Industry	2015/8/31
M.TANIGUCHI	Japan Science and Technology Agency, President Award	2015/8/27
T.MAJIMA	Korean Society of Photoscience,Merit Award	2015/8/25
T.GOTO	TAM Presentation Award	2015/8/7
F.OKURA	The 18th Meeting on Image Recognition and Understanding (MIRU2015) Outstanding reviewer	2015/7/30
T.MAJIMA	Japanese Society for Photomedicine and Photobiology Award	2015/7/17
S.YAMASAKI	6th Symposium on Antimicrobial Resistance in Animals and the Environment (ARAE 2015), Poster Award	2015/7/14
T.YOSHIDA	Japanese Society of Radiation Chemistry Yang Scientist Award	2015/5/27
Y.MAKIHARA	The 11th IEEE Int. Conf. on Automatic Face and Gesture RecognitionOutstanding Reviewer	2015/5/6
T.SEKITANI	MEXT Young Scientist Award	2015/4/20
Y.KANAI	Funai Research Encouragement Award	2015/4/15
M.TANIGUCHI	APEX / JJAP Editorial Contribution Award	2015/4/14

2. Education

ISIR accepts graduate students 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, 2016 is as follows.

Field / Course	Science	Engineering	Engineering Science	Pharma-ceutical Science	Information Science and Technology	Frontier Biosciences	Total
Master Course	27	50	13	2	16	-	108
Doctor Course	27	28	4	2	12	2	75
Total	54	78	17	4	28	2	183

Number of students who had obtained Master's or Doctor's Degree in FY2015 is as follows.

Field / Degree	Science	Engineering	Pharmaceutical Science	Information Science and Technology	Total
Master’s Degree	5	21	1	8	35
Doctor’s Degree	9	5	0	2	16
Total	14	26	1	10	51

3. International Exchange

1) Exchange Agreement

At Present, academic exchange agreements are concluded with the following 28 organizations.

Otto-von-Guericke University, Magdeburg (Faculty of Natural Science)
Pukyong National University (Basic Science Research Institute)
Forschungszentrum Jülich GmbH
Pusan National University(College of Natural Sciences)

Hanyang University
National Taiwan University
Centre National de la Recherche Scientifique
RWTH Aachen University
Peking University (The School of Electronics Enginering and Computer Science)
Chungnam National University(College of Natural Sciences)
National Taiwan Normal University(College of Science)
University of Geneva(Faculty of Science)
Inner Mongolia Normal University(The School of Chemistry and Environment Science)
University of Augsburg
Pohang University of Science and Technology
De La Salle University(College of Computer Studies)
Assiut University
Interuniversitair Micro-Electronica Centrum vzw (IMEC)
University of Bordeaux
Bielefeld University（Faculty of Chemistry）
University of Minnesota (The Biotechnology Institute)
Pacific Northwest National Laboratory
Korea Institute of Ceramic Engineering and Technology
Advanced Radiation Technology Institute/Korea Atomic Energy Research Institute
Eindhoven University of Technology (Department of Mechanical Engineering)
Chulalongkorn University (Department of Computer Engineering, Faculty of Engineering)
Sun Moon University (College of Engineering)
Shanghai University (School of Environmental and Chemical Engineering)

2) Foreign Researchers and Students

The Number of foreign researchers and students staying in ISIR as of March 31, 2015 is 75 in total. Details are, Assistant Professor(include of specially appointed staffs) (2), Specially Appointed lecturer(1),Specially Appointed Associate Professor(4), Specially Appointed Researcher(2), Specially Appointed Technical Staff(1),Part-time Employee (11),Graduate Students 40(Doctor Course,29, Master Course,11), Research Students (11).

Their nationalities are; China(34), Korea(6), Thailand(7), Indonesia(3), Bangladesh(2), India(3), The Netherland(1), Viet Nam(3), Russia(2), Taiwan(3), Philippine(2), Malaysia (2), Egypt(4), U.S.A.(1), Costa Rica(1), England(1).

The Number of visiting Research Scholar in 2015 is 53.Their nationalities are; China(15), Hong Kong(9), U.S.A.(5), Thailand(6), Korea(4), Australia(2), Italy(2), Taiwan(2), France(1), Estonia(1), Canada(1), Denmark(1), Germany(1), India(1), Vietnam(1), Egypt(1)

3) International Conferences and Symposiums

Number of presentations (plenary, invited, oral and poster in various international conferences and symposia) by staff of ISIR is 439 in total.

Number of ISIR staffs who have been working as committee members of International Conferences or Editorial Board of international academic journals are 139 in total. For more details, see the part of activity of divisions and facilities.

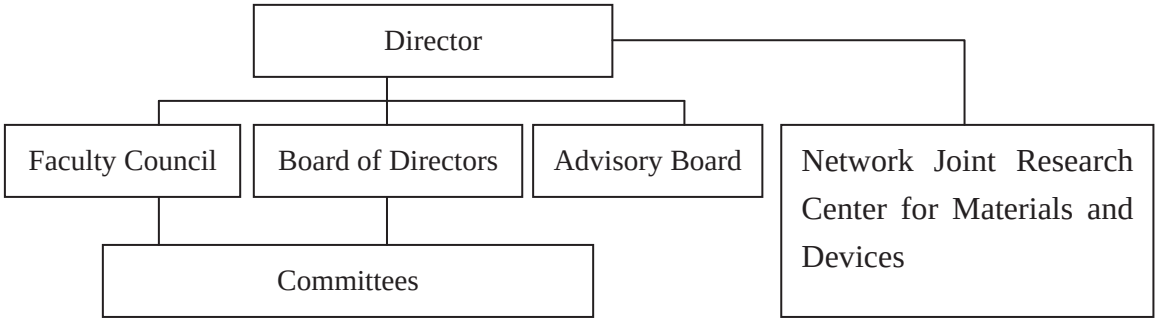
4. Concluding Remarks

(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) 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 Center for Collaborative Research Education and Training was started for promoting the foreign exchange. It 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/index_e.html). 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 seven departments; Information Science Departments (Knowledge Science, Intelligent Media, Architecture for Intelligence, Reasoning for Intelligence), Quantum Science Departments (Photonic and Electronic Materials, Semiconductor Electronics, and Advanced Electron Devices. The former four and the latter three 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 nanotube
- Development of noise-robust spoken dialogue robots and knowledge acquisition through dialogues
- 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 Quantum System Electronics

Professor: Akira OIWA
Associate Professor: Shigehiko HASEGAWA
Assistant Professor: Haruki KIYAMA
Guest Researcher: Shuichi EMURA
Specially Appointed Researcher: Hiroki SHIOYA (2015.4.1-2015.5.31)
Graduate Students: Yoshihito SUGETA, Kentaro DEHARA, Takashi HIRAYAMA, Tomohiko ABE, Masamitsu KIMURA, Ryoki SHIKISHIMA, Tomohiro Nakagawa, Yuta MIYAZAKI,
Under Graduate Students: Yuhei KUROKAWA, Masaki TADA, Panin Pienroj, Rio FUKAI
Supporting Staff: Akiko WATANABE

Outlines

We study the quantum and spintronic devices that can control the quantum mechanical properties of light, electrons and spins. Single electron spin is a suitable candidate of a quantum bit (qubit) for quantum computation. Hence, we develop spin qubits and also quantum interfaces between single photons to single electron spins in quantum dots toward long distant quantum communications. We investigate magnetic semiconductors and spin currents generated by spin injections from ferromagnets to semiconductors. We study the growth and characterization of high quality materials and perform precise quantum transport measurements to explore novel phenomena emerging in quantum nano-structures that can control the photon, electron and spin degrees of freedom.

Current Research Projects

Charge Sensing Using InAs Self-Assembled Quantum Dots

InAs self-assembled quantum dot (QD), which has a large g-factor and a strong spin-orbit interaction, is a suitable system for spin qubits that operate with high speed by controlling electric field. For the basic research and applications of this system, we develop the charge sensing using the adjacent two QDs. We fabricated parallel double QD transistors by attaching source-drain and side-gate electrodes as shown in Fig. 1. Owing to the electrostatic coupling between the two QDs, the electrical transport of one of the QDs sensitively reacts to the electron number in the other QD and is expected to work as a charge sensor. In the transport measurements at low temperatures, we observed the conductivity changes synchronized between the two QDs, indicating the charge sensing.

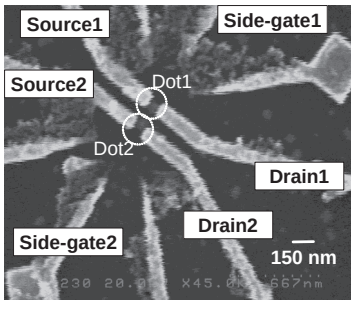


Fig. 1 SEM picture of parallel InAs self-assembled double QD transistor

Design of Bull's Eye Structures for Efficient Photon Polarization - Electron Spin Quantum State Conversion

Quantum repeaters are indispensable for long distance quantum communications. Owing to the long spin coherence time and electrical controllability of QDs, QDs are suitable for the quantum repeaters. In the previous works, however, the conversion efficiency from photon to electron spin has been low and the improvement of the efficiency is an urgent subject for applications. Thus, we have simulated the local electric field enhancement by the bull's eye structure, which consists of a concentric metallic grating, on the QD (Fig. 2). As a result, we have found that the electric field at the position of the QD is increased about 14 times by the bull's eye structure.

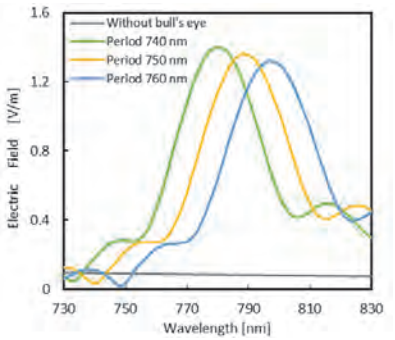


Fig. 2 Result of the simulation of the electric field strength at the position of QD.

Cooper Pair Splitting and Verification of Non-Local Entanglement in Parallel Double Quantum Dot Josephson Junctions

In the solid state the production, isolation and manipulation of entangled electron spins has not been well established. In parallel double QD Josephson junctions, electrons forming a Cooper pair in a superconductor tunnel to two separate quantum dots due to charging effect and are recombined in the other superconductor, causing supercurrent only when the spin singlet correlation is maintained. While tuning independently the chemical potential of the QDs with side-gates the supercurrent due to the Cooper pair splitting is identified and the non-local entanglement is confirmed.

Crystal Growth and Characterization of Dilute Magnetic Semiconductors toward Application to Spintronic devices

Dilute magnetic semiconductors (DMSs) are gathering great interest as a candidate for new functional materials. Nitride-based DMSs such as GaCrN, GaGdN, and GaSmN have been grown by using plasma-assisted molecular beam epitaxy (PA-MBE). It has been reported that these materials show hysteresis loops in their magnetization curves even at room temperature (RT). In 2015, in order to increase the Gd concentration in GaGdN, GaGdN/GaN superlattices were grown by utilizing a δ-doping technique. The structural analyses revealed that the present approach can realize desired structures with extremely high Gd concentrations.

Spin Injection from Ferromagnets into III-Nitride Semiconductors

Spin injection from ferromagnets into III-Nitride semiconductors is a very important subject to realize semiconductor spintronic devices. We have demonstrated spin injection and detection through a Co/GaN Schottky barrier at RT. In 2015, we examined the structure of γ'-Fe_4N/GaN interfaces formed by PA-MBE toward the improvement of spin injection efficiency. It was found that the interface is atomically abrupt. Moreover, an atomic displacement in γ'-Fe_4N takes place to relax the lattice mismatch.

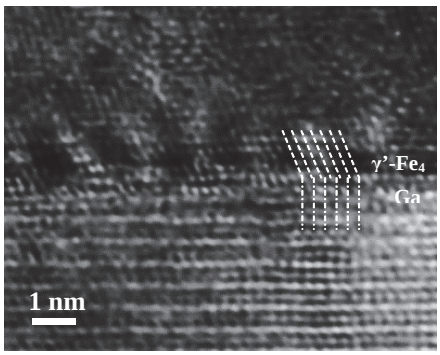


Fig. 3. Cross-sectional TEM image of a γ'-Fe_4N/GaN interface.

Department of Semiconductor Electronics

Professor: Kazuhiko MATSUMOTO
Guest Professor: Kenzo MAEHASHI
Associate Professor: Koichi INOUE
Guest Associate Professor: Yasuhide OHNO
Assistant Professors: Yasushi KANAI, Takao ONO
Guest Researcher: Masato MIYAKE
Graduate Students: Takashi IKUTA, Satoshi OKUDA, Yusuke ISHIBASHI, Masayuki OKANO, Kaho KAMADA, Ryota HAYASHI, Yuki MORI
Under Graduate Students: Ryo OKAZAKI, Takuya KAWATA
Supporting Staffs: Reiko YAMAUCHI, Ayumi ENOMOTO

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

Electrical Detection of Polymerase Chain Reaction (PCR) Using Graphene Field-Effect Transistors (GFETs)

We carried out PCR on GFETs in collaboration with Prof. Nakatani, ISIR, for high-sensitive detection of DNA molecules. Dirac point of GFETs shifted after negatively-charged DNA primer

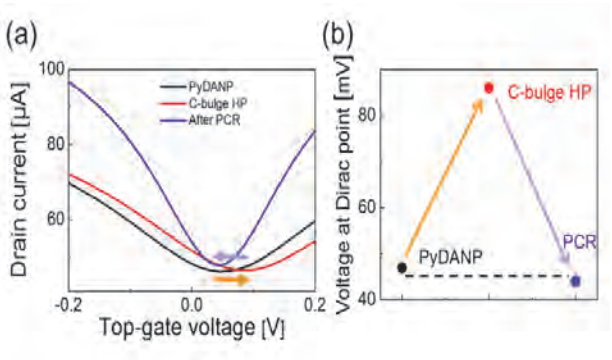


Fig. 1. (a) GFET transfer characteristics before (black) and after (red) DNA primer capture and after PCR (blue). (b) Dirac-point shifts on the gate voltages. Dirac point shifted positively due to hole doping by DNA primer, and shifted back to the original position after PCR.

was captured on the GFET channel using PyDANP, a newly synthesized molecule by Prof. Nakatani's group. After thermal cycling with target DNA and PCR solutions, it shifted back to the original position. It is assumed to be due to the release of the primers through the PCR. These results will contribute to the application of GFETs to PCR assay, and furthermore, to detection of small amount of pathogen DNA inside the human body.

Laser irradiated graphene synthesis on polymer films for the application to strain sensors

We have investigated a method of graphene synthesis at a desired position on polymer substrates by focused laser irradiation, for the application to new strain sensors. Poly-ethylene-naphthalate (PEN) films were used as substrates, on which Ni metal was deposited by the electron-beam evaporation in a striped pattern as shown in Fig. 2 (a). A continuous wave (CW) Ar-ion laser with the wavelength of 514.5 nm was focused onto a small spot with about 2 μm diameter at the middle point of the Ni stripe in a vacuum. Due to the local heating by the irradiation, the metal was partially melted and removed outside of the spot. During the irradiation, a graphene layer was synsesized by thermal decomposition of the polymer surface and crystallization in the presence of Ni catalyst (Fig. 2 (b)). The both sides of recidual Ni metal outside of the irradiatted spot can be used as two electrodes in the GFET devices. The irradiated spots in such samples were investigated by optical microscopy, Raman scattering spectroscopy in Fig. 2 (c) and electrical measurements in Fig. 2 (d), where, in GFET, we observed typical ambipolar characteristics dependent on the side gate voltages. These results have confirmed the existence of graphene on the surface. Since the electric conductance changes sensitively to the strain induced by bending deformation of the substrates, the fabricated devices are expected to be useful as a strain sensor.

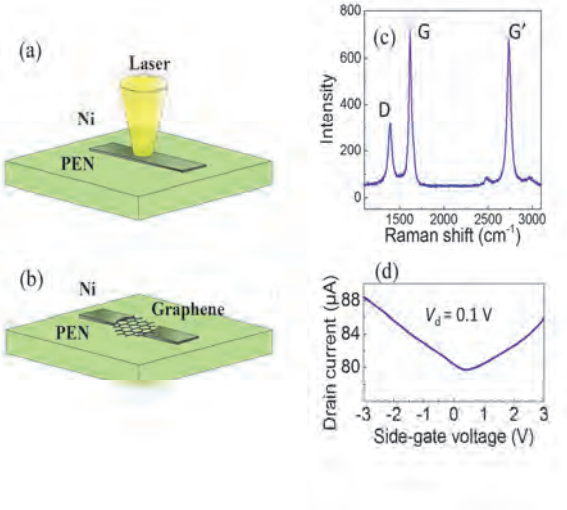


Fig. 2. (a) Schematic structure of the sample and the laser irradiation position, where graphene is synthesized (b). (c) Typical Raman scattering spectra of the irradiated position. (d) Electrical characters of the GFET (d). The side-gate voltage is applied through the ionic liquid as a gate insulator.

Department of Advanced Electronic Devices

Professor:	Tsuyoshi SEKITANI
Assistant Professors:	Kouichi SUDO
Specially-appointed Associate Professor:	Takafumi UEMURA
Assistant Professor:	Teppei ARAKI, Shusuke YOSHIMOTO
Specially-appointed Assistant Professor:	Yuuki NODA
Specially-appointed Reasercher:	Toshikazu NEZU, Afreen AZHARI
Reasercher:	Tomoya ARAI, Kenichi SASAI, Ren SMIS
Technician:	Tamaki OKA, Aiko YAGURA, Hirokazu IIDA, Mihoko AKIYAMA, Naoko NANBA, Masaru SHIMIZU, Yuko KASAI, Fumio KURAHASHI, Toshihisa HAMAGUTI, Takako OYAMA
Graduate Students:	Masaya KONDO, Ashuya TAKEMOTO
Under Graduate Students:	Masahiro SUGIYAMA, Humika TANABE
Exchange Students:	Swen DONALD
Supporting Staff:	Michi UEDA, Taki HONMA, Tomoko TAKAHASHI

Outlines

Our laboratory has been carrying out research on the physical properties of base materials used in flexible electronics and their applications on the basis of the excellent electrical and mechanical properties (e.g., flexibility), self-assembly phenomena, and low-energy processability of organic materials. In particular, we succeeded in realizing a high integration of organic transistors by developing technologies based on the characteristics of organic materials in a wide range of fields. These technologies include lamination technology for organic nanomolecular layers, technology to control an organic semiconductor/insulator interface, technology to control the physical properties of organic molecular materials, evaluation technology, and technology to design organic circuits. We established the fundamental technology for fabricating flexible organic thin-film transistors (TFTs) and developed ultraflexible electronics and stretchable electronics with excellent mechanical properties, demonstrating the usefulness of these devices for the first time in the world.

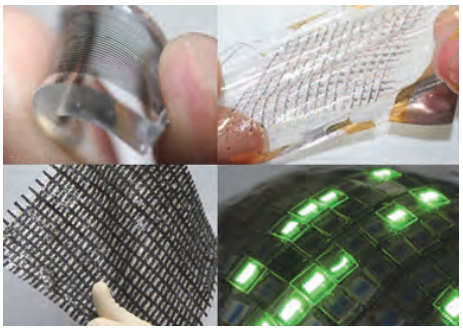
We have not only developed electronic devices, but also fabricated an 1) organic light-emitting diode (OLED) with a conjugated polymer or 2) organic photoelectric conversion element with a bulk heterojunction [solar cell, optical photodetector (OPD)] on a 1-μm-thick plastic film, realizing imperceptible electronics. This is expected to become the next-generation human interface and is being studied in cooperation with medical doctors to apply them to devices for use in next-generation medicine and medical welfare.

Current Research Projects

Improvement of performance of flexible organic transistors

We established new technologies to substantially improve the performance of organic transistors. In addition, we explored the field of flexible electronic devices fabricated using organic transistors before the rest of the world. In particular, we were the first to realize an ultraflexible organic transistor (bending radius,≤ 10 um) that has a high electrical performance (mobility of 3.2 cm^2/Vs when driven at 2 V) exceeding that of amorphous silicon by combining various technologies related to materials, physical properties, processes, and circuit design in a concerted manner. Thus far, high performances in terms of response speed, mobility at a low-voltage, mechanical flexibility, heat resistance, and low noise were realized. We also established a fabrication process for organic transistors with the world's highest performances in terms of the above-mentioned indices.

Development of ultraflexible and stretchable electronics



Since 2008, large-area organic electronics have been applied to devices used for obtaining human bio information. In particular, sensors to be attached to the human skin should be conductive like metals and stretchable like rubber. On the basis of this idea, we developed rubber with the world's highest conductivity using carbon nanotubes as an additive and succeeded in fabricating the first-ever large-area integrated circuit that is as stretchable as a rubber sheet. With this success, we have opened the door to a new field of stretchable electronics.

Patch-type EEG Sensor using stretchable electrode sheet

In this study, by the fusion of highly conductive stretchable wiring and ultra-high-precision analog front-end, low-power wireless technology, it has developed a brain wave sensor having a large medical equipment and the equivalent measurement accuracy. Compared with the conventional EEG measurement instrument which is also a few meters, the sensor thickness 6 mm, lighter weigh 24 g, it is possible to carry out simply by measuring brain wave pasted on the forehead. In the present study, only measurement by the brain wave sensor to compare the brain activity of Alzheimer-type dementia patients and healthy subjects, was discovered to be able to distinguish. In the future, primary care clinic of domestic and regional, long-term care facilities, etc., promote efforts to simple test of dementia.

Department of Intelligent Media

Professor:	Yasushi YAGI
Associate Professors:	Yasushi MAKIHARA, Daigo MURAMATSU (2015.11.1-)
Assistant Professor:	Ikuhisa MITSUGAMI, Fumio OKURA
Specially Appointed Assistant Professor:	Noriko TAKEMURA (2016.2.1-)
Postdoctoral Researchers:	Mitsuru NAKAZAWA (2016.4.1-2016.4.30), Masataka NIWA, Wei LI (2016.4.1-2016.6.30)
Visiting Foreign Researchers:	Chi XU (2016.1.1-), Xiang LI (2016.1.1-)
Graduate Students:	Kazuhiro SAKASHITA, Andrey GRUSHNIKOV, Kohei SHIRAGA, Ken'ichiro TANAKA, Ruochen LIAO, Zasim UDDIN, Yang YU (2015.10.1-), Taro IKEDA, Sho IKEMOTO, Kazuma KIKUCHI, Takuhiro KIMURA, Tomonori HASHIMOTO, Saaya IKUMA, Jun-ichi KAMIMURA, Atsuyuki SUZUKI, Chuehhan LO
Under Graduate Students:	Takahiro ISOKANE, Gakuto OGI, Yamato OKINAKA, Shoya SUNAGAWA, Yuta MIYAZAKI
Research Student:	Yang YU (2015.4.1-2015.9.30)
Secretaries:	Masako SUGIMOTO, Kumiko NAKAGAWA, Naoko TAGASHIRA (2015.12.1-)
Supporting Staff:	Aya IIYAMA (2015.4.1-2015.5.31), Yoko IRIE (2015.4.1-2015.5.31), Yoshimi OHKOHCHI, Mika IGUCHI, Keiko IMOKARA (2015.10.1-), Naoki HASHIMOTO (2015.10.1-), Yoshiko MATSUMOTO (2015.10.1-)

Outlines

The studies in this laboratory focus on computer vision and media processing including basic technologies such as sensor design, and applications such as an intelligent system with visual processing functions. Some of our major research projects are development of a novel vision sensor such as an omnidirectional mirror, biomedical image processing such as an endoscope and microscope images, person authentication, intension, and emotion estimation from human gait, and its applications to forensic and medical fields, photometry analysis and its application to computer graphics, an anticrime system using a wearable camera, 3D shape and human measurement using infrared light.

Current Research Projects

Recovering Inner Slices of Translucent Objects by Multi-frequency Illumination

This paper describes a method for recovering appearance of inner slices of translucent objects. The outer appearance of translucent objects is a summation of the appearance of slices at all depths, where each slice is blurred by depth-dependent point spread functions (PSFs). By exploiting the difference of low-pass characteristics of depth-dependent PSFs, we develop a multi-frequency illumination method for obtaining

the appearance of individual inner slices using a coaxial projector-camera setup. Specifically, by measuring the target object with varying the spatial frequency of checker patterns emitted from a projector, our method recovers inner slices via a simple linear solution method. We quantitatively evaluate accuracy of the proposed method by simulations and show qualitative recovery results using real-world scenes.

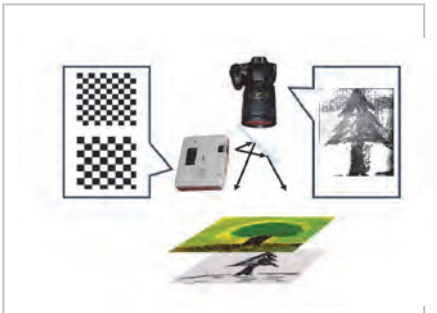


Fig.1 Overview of measuring device

Quality-dependent Multi-modal Biometrics from a Walking Image Sequence

This paper describes a quality-dependent score-level fusion framework of head, gait, and the height biometrics from a single walking image sequence. Individual person authentication accuracies by head, gait, and the height biometrics, are in general degraded when spatial resolution (image size) and temporal resolution (frame-rate) of the input image sequence decrease and the degree of such accuracy degradation differs among the individual modalities. We therefore set the optimal weights of the individual modalities based on linear logistic regression framework depending on a pair of the spatial and temporal resolutions, which are called qualities in this paper.

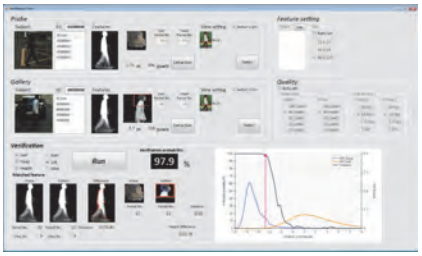


Fig.2 Multi-modal verification system

Performance Evaluation of Gait Authentication Methods using 3-D Gait Database

In this paper, we evaluate the performance of gait authentication considering viewpoints and resolution differences. For realizing it, we use full-body volumes of walking people and back-project them to various sensor image planes with various resolutions. As a result, we confirmed that depth-based method is more effective in such situations.

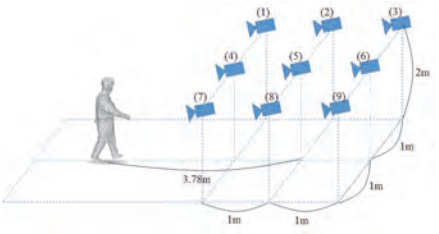


Fig.3 Camera setup for evaluation

Normal Distribution Analysis based on the Reflected Light Measurement of Metallic Coating and Hairline Processing

In this paper, we statistically analyze normal distribution of the metallic coating and hairline processing for texture quantification. We estimate normal distributions by fitting a Gaussian Mixture Model to the normal likelihood estimated from the reflection data. At that time, we evaluate normal distributions based on the observation scale because the object such as metallic coating and hairline processing which have a meso structure make different reflection according to the observation distance.

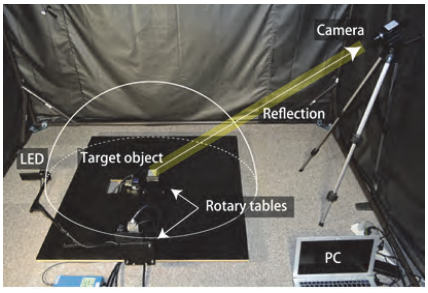


Fig.4 Camera setup for surface normal

Department of Reasoning for Intelligence

Professor:	Takashi WASHIO
Associate Professors:	Shohei SHIMIZU, Yoshinobu KAWAHARA
Assistant Professor:	Mahito SUGIYAMA
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Under Graduate Students:	Anand SRISAENPANG, Ryohei KATAYAMA, Atushi FUKUNAGA, Kei MIYAZAWA,
Supporting Staff:	Hiroko OKADA, Nana KUMASHIRO, Ayako FUJIWARA

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 machine learning and data mining. We also study the application of these techniques to variety of fields such as science, sensing, information network, quality/risk management, medicine, security, marketing and finance. Currently, we work on the following four research projects.

Current Research Projects

Information estimation using 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, sensing network and scientific measurement technologies. Examples are medical patient data on the inspection, diagnosis, therapy and medicine dose, global climate data consisting of various and massive meteorological measurements and the profile data of thousands of gene expressions in biological systems. We studied novel techniques to estimate some important information and discover useful knowledge from such data acquired from large scale and complex structured systems. Following the last year, we studied advanced machine learning and data mining methods for searching models and reasoning on the models based on given data having thousands of dimensions. Based on these techniques, we also developed new methods for clustering, classification and anomaly detection, and obtained more efficiency and accuracy than the conventional methods.

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. Following the last year, we extended a method for learning causal orders in the presence of latent confounders and applied the method on brain imaging data.

Machine learning from high-dimensional data by using structured regularization

Intelligent information processing technologies for large-scale and high-dimensional data (so called, *Big Data* technologies) become increasingly important because of recent accelerating technical progresses in data acquisition and accumulation. It is often the case that we obtain more accurate estimate by introducing our presumed structural constraints on the observed variables to machine learning. We study theories and techniques for developing fast and accurate algorithms by using such structural constraints. Following the last year, we mainly developed fast algorithms for structured sparse learning and group structure learning in data. Furthermore, we applied these algorithms to several real-world problems including computer vision, and confirmed the utility of the algorithms in each application.

Statistically tested hypothesis discovery from large scale data

Techniques that discover combinatorial structures (patterns) from large databases have been developed and applied in a wide range of domains from drug discovery to marketing. Toward a deeper understanding of phenomena, in many fields in particular in natural sciences, there is a compelling need for discovering *statistically significant patterns* from large databases to statistically support the reliability of discovered knowledge. To this end, we develop scalable methods that find statistically reliable patterns from massive data, in which the false positive rate of patterns is rigorously controlled through the hypothesis testing process. There are two big problems to be solved: combinatorial explosion of the number of patterns and inflation of the false positive rate caused by repeating hypothesis testing. Following the last year, we have developed an efficient method that finds substructures from graph databases while controlling the false positive rate and confirmed the effectiveness of our method on real-world datasets including chemical compounds and proteins.

Department of Knowledge Science

Professor: Kazunori KOMATANI
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Assistant Professor: Ryu TAKEDA
Specially Appointed Assistant Professor: Yuki YAMAGATA (-2015.9.30)
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Yuki YAMAGATA (-2015.9.30), Takeshi MASUDA
Kyohei TADA, Sho TORIMURA, Ryosuke NAKANO
Under Graduate Students: Kohei OHNO, Takahiro KAJINO
Supporting Staff: Kikuko TANIBATA (2015.12.1-)
Chizuko MOTOZONO (-2015.12.31)

Outlines

Intelligence of machines, e.g., to talk with humans, is still under development, while computation power and robot locomotion have drastically improved. To realize human-friendly and helpful robots, the spoken dialogue function, which human beings have in nature, is indispensable. We study basic technologies on spoken dialogue systems across several layers from acoustic signal processing to social interaction. We have also been involved in the ontology engineering, which organizes human knowledge and describes it in a machine-readable format.

Current Research Projects

Development of Human-Robot Interaction System based on Deep Learning

The fundamental functions for robots that interact with humans are the detection and direction estimation of speech (sound source localization) and speech recognition. The efficient processing of these functions is also important for the resource restricted situations, such as robots. We improve the accuracy of sound source localization and speech recognition by using deep learning, and also tackled the efficient processing of deep learning.

We proposed a model that utilizes the phase information explicitly in the neural network, and improved the accuracy of sound source localization compared with previous methods under a restricted condition. The acoustic model used in speech recognition is also trained by deep learning, and outperformed the previous acoustic model based on Gaussian mixture model. We also proposed a training algorithm for deep learning to reduce the memory usage and also achieved the efficient forward calculation of the reduced neural networks.

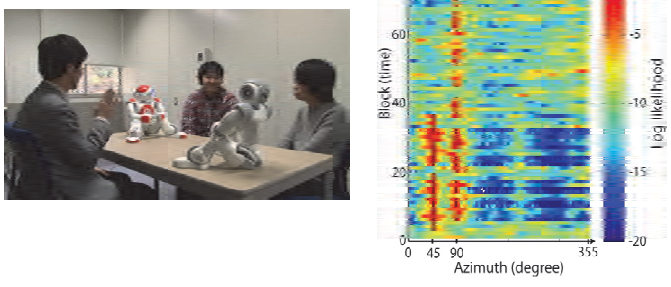

Fig.1 Human-robot interaction (left) and localization results of two speakers (right)

Knowledge Acquisition through Dialogues

To acquire new knowledge from an interlocutor's utterance is one of intelligent abilities of human beings. Current dialogue systems talk with humans by using knowledge designed by its system developpers, but do not have ability to obtain new knowledge. Especially, since to completely describe knowledge in various domains is difficult, a technique to acquire such knowledge during dialogues is required.

This year, we tackled an issue to acquire classes on unknown words through implicit confirmation. The target domain is a text chat on cooking and restaurants. The system tries to identify the correct class of an unknown word (i.e., that not in the system's ontology), while it avoids repeating annoying explicit confirmation requests, like "Is barna cauda Italian?" We proposed a method to acquire the class by focusing on a user response for the system's confirmation, after continueing dialogues with implicit confirmations as if the system knows the word.

We also investigated several issues to aquire acoustic and language models for automatic speech recognizers, which will be required in spoken dialogue systems. As to language models, we have tried to obtain vocabulary in a bottom-up manner on the basis of non-parametric Baysian estimation.

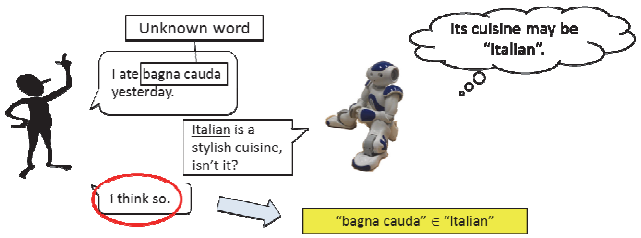

Fig.2 Example of implicit confirmation and acquiring class of unknown word

Intelligent Systems based on Ontological Engineering and Linked Data technologies

We study on developments of intelligent systems based on fundamental theories of ontological engineering and Linked Data technologies. The research issues include following 3 topics. 1) Theories about the fundamental issues on ontology and Linked Data from both scientific and engineering viewpoints, 2) Development of software tools for ontology and Linked Data building/utilization based on the theories, and 3) Developments of applications using them in domains. Currently, we develop ontologies and applications in several domains such as clinical medicine, biomimetics and open data in governments. For instance, we developed a web-based application to browse a disease ontology based on Linked Data (Fig.3). In 2015, we collected public information by local governments and published then as Linked Open Data (LOD). We also developed a smartphone application to get these information according to the user's interests.

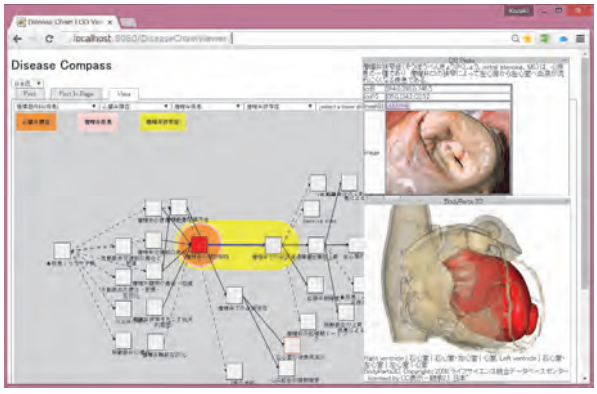

Fig.3 A browsing system for disease ontology based on Linked Data (http://lodc.ed-ontology.jp).

Department of Architecture for Intelligence

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Assistant Professor: Ken-ichi FUKUI(-2015.6.30)
Graduate Students: Danaipat SODKOMKHAM, Ira PUSPITASARI(-2015.9.30), Nattapong THAMMASAN, Hongle WU, Sopchoke SIRAWIT, Graciela Nunez NARZAEZ, Ryosuke OTSUKI, Wataru FUJITA, Shogo HAYASHI, Mai FURUKAWA, Washin KALINTHA, Juan Lorenzo HAGAD
Under Graduate Student: Akinori OSAMURA
Research Students: Bassel ALI
Supporting Staff: Megumi TANABE, Mitsuyo OHTSUKA, Akiko YAMAMOTO

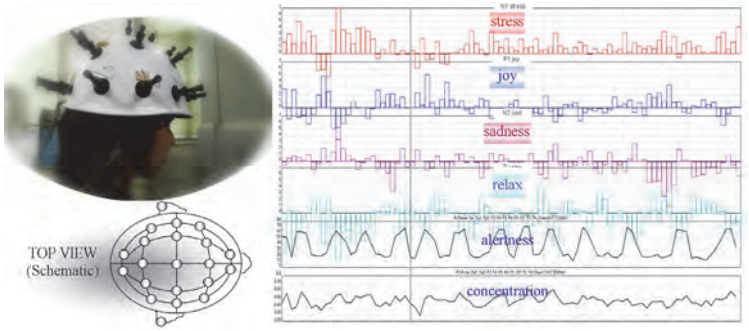
Outlines

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. Knowledge Discovery from Event Sequence Data, and 3. Intelligent Ubiquitous Sensor-Networks.

Current Research Projects

Constructive Adaptive User Interfaces

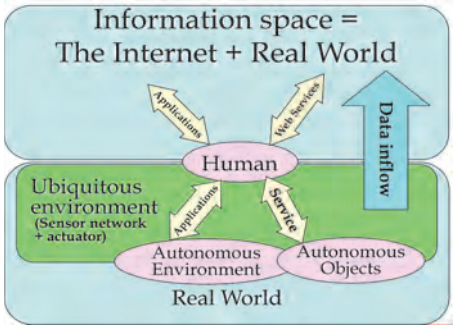
This department is developing a computer with learning ability, for which it researches efficient learning algorithms, acquisition of background knowledge for learning, application to Intelligent Tutoring Systems. These are applied to adaptive user interfaces. The conventional adaptive user interfaces 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.



Knowledge Discovery from Event Sequence Data

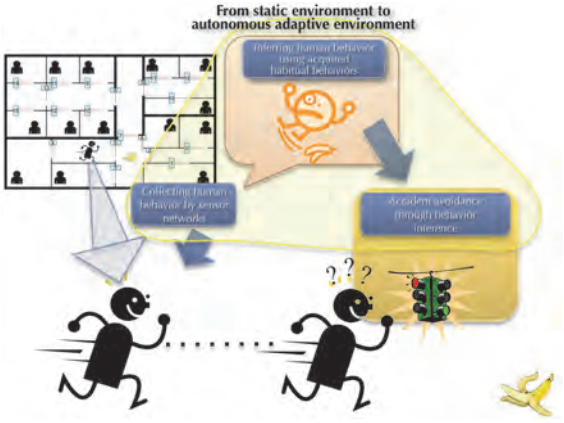
Human behaviors and physical phenomena change over time. To extract rules or patterns inherent in the time varying data helps us to understand the phenomena, for monitoring, and for support. In this laboratory, we have proposed a concept of “co-occurrence clusters” that should satisfy both space proximity of the events (cluster) and time proximity between clusters. Then, we proposed a novel algorithm to extract co-occurrence clusters. Moreover, we extended the algorithm to estimate time intervals of the events, called cluster sequence mining. We then applied these algorithms to extract damage patterns in a fuel cell and earthquake occurrence patterns. In a fuel cell application, from Acoustic Emission event sequence, we have succeeded to identify components that affect largely to the other components. Also in earthquake application, from a hypocenter list around Japan after the Tohoku earthquake, we have succeeded to identify earthquake co-occurrence patterns suggesting interactions between asperity that particularly appear in trench type earthquakes.

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.



Division of Advanced Materials and Beam Science

Outline

This division is composed of seven departments with the following research fields: Quantum Functional Materials, Advanced Interconnection Materials, Semiconductor Materials and Processes, Advanced Hard Materials, 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 evolutional 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 basis properties
- Explorations of topological superconductors and other novel superconductors
- Fabrication of ultra-low reflectivity Si surfaces by surface structure chemical transfer method
- Si nanoparticles produced from Si swarf for light emitting and battery materials
- Development of hetero-semiconductor oxide ceramic composites through self-organization route and their formation mechanisms
- Elastic properties analysis of Mg-Zn-Y alloys with long-period stacking ordered structures
- Development of oxide nanotubes having novel photo-chemical multifunctions by advanced structure tuning
- Development of printed flexible wiring and interconnection and characterization of their basic properties
- Development of WBG semiconductor system integration and basic interconnection research
- 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

Professor:	Yoichi ANDO
Assistant Professors:	Alexey TASKIN
Post Doctoral Fellows:	Fan YANG, Zhiwei WANG, Subhamoy GHATAK
Graduate Students:	Yuri MAEKAWA, Toshiaki SAKAI
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 and 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 a relatively new 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 time reversal symmetry. 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 host Majorana fermions on the surface. Majorana fermions are peculiar in that particles are their own antiparticles, and they were originally conceived as a model for mysterious neutrinos. Currently their realization in condensed matter is of significant interest because of their novelty as well as the potential for quantum computation.

Department of Semiconductor Materials and Processes

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Associate Professor: Taketoshi MATSUMOTO
Assistant Professor: Kentaro IMAMURA, George HASEGAWA
Specially Appointed Assistant Professor: Sumio TERAKAWA, Yoshihiro NAKATO,
Specially Appointed Researcher: Yuki KOBAYASI, Akira TAKAMORI
Specially appointed technical staff: Chika KUROSAKI
Graduate Students: Tomoki AKAI, Daichi IRISHIKA, Katsuya KIMURA, Takaaki NONAKA
Tatsuya ICHIKAWA, Yuya, ONITSUKA, Yosuke YAMADA, Shunta FUJIE
Undergraduates: Yuya SAKAE
Support Staff: Masuko SUMIYOSHI

Outlines

The modern society is based on semiconductor technology. Our research is aiming to improve the characteristics of semiconductor products 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, and , 3) highly efficient laser light.

Current Research Projects

Ultralow reflectivity surfaces by formation of nanocrystalline Si layer for crystalline Si solar cells [paper 1]

We have developed a simple method to form a nanocrystalline Si layer, which simply involves contact of Pt catalysts with Si wafers immersed in an H_2O_2 plus HF solution. The reflectivity becomes less than 3% after the formation of the nanocrystalline Si layer of ~150 nm thickness. High quality pn-junction can be produced on the nanocrystalline Si/crystalline Si structure. With surface passivation using the deposition method, p-type single crystalline Si-based solar cells with the nanocrystalline Si layer generate a high photocurrent density of 39.2 mA/cm^2 under the standard test condition (STD) even without anti-reflection coating and the conversion efficiency of 18.2% is achieved. The passivation

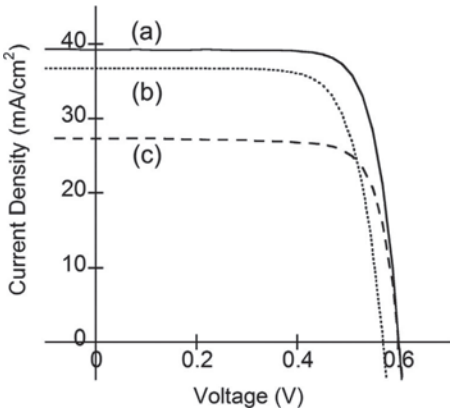

Fig. 1 I-V curves of the p-Si-based solar cells: (a) both with a nanocrystalline Si layer formed by the SSCT method and a PSG layer; (b) with only a nanocrystalline Si layer; (c) without a nanocrystalline Si layer.

method using deposition of phosphosilicate glass on the nanocrystalline Si layer followed by annealing in forming gas improves the quantum efficiency in the short-wavelength region ranging between 300 and 600 nm.

High aspect ratio Si micro-holes formed by wet etching using Pt needles [paper 3]

Si micro-holes with a high aspect ratio can be formed by use of catalytic activity of Pt needles, i.e., contact of Pt needles with Si wafers immersed in an HF plus H_2O_2 solution. In the case of p-Si with ~10 Ω cm resistivity, the shape of the Pt needle is accurately transferred to the Si substrate, and the aspect ratio of 8 is achieved. High-resolution TEM observations of the sidewall of the Si micro-holes show that they are formed through formation of a nanocrystalline Si layer followed by its dissolution. By comparing micro-holes formed in n-Si and in p-Si, it becomes obvious that diffusion of injected holes, which form the nanocrystalline Si layer, affects the shape of micro-holes. In the case of n-Si, injected holes diffuse to the Si/solution interface due to the Si band-bending resulting from the difference between the redox potential of the solution and the Si Fermi level, and cause an Si dissolution reaction at non-contact regions with the Pt needle.

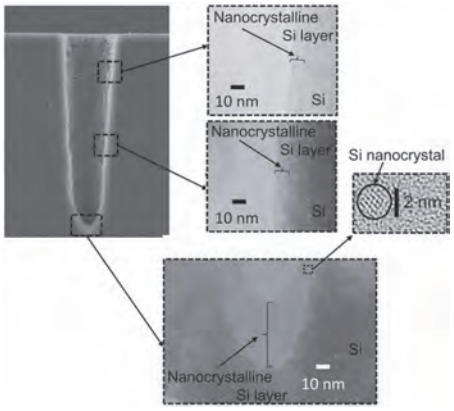

Fig. 2 Cross-sectional SEM and TEM micrographs of the micro-hole formed in p-Si.

Photoluminescence Enhancement of Adsorbed Species on Si Nanoparticles [paper 6]

We have fabricated Si nanoparticles from Si swarf using the beads milling method. The mode diameter of produced Si nanoparticles was between 4.8 and 5.2 nm. Si nanoparticles in hexane show photoluminescence (PL) spectra with peaks at 2.56, 2.73, 2.91, and 3.09 eV. The peaked PL spectra are attributed to the vibronic structure of adsorbed dimethylanthracene (DMA) impurity in hexane. The PL intensity of hexane with DMA increases by ~3000 times by adsorption on Si nanoparticles. The PL enhancement results from an increase in absorption probability of incident light by DMA caused by adsorption on the surface of Si nanoparticles.

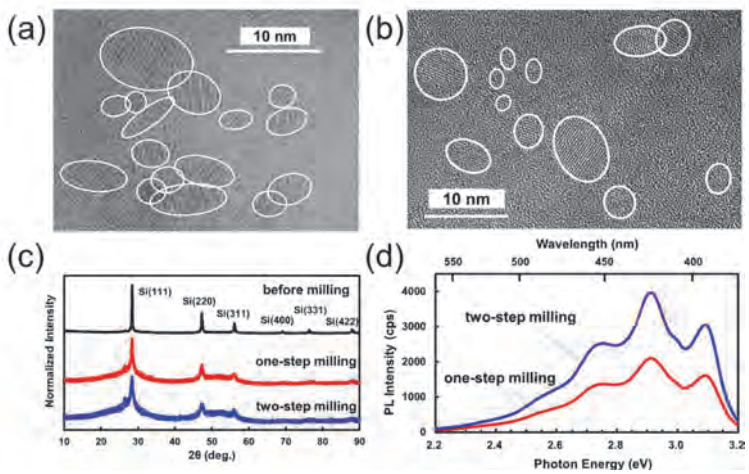

Fig. 3 TEM micrographs of Si nanoparticles fabricated by one-step (a) and two-step milling (b). (c) XRD patterns and (d) PL spectra of Si nanoparticles fabricated by one-step and two-step beads milling methods.

Department of Advanced Hard Materials

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Associate Professor:	Masakazu TANE
Assistant Professor:	Tomoyo GOTO
Assistant Professor:	Sung Hun CHO (2015.11.1-present)
Specially Appointed Researcher:	Hisataka NISHIDA
Graduate Students:	Sotaro BABA, Shengfang SHI, Shunghun EOM Kensuke FUJII, Keisuke YAMORI, Hiroki NISHIYAMA Yuki RIKISO, Wanqing JIANG
Research Student:	Wanqing JIANG
Supporting Staff:	Ai TAKAHARA

Outlines

The importance of the material as a social infrastructure is increasingly growing in recent years. In this department, we are carrying out next-generation materials research and development of ceramics and metals from crosscutting point of view. The subject covers crystal structures, nano to macro scale hierarchical structural design and process control, fusion of various functions and fundamental understanding of materials characteristics for advanced hard and nanostructured materials. To achieve research goals, we are adapting: oxide and nonoxide ceramic-based composites with synergy functions, structure-function harmonized hetero-semiconductor ceramic composites, the original methodology for elastic properties measurement/analysis for advanced elasticity-controlled metal-based materials, structures/functions tuning of low-dimensional anisotropic oxide nanomaterials. Our emphasis is placed also on the practical application of developed materials and technologies as structure components for various devices and instruments, next generation biocompatible, environmental and energy materials, all which are the strongly demanded materials technologies to solve crucial problems arising in our society.

Current Research Projects

Elastic properties of Mg-Zn-Y alloys with long-period stacking ordered structures

The elastic properties of Mg–Zn–Y alloy single crystals with an 18R- or 10H-type long-period stacking ordered (LPSO) structure were studied. Directionally solidified (DS) Mg–Zn–Y alloy polycrystals, mainly consisting of 18R- or 10H-type LPSO structure, were prepared using the Bridgman technique. For the DS polycrystals, a complete set of elastic constants was measured during cooling from 300 to ~5 K, using electromagnetic acoustic resonance and the crystallographic texture was analyzed by X-ray pole figure. By analyzing the elastic stiffness of DS polycrystals on the basis of an inverse Voigt–Reuss–Hill approximation, the elastic stiffness components of the single-crystalline LPSO phases from 300 to ~5 K were clarified. The elastic properties of the 18R- and 10H-LPSO phases were also calculated by first-principles calculations based on density functional theory. Comparison of the measured elastic properties at ~5 K with the first-principles calculations revealed that the elastic properties of the LPSO

phase were virtually dominated by the formation energy of short-range ordered solute atom clusters.

Self-organized hetero-structure design and control for SnO_2-TiO_2 oxide semiconductor composites

Heterogeneous composite structure and interface has been development in a bulk binary SnO_2-TiO_2 ceramic through self-organized spinodal phase separation route to add different semiconductor properties. Addition of small amount of Fe_2O_3 to this system accelerated the spinodal phase decomposition with nano-scale lamellar structures through one step sintering processes, i.e. without any heat-treatment (Fig.1). It was found that the both hetero structure and electrical resistivity of the composites were strongly depended on the amount of Fe, sintering temperature and time. Such a structure modification would provide unique semiconductor oxide composite with low-dimensional hetero-structure within its bulk form.

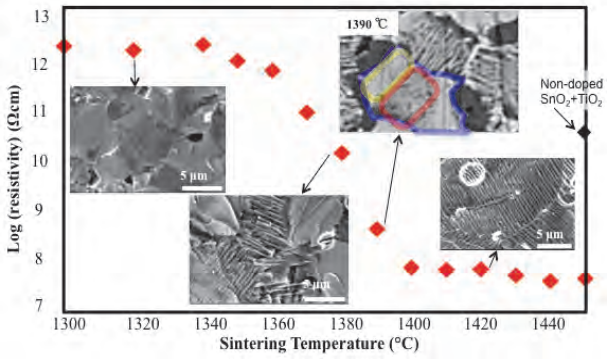


Fig.1 Variation of electrical resistivity and microstructure development for for 5mol%Fe_2O_3 doped SnO_2-TiO_2 binary ceramics on the sintering temperature from 1300°C to 1450℃ for 24h, sintered under the atmospheric condition.

Development of physically and photochemically functionalized titania nanotubes through structure tuning.

Titania (TiO_2) nanotube (TNT), which could be synthesized by the low temperature solution chemical route, was modified by doping or co-doping Cr, V, and Nb elements. It was found that the adsorption amount of methylene blue (MB) on TNTs was high and increased by the doping, while those of rhodamine B (RhB) was small (Fig.2). These different was considered due to the combination between unique nano- and crystalline structure of TNTs and the molecular shape. Because MB was planner while that of RhB was rigid structure, the MB might intercalated into the TNTs (Fig.2c). In addition, the doped TNT exhibited good visible-light responsible photocatalytic properties. These results imply that the structure modification for one-dimensional nanostructured oxides is a promising way to tune the advanced environmental-friendly functions.

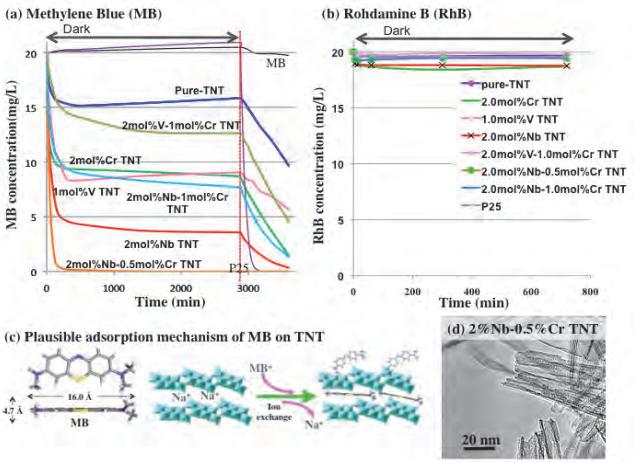


Fig.2 MB and RhB adsorption properties under the dark condition for various metal cation doped TNTs (a and b), plausible adsorption mechanisn (c), and typical TEM image of the doped TNT (d).

Department of Advanced Interconnection Materials

Professor: Katsuaki SUGANUMA
Specially Appointed Professor: Tetsuro MURAMATSU, Keiji YAMAMURA
Associate Professor: Shijo NAGAO
Assistant Professor: Tohru SUGAHARA
Specially Appointed Assistant Professor:Jinting JIU
Specially Appointed Technical Staff: Emi YOKOI
Postdoctoral fellow: Chuantong CHEN, Chunhui WU
Specially Appointed Researcher: Aishi SUATAKE, Hiroshi FUJITA, Shinya SEKI, Seiichiro KIHARA, Akio SHIMOYAMA, Norio ASATANI, Koji KIHARA,
Technical staff: Noriko KAGAMI, Yasuha IZUMI, Tsukasa TAKAHASHI, Akane TANAKA, Yoshiko HARADA, Naoko NANBA, Tomoe HORIE
Graduate Students:Takuya KADOGUCHI, Semin PARK, Tetsuji INUI, Shuren Cong, Jun WAN, Jianchun LIU, Hao ZHANG, Hao ZHANG, Shunsuke KOGA, Sho AKUTAGAWA, Tengyoku GO, Hiroki YOSHIKAWA, Yusuke GOYA, Yue GAO
Research Student: Wanri LEE, Sunjun NOH
Supporting Staff: Keiko SUZUKI, Satomi YAMAWAKI, Yoko KATAOKA

Outlines

Through nanotechnologies and knowledge for organic/inorganic materials, we are conducting the development of environmentally conscious electronics system integration technologies for energy saving technology and also for IoT, i.e. lead-free soldering, power electronics interconnection materials, sensing devices with nano wires, and functional ceramic sensors by solution process.

Current Research Projects

· Ag Sinter Joining and Its Low Temperature Sintering Mechanism

We have established low temperature and low pressure joining technology for next generation power devices. Ag particles paste and even Ag films can be sintered and bonded below 200 ºC in air. Ag can absorb oxygen at low temperature along its grain boundaries resulting in formation of Ag-O liquid, which was proved by thermodynamic simulation. Under a slight stress in an assembled device, which is compressive stress caused by thermal expansion mismatch between a substrate and a Ag film, Ag-O liquid is squeezed out from grain boundaries.

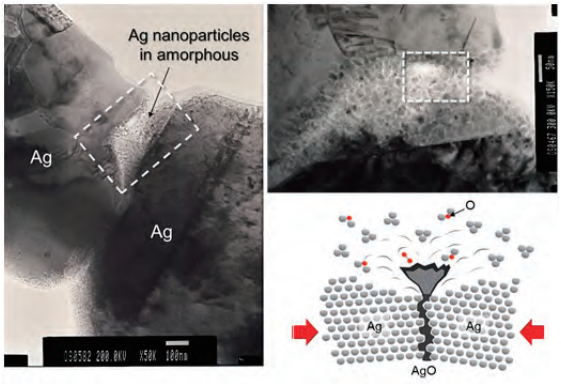


Fig. 1 TEM and Joining mechanism of Ag films in SMB process.

Fig. 1 shows TEM of Ag film bonding (SMB) and a schematic of Ag-O liquid eruption from grain boundary.

Fig. 2 Ag sinter layer structure filled with heat-resistant naocomposite polymer.

· Ag Sinter Joining for WBG Die-attach

We have proposed Ag sinter joining for wide band gap power semiconductors. Its high temperature performance and reliability exceed those of the conventional soldering or TLP. Fig.2 shows one example that the combination of Ag sinter joined die-attach with a newly developed nano polymer composite provides a super stable structure even in a sever thermal cycles by the micro porous joint structure filled with the nanocomposite.

· Transparent Stretchable Sensor

Stretchable wiring is one of the essential technology for wearable devices. We have developed a transparent wiring method with Ag or Cu nanowires. Those devices can be transparent which is shown in Fig. 3.

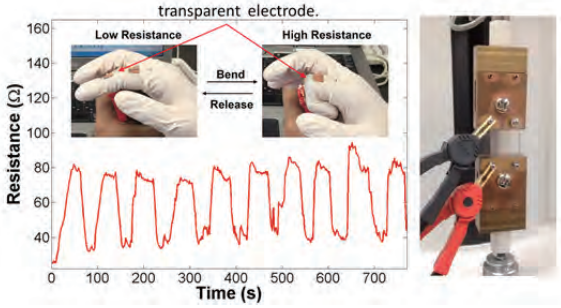


Fig. 3 AgNW trans parent pressure sensor and its tensile

· Formation of Nanostructural Metal and Oxide Thin Films Applying for Electric Devices by Metal Organic Decomposition Method

Metal Organic Decomposition (MOD) Method is one of the attractive attention method to form the metal and oxide fine thin films as low energy consumption for sintering/curing. The precursor (inks), which are the starting material of metal salt and complex agent as stabilizer with solvent, are decomposed by using thermal heat or alternative heating method with printing technique for next generation electronics devices, and formed the thin films. Oxide precursor inks are developed in this study. Nanostructural metal oxide thin films by printing method were fabricated as gas sensors and organic photo voltaic(OPV) solar cells.

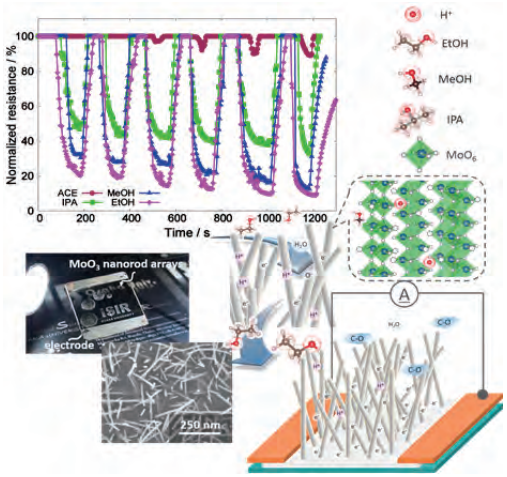


Fig.4 Ceramics nanorods sensor devices by liquid process.

Department of Excited Solid-State Dynamics

Associate Professor: Shin-ichiro TANAKA
Associate Professor: Jun'ichi KANASAKI

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 elucidate the fundamentals of many-body interactions including electron-lattice, electron-electron, spin-orbit interactions, which rule the physics concerning the excitation-induced processes, by using extensive experimental studies:

1) primary processes of the photoinduced structural changes,
2) ultrafast carrier dynamics in semiconductors and carbon materials
3) elemental processes of the many-body interaction following the excitation in solids

As topics in the first category, we direct determine photo-induced structural changes and novel structural orders on surfaces at the atomic levels, by means of scanning tunneling microscopy and spectroscopy. As topics of the second category, we have studied ultrafast carrier dynamics in semiconductors (IV and III-V) and carbon materials by using two- photon photoemission spectroscopy. As topic of the third category, we are developing new experimental methods using highly sophisticated electron and optical spectroscopies.

Current Research Projects

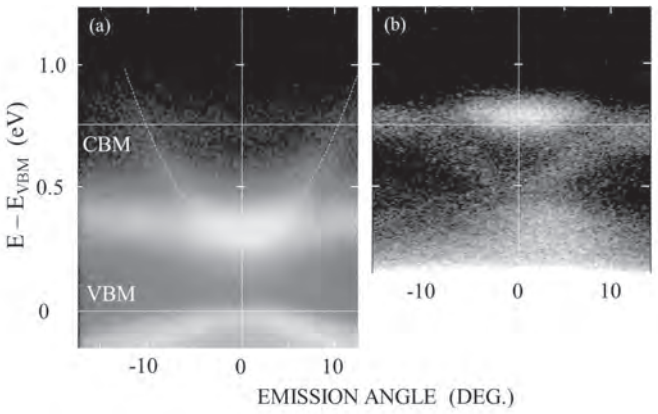
Electronic structures of surface conduction band on semiconductor surfaces

Surface band (SB) structure is one of the most important concepts in the fields of surface physics and applied surface science. We have determined the surface conduction band structure of the clean Ge(001)-c(4x2) and Ge(111)-c(2x8) with high energy and momentum resolution by means of time-resolved two-photon photoelectron spectroscopy. Electrons with the high excess energy are injected into the bulk conduction band with 824 nm pump laser pulses (0.4 ps) and the subsequent electron dynamics is probed with the third- or fourth-harmonic pulses with changing the delay time between the pump and probe pulses. In this study, the electrons transiently populated and relaxed in the unoccupied SB are directly imaged as functions of energy and momenta parallel to the surface to determine the surface conduction band structure.

On Ge(001)-c(4x2), the structure of unoccupied (π*) SB is asymmetric: the dispersion is little in the direction ($\bar{\Gamma}\bar{J}$) perpendicular to the surface dimer row, while large in the direction ($\bar{\Gamma}\bar{J}'$) parallel to the dimer row. On this surface, photogenerated electrons are transferred fast into the dispersive branch ($\bar{\Gamma}\bar{J}'$) of the π*-SB, followed by the relaxation toward the bottom at the $\bar{\Gamma}$-point in the surface Brilluoin zone. In figure (a), the relaxation pathway of photo-excited electrons along the Γ-$\bar{J}'$ direction is superimposed as broken curve on the angle-resolved photoelectron image acquired at 4.0 ps. Also imaged as a flat band is the branch along the $\bar{\Gamma}\bar{J}$ direction. The bottom of

the π*-SB has been determined exactly to be 0.3 eV above the valence band maximum.

The photoelectron image at 1.5 ps after excitation of Ge(111)-c(2x8) is shown in Fig. (b). On this surface, photo-injected electrons are transferred to the SB after relaxation to the bottom of bulk conduction band, because of small overlapping of bulk and surface energy bands. The surface electrons are then relaxed towards the bottom at $\bar{\Gamma}$ point located 0.3 eV below that of bulk conduction band.



Evaluation of the spin-orbit interaction in the 5d-valence band of the Au film and the Si(111)-$\sqrt{3}\times\sqrt{3}$-Au surface

Spin-orbit interaction (SOI) is one of the most important properties in matter. Here, the SOI at the 5d-valence band both in deposited Au-film and the Si(111)-√3×√3-Au surface are evaluated by using the Auger-electron photoelectron coincidence spectroscopy, which is a relatively new experimental method, and has been developed as a co-work with the prof. Mase's group of the Institute of Materials Structure Science. The CVV Auger electron spectra after the Auger relaxations of the Au-$4f_{7/2}$ and $4f_{5/2}$ holes are resolved by taking the coincidence with the Au-$4f_{7/2}$ and $4f_{5/2}$ photoelectrons, respectively, as shown in Fig. 2. The two-hole binding energy of the Auger final state can be deduced from the Auger electron kinetic energy and the 4f-binding energies, then the two-hole density of states of the Au-5d bands is derived [Figs. 3(a)]. Differences in the spectra are interpreted in terms of the difference in the J-values of the valence 5d-holes according to the selection rule of the Auger transition. Then, it is possible to compare the projected two-hole states of |5/2>|3/2> and those of |3/2>|3/2> by taking the $4f_{5/2}$ components and that to subtract the $4f_{5/2}$ components from the $4f_{7/2}$ components according to the angular momentum coupling using the J-J coupling scheme [Fig. 3(c)]. Finally we can estimate of the strengths of the spin-orbit interaction; 3.4 eV for the Au-film and 2.5 eV for the Si(111)-√3×√3-Au surface. It is interesting to evaluate the difference in SOI as a result of the change in the chemical environment.

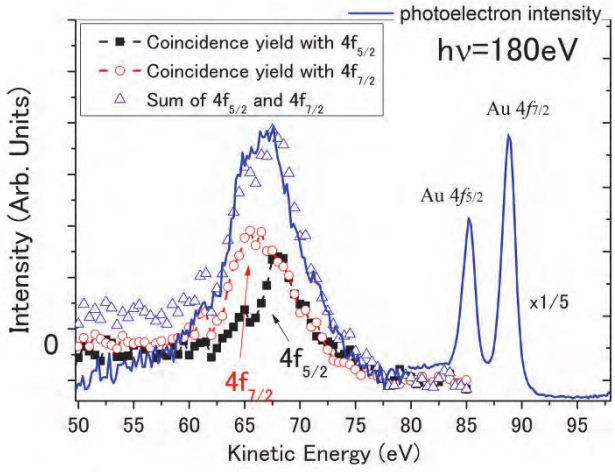


Figure 2

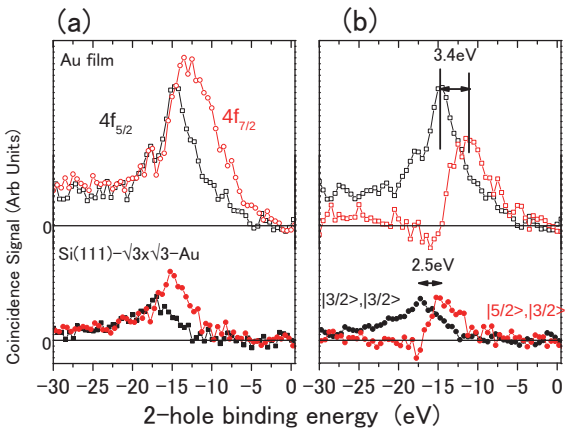


Figure 3

Department of Accelerator Science

Professor: Goro ISOYAMA
Assistant Professors: Keigo KAWASE
Akinori IRIZAWA
Specially Appointed Assistant Professor: Masaki FUJIMOTO (2015.10 ~)
Graduate Students: Masaki FUJIMOTO (~ 2015.9)

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.

Current Research Projects

Studies of the THz-FEL Characteristics

We are conducting research for upgrade of the THz-FEL, which operates at a power level reaching saturation over the wavelength range from 25 to 150 μm (2 to 12 THz). The maximum output energy of THz-FEL macropulse has rearched 25 mJ at the wavelength of 67 μm, and then, it is used for various application studies. In order to study the time structures of the micropulse of the THz-FEL, we have carried out the cross-correlation measurements between the THz-FEL and Ti:Sapphire laser pulses using electro-optic (EO) effects.

The preliminary results of the EO cross-correlation measurements for the THz-FEL pulses with the wavelength of about 100 μm are shown in figure 1. Comparing with the different detuning positon which is optical cavity length, correlation diagrams are clearly shown the different structures. When the cavity round-trip time of light and bunch separation time of the electron beam are matched, its cavity length is called a perfect synchronized length. When the cavity length is shorter than the separation of the electron bunch, that is, the round trip time of the THz-FEL pulses in the cavity is shorter than the repetition interval of the Ti:Sapphire laser pulses, the THz micropulses go ahead of the probe pulses synchronizing to the rf clock. The correlation diagram of the finite detuning case (Fig. 1(a)) clearly shows the running of the microupulses on the time comparing with the near perfect synchronized case (Fig. 1(b)). The slope of the trace on Fig. 1(a) is almost agreement with the detuning

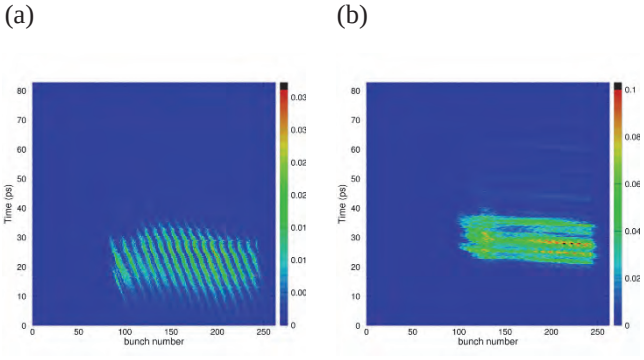


Figure 1: (Preliminary results) Diagrams of the EO cross-correlation for the THz-FEL with the wavelength of about 100 μm (a, b). The horizontal axis corresponds to the micropulse number in the macropulse but its origin does not mean the first micropulse. The vertical axis corresponds to the time of micropulses.

length from the perfect synchronized length. The resulting diagrams, therefore, show evolutions of the THz-FEL.

Hereafter, to evaluate the peak intensity and pulse structure of the FEL micropulses, we should study this technique in detail such as the dependence of the EO signal on the THz intensity.

User Experiments Using Intense Pulse THz FEL

We are searching and developping experiments using the intense pulse THz FEL. A high-speed spectroscopic imaging and an in situ microdetecting of complex compounds have been succeeded utilizing monochromatic and intense character of FEL. The THz FEL is taken out from a coupling hole of resonator mirror and is lead to the end station as a parallel beam. The best focus has been reached 167 μm of FWHM which is comparable to the diffraction limit of 127 μm at a wavelength of 100 μm. The estimated electric field exceeding 10 MV/cm enables us to try nonlinear experiments in materials. As shown in Fig. 2 the transmission of single crystal semiconductor Si is drastically changed under the focal condition. The considerable transmissions using a black body radiation are generally observed for semiconductors with the poor wavelength dependence in the far-infrared region except for the phonon absorptions. THis work revealed the novel response for transmission of Si by using the intense THz FEL. The low-energy FEL affects on solids as a low-frequency high-electric field which is defenitely different from the high-energy lasers causing multiphoton absorption. The other materials of solids will be examined for searching such kinds of eccentric nonlinear excitations.

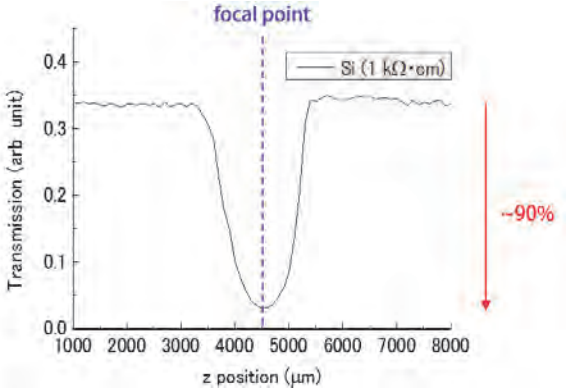
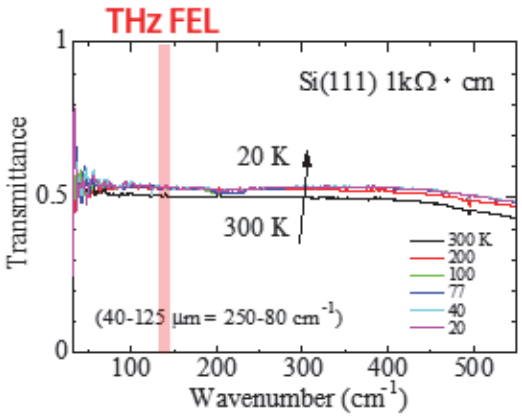


Fig. 2 Transmission change of single crystal semiconductor Si near the focal point of THz FEL.



Transmittance of Si in far infrared region using black body radiation.

Department of Beam Materials Science

Professor: Takahiro KOZAWA
Associate Professor: Yusa MUROYA
Assistant Professor: Kazuo KOBAYASHI
Assistant Professor: Hiroki YAMAMOTO
Graduate Students: Satoshi ENOMOTO, Asuka KIMURA, Akihiro KONDA, Tesuro YOSHIDA, Wataru KANAMORI, Yuko TSUTSUI
Supporting Staff: Kinuko WATANABE

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

Study on Radiolysis of Water at Extreme Conditions

To elucidate the radiolysis of water will be important on the fruitful support to evaluate and control the radiation effects. As it produces quite reactive intermediates, they will undergo various redox reactions. In order to study the fundamental process of radiolysis at high temperature condition, it was introduced a flow-type high temperature and high pressure (HTHP) system which can be applied to both of electron pulse radiolysis and gamma radiolysis experiment at ISIR (Fig. 1). Temporal behavior of a hydrated electron (e^-_{aq}) in light water was measured at HTHP (R.T. to 250 ^oC, 25 MPa) at different dose as shown in Fig. 2. Nanosecond time-resolved measurement at HTHP could be successfully performed. The decays are supposed to involve some important chemical reactions, such as $e^-_{aq} + e^-_{aq} + 2H_2O \rightarrow H_2 + 2OH^-$, $H + H_2O \rightarrow H_2 + OH$, which are relating to molecular hydrogen production. However, the degrees of cumulative variation are not still clear at HTHP. Further experiment and numerical simulation are expected to elucidate such important primary processes.

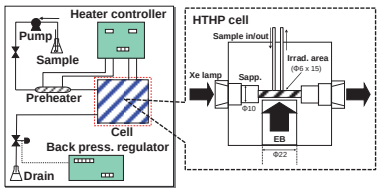


Fig. 1. Flow-type HTHP system for pulse radiolysis and gamma radiolysis experiment.

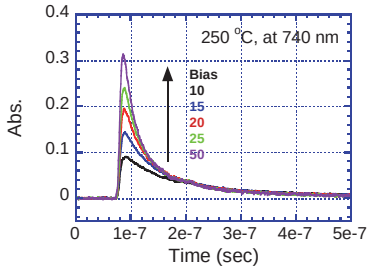


Fig. 2. Dose dependent time behaviors of e^-_{aq} at 250 ^oC, 25 MPa (probed at 740 nm).

Study on Main Chain Scission and Dissolution Behavior of Poly(methyl methacrylate) Induced by Ionizing Radiation

Ionizing radiations such as extreme ultraviolet (EUV) and electron beam (EB) are the most promising exposure source for next-generation lithographic technology. In the realization of high resolution lithography, it is necessary for resist materials to improve the trade-off relationship among sensitivity, resolution, and line width roughness (LWR). In order to overcome them, it is essential to understand basic chemistry of resist matrices in resist processes. In particular, the dissolution process of resist materials is a key process. In this study, main chain scission and dissolution behavior of poly(methyl methacrylate) (PMMA) as main chain scission type resist was investigated using quartz crystal microbalance (QCM) method and gel permeation chromatography (GPC) in order to understand the relationship between the degree of PMMA degradation and dissolution behavior. The relationship between the molecular weight after irradiation and the swelling behavior was clarified.

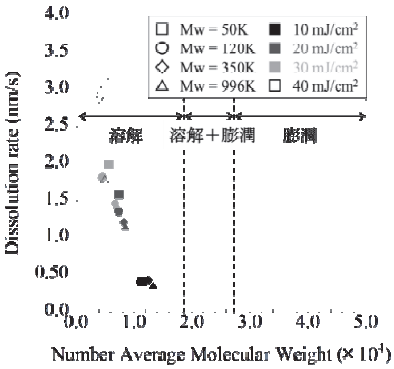


Fig.3 Relationship between dissolution rate and number average molecular weight. Developers are (a) MIBK:IPA=1:3.

Deprotonation of Guanine Cation Radical in Quadruplex from Telomeric DNA

The ends of eukaryotic chromosomes called telomeres are essential for genome integrity. Telomeric DNA consists of tandem repeats of G-rich sequences. In the presence of K^+, G-rich sequences can form G-quadruplex structures, built from stacking of multiple planar G•G•G•G tetrads (Fig. 4). Because G repeats are uniquely sensitive to oxidative damage, we hypothesized that G_4 sequences are targeted for oxidative base modification. In this work, we examined one-electron oxidation of K^+-containing quadruplex formed from 12-nucleotide repeat sequence of d(TAGGGTTAGGGT) (QG_4).

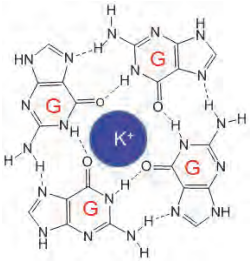


Fig. 4 Structure of QC_4

The **G** cation radical in QG_4, produced by oxidation with SO_4^-•, deprotonates to form the neutral G radical. The characteristic absorption maximum of **G** cation radical around 450 nm was shifted to a longer wavelength, compared with G-containing double-stranded oligonucleotide. This result provides spectroscopic evidence of the positive charge along the extended π orbitals of DNA bases in G-quadruplex. Interestingly, the rate constant of deprotonation (2.8×10^6 s^{-1}) is much slower than those of G-containing double-stranded oligonucleotide. In addition, in order to identify the protonation site in QC_4, benchmark ESR spectra from 1-methyl dG and dG were employed to analyze the spectral data obtained in one-electron oxidized QC_4. The ESR identification of G radical in QG_4 is supported by characteristic for G(N1-H) • in model compounds.

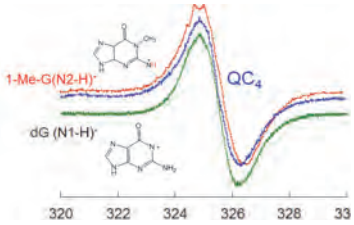


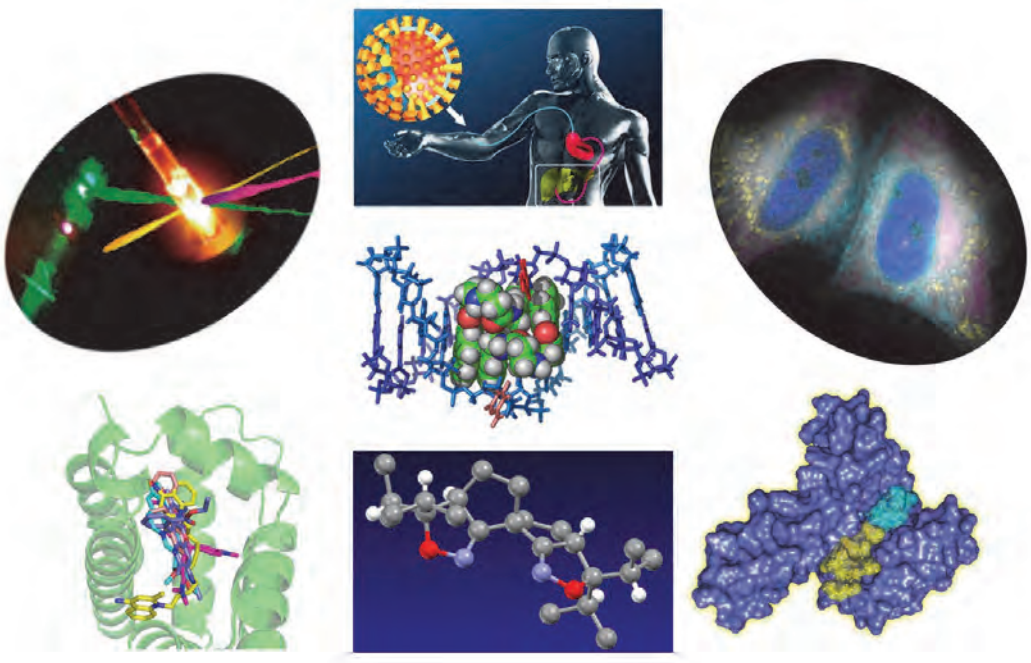
Fig. 5 ESR Spectra for one electron oxidized form of dG, 1-Me-dG, and QC_4

Division of Biological and Molecular Sciences

Outline

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 Biomolecular Science and Reaction, Dept. of Biomolecular Science and Regulation, and Dept. of Biomolecular Science and Engineering. These departments are engaged in research in various fields of biological science including development of in vivo pinpoint DDS nanocarriers, development of therapeutic strategies to control infectious diseases and development of biosensors based on fluorescent protein and/or chemiluminescent protein.

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



Department of Molecular Excitation Chemistry

Professor: Tetsuro MAJIMA
Associate Professors: Mamoru FUJITSUKA, Kiyohiko KAWAI
Assistant Professor: Yasuko OSAKADA
Specially Appointed Assistant Professor: Sooyeon KIM
Specially Appointed Professor: Akira SUGIMOTO
JSPS Foreign Researchers: Zhaoke ZHENG (-2015.5.31), Zaizhu LOU (2015.7.14-), Mingshan ZHU (2015.11.30-)
Guest Foreign Researchers: Xiaoyan CAI (2015.9.29-), Shaoqing SONG (2015.12.15-), Rui SUN (2016.1.25-3.20), Wei-Kang WANG (2016.3.30-)
Graduate Students: Peng ZHANG, Shih-Hsun LIN, Chao LU, Atsushi TANAKA, Osama ELBANNA, Xiaowei SHI (2015.10.1-), Ayaka KURODA, Kota NOMURA, Yuma ICHINOSE, Yoji YAMAMOTO (-2016.1.5), Jie XU (2015.10.1-), Yang ZHOU (2015.10.1-)
Research Student: Yang ZHOU (-2015.9.30)
Supporting Staff: Sanae TOMINAGA (2015.10.1-)

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 two lasers, three-color three lasers, and electron pulse-laser
3. DNA photochemistry such as charge transfer in DNA and photosensitized DNA damage
4. Photocatalysts for solar energy conversion such as metal and metal oxide nanoparticles
5. Fluorescence detection of reactive oxygen species by novel fluorescent probes
6. Single-molecule and single-particle chemistry

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 so on. From these studies, we have clarified various reaction processes of excited states of short-lived intermediates. We investigated excited state properties of fullerene (C_{60}) radical anion by means of femtosecond laser flash photolysis. The deactivation process of excited $C_{60}^{\bullet-}$ including the internal conversion from the D_1 to the D_0 state and the cooling process of the vibrationally hot ground state (D_0^{hot}), was observed spectroscopically for the first time. The intramolecular electron transfer (ET) processes from the excited $C_{60}^{\bullet-}$ were confirmed by the transient absorption spectra. Clearly, both D_1 and D_0^{hot} states acted as precursors for the ET, i.e., dual ET pathways were confirmed. From the present study, it

was indicated that fast and efficient ET processes became possible from the excited state in accordance with the ET theory.

Kinetics of biomolecules accessed by single-molecule fluorescence measurement

We are interested in biological phenomena taking place in a time range of 10^{-6} - 1 sec, and have focused on the fluctuating emissions between bright “on” and dark “off” states of fluorescent molecules, so-called “blinking”. We controled the blinking to monitor the microenvironment of the fluorescent probe. In the presence of a reductant, the triplet state was converted to the radical anion off-state. The duration of the off state corresponds to the lifetime of radical anion of the fluorescent molecule. An oxidant was added to regenerate the intact fluorescent molecule. The bimolecular ET reaction rate changed dramatically along with the changes in microenvironment of fluoesent molecule, which enabled sensitive detection of subtle conformational changes of DNA.

Photofunctional molecules and materials toward materials science and biology

We are currently studying to develop novel photofunctional molecules, materials, and methods to regulate biological phenomena in cells, as well as to convert energy of light, particularly imaging and regulation methods with photo-functional nano-probes in vitro and in vivo, based on photochemical reactions such as ET and thermal deactivation.

Detection of reactive oxygen species through developing efficient fluorescent probes

Singlet oxygen, one of the reactive oxygen species, plays a pivotal role in a cytotoxic effect of photodynamic therapy. However, singlet oxygen can diffuse merely shorter than 400 nm due to its lifetime in water (< 3 μs). In order to clarify the paradoxical correlation between the short diffusion distance and critical cytotoxicity of singlet oxygen, we have developed a new fluorescent probe which can detect singlet oxygen inside of living cell. This development has been commercialized in 2016. Furthermore, we have established a molecular design of slipped-stacked self-assembly fluorescent dyes in water. This achievement proposes the future sensory application, for example, singlet oxygen detection through color change (blue to pink).

Nanocatalysts for light energy conversion

To design an efficient light energy conversion system, it is important to reveal and understand the molecular interactions and the mechanism of chemical reactions at heterogeneous interfaces. We have investigated the light energy conversion processes occurring on a variety of nanocatalysts using single-particle and single-molecule fluorescence imaging techniques and gain information related to spatial and temporal heterogeneities in reactions, which are always masked by ensemble averaging. Plasmon-enhanced H_2 generation and formic acid dehydrogenation using Pt- and Pd-modified Au nanorods (AuNRs), respectively, were studied under visible and NIR irradiation. Pt- and Pd-tipped AuNRs exhibited much higher activity than fully covered AuNRs. The analysis of energy relaxation of plasmon-generated hot electrons indicates the ET from the excited Au to Pt and Pd. Pd-modified AuNRs exhibited efficient plasmon-enhanced catalytic formic acid dehydrogenation even below room temperature (5 °C). The tip-coated Pt and Pd affected significantly the plasmon resonance energy transfer, indicating a complete quenching phenomenon at the LSPR region.

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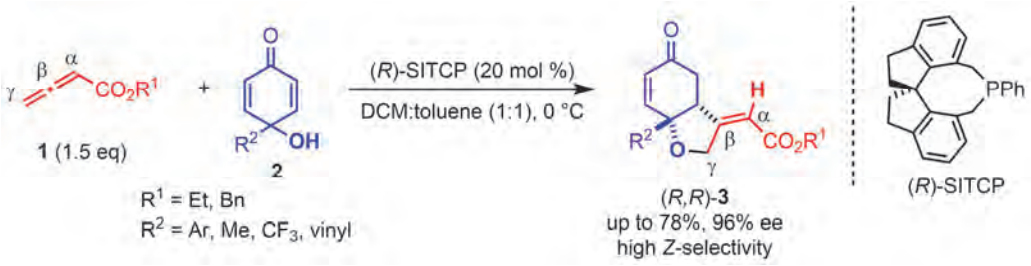
Outlines

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

Organocatalytic Enantioselective Synthesis of Heterocycles Bearing Two Contiguous Stereogenic Centers

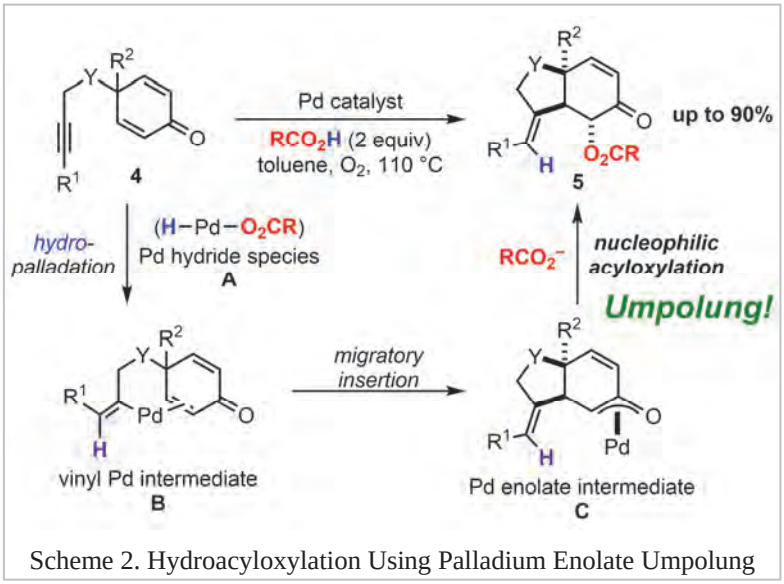
The development of novel synthetic method for highly functionalized heterocycles bearing two contiguous stereogenic centers is a subject of intensive research because of the potential use in medicinal chemistry. In this time, we have developed an enantio-, diastereo-, regio-, and chemoselective (*R*)-SITCP-catalyzed domino reaction of allenic esters **1** with dienones **2**. The designed sequence involving oxy-Michael and Rauhut–Currier (RC) reactions produced highly functionalized tetrahydrobenzofuranones (*R*,*R*)-**3** in up to 78% yield and 96% ee with high *Z*-selectivity (Scheme 1).



Scheme 1. Enantioselective Synthesis of Heterocycles Bearing Two Contiguous Stereogenic Centers

Efficient Synthesis of Functionalized Carbonyl Compoundes Based on Palladium Enolate Umpolung

Palladium enolates are known not to exhibit any reactivity toward a nucleophile but to react with electrophiles such as aldehydes. Nucleophilic interception of the palladium enolate is therefore promising to be a powerful synthetic method of functionalized carbonyl compounds. We have successfully developed such palladium enolate *umpolung* reaction. This time, we found a new catalytic transformation based on the *umpolung* chemistry, i.e. cyclative hydroacyloxylation of substrates **4**. Treatment of **4** with carboxylic acids in the presence of a palladium catalyst in toluene afforded bicyclic products **5** bearing tri-substituted alkene and α-acyloxy carbonyl moieties in good yields (Scheme 2).



Scheme 2. Hydroacyloxylation Using Palladium Enolate Umpolung

Green Powder-phase Oxidation Using Apatite Powder

We have developed a green powder-phase oxidation reaction (Nonhalite® method) 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. Halogen-free, high purity epoxy resins are requested for the application to electronic materials. The epoxidation with hydrogen peroxide is one of halogen-free reaction processes. In our powder-phase oxidation reaction, halogen-free glycidyl ethers were obtained at high purity without being hydrolyzed, although the glycidyl ethers were easy to be hydrolyzed in the conventional liquid phase conditions with hydrogen peroxide. We developed the powder-reaction apparatus, and, using this, production of the glycidyl ethers 100 g per 1 batch was enabled.

Department of Regulatory Bioorganic Chemistry

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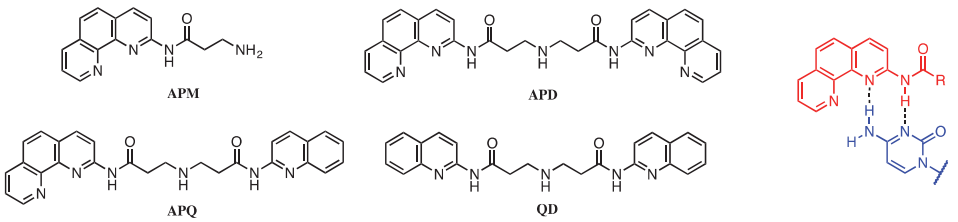
Outlines

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 synthetic ligands for specific sequence and structure of DNA/RNA, including trinucleotide repeat, 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

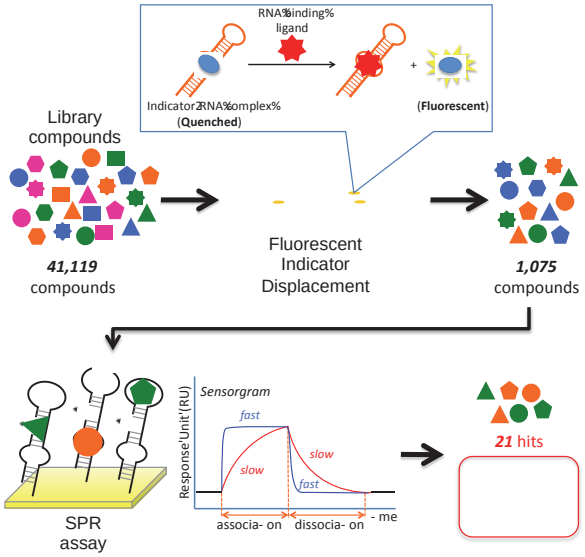
Design and synthesis of a small molecule that binds to a C–C mismatch DNA.



Recognition of specific sequences and structures of nucleic acids by small molecules is important for the modulation of specific gene expression, chemotherapeutic purposes, and the detection of genetic mutations. We have designed and synthesized ligands with three-ring system for the recognition of a cytosine bulge and a cytosine-cytosine mismatch. The 2-amino-1,10-phenanthroline was selected as a recognition unit among the possible three-ring systems of a parent recognition unit of 2-amino-1,8-naphthyridine. The 2-aminopropanamide of 2-amino-1,10-phenanthroline

(**APM**) bound to the cytosine bulge DNA. Other single nucleotide bulges were stabilized by the ligand with much lower efficiency. The dimer **APD** consisting of two molecule of **APM** was found to stabilize the C-C mismatch DNA selectively. Structure-activity relationship studies revealed that the **APD**-binding to the C-C mismatch DNA requires both phenanthroline heterocycles in a molecule.

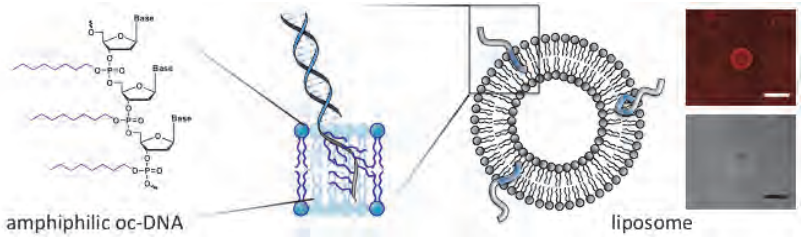
Exploratory study on the RNA-binding molecules: Library Screening



Library screening is one of the powerful methods to obtain lead compounds that can bind to the target molecules, however, there are some issues to be addressed when the target is RNA. We have conducted exploratory study on small molecules binding to the precursor of miR-29a (pre-miR-29a) from a chemical library by combination of fluorescent indicator displacement (FID) assay using the xanthone derivatives as a fluorescent indicator and surface plasmon resonance (SPR) assay [**Original Paper 2**].
The screening was started from FID assay using about 40,000 compounds library having basic nitrogen supplied from Drug Discovery Initiative (DDI), The University of Tokyo, and 1,075 compounds were selected for the next assay. Selected compounds were subsequently assayed by SPR, and we were successfully able to identify 21 compounds as hit compounds. Comparison of assay data between hits and other compounds having same substructures enables discussion on the importance of the substructures and substituents for binding to the pre-miR-29a. The set of assays we developed here is a useful and practical method for screening of RNA binding molecules.

A membrane insertable amphiphilic DNA.

With recent development of DNA chemistry and nanotechnology, DNAs have emerged as a promising molecular tool to modify and add functions to lipid membranes, including cellular membranes. The membrane-binding DNA is now indispensable tool for the applications. In order to develop an intelligent hydrophobic anchor composed of DNA, we designed and synthesized a novel membrane-insertable amphiphilic DNA.
We synthesized a hydrophobic DNA consisting of 9 consecutive octyl phosphotriester linkages as a membrane-insertable binding module. Binding of the amphiphilic DNA was investigated with Förster resonance energy transfer (FRET) experiments and fluorescence microscopy. The amphiphilic DNA binds to lipid membrane by inserting the hydrophobic region, and the binding is facilitated by presence of the complementary DNA strand [**Original Paper 1**].



Department of Organic Fine Chemicals

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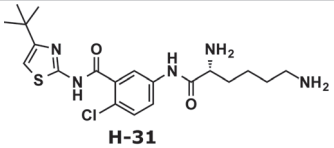
Outlines

The major goals of this department are to identify promising lead compounds for drug development and to explore their mechanism of action. Our research interests focus on small organic compounds that potentially modulate protein-protein interactions. These compounds are also utilized as tools to elucidate intracellular signaling pathways. We are also working on peptide nucleic acids aiming to develop devices for sequence-specific detection of viral genes. Our research extends further to generate lines of model mouse in which spatio-temporal morphogenetic signal-transduction activities become defective. They provide a novel strategy for understanding the mechano-chemical basis as well as development of diagnosis and therapy for diseases.

Current Research Projects

Inhibitors of bacterial multidrug efflux transporters

Multidrug resistance of bacteria is a serious problem in the therapy of infectious diseases. MexB and MexY are principal multidrug efflux transporters in *Pseudomonas aeruginosa* and they are overexpressed in most of clinically isolated multidrug resistant *P. aeruginosa*. From a focused library designed based on a know inhibiter of efflux transporters, **H-31** that inhibits both MexB and MexY has been obtained.



H-31
Fig. 1. MeB/MexY inhibitor

Intracellular generation of a diterpene-peptide conjugate that inhibits 14-3-3-mediated interactions

It has been implicated dysregulation of 14-3-3 interactions in cancer and neurologic diseases, suggesting 14-3-3 as a new therapeutic target. We aimed to perform an in-cell synthesis of 14-3-3-PPI inhibitors and found that an aldehyde-containing fusicoccin and a hydroxylamine-containing peptide generate the corresponding oxime-conjugate in HEK293 cells. The conjugate showed proliferation-inhibition activity toward HEK293 through modulation of 14-3-3-PPIs.

Detection of influenza virus drug-resistance by tolane-peptide nucleic acid

We confirmed that peptide nucleic acid (PNA) modified with tolane derivatives at the N-terminus possesses increased binding affinity to the complementary sequences by stacking interactions (Fig. 2a). Tolane-PNA efficiently detected a single base mutation in neuraminidase gene of influenza virus that associates with the drug-resistance. As tolane-PNA was immobilized on the test line of lateral flow strip, it selectively detected the drug-resistant neuraminidase gene of influenza virus (Fig. 2b).

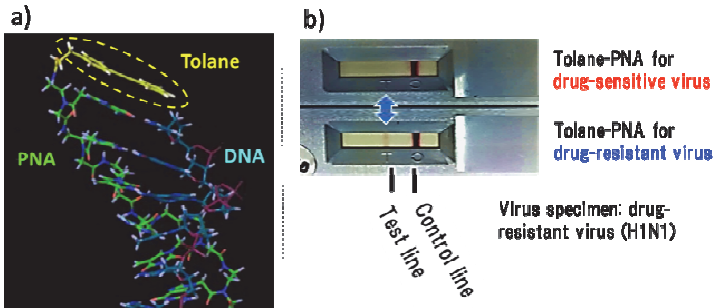


Fig. 2. a) Estimated duplex structure between Tolane-PNA and DNA. b) Detection of drug-resistant influenza virus by tolane-PNA

Genetic modification of brain-specific vacuolar-type proton ATPase

Vacuolar-type proton ATPases (V-ATPases) are large multimeric, membrane-associated protein complexes that carry out the active transport of protons. V-ATPases are involved in the acidification of intracellular compartments and the extracellular environment. The enzymes are distributed in various endomembrane organelles. Reflecting versatile function, its loss causes various pathophysiological disorders in tissue-morphogenesis, endocrine regulation, perception, and so on. Therefore, molecular and pharmacological tools for modifying its activities are expected to provide strategies overcoming the arrays of pathological status. V-ATPase is a rather large protein complex composed of multiple subunits: moreover, multiple isoforms are expressed in mammalian cells.

The neuronal tissues are rich in V-ATPase: the pH gradient and membrane potential generated by V-ATPase drive the neurotransmitter accumulation in synaptic vesicles. The mammalian genome contains 3 distinctive genes for *G* subunit, namely *ATP6V1G1*, *ATP6V1G2*, and *ATP6V1G3*. *G1* isoform is expressed ubiquitously, while, *G2* and *G3* isoforms show restricted tissue-specific distribution in the brain and kidney, respectively. Using gene targeting, we generated a mouse lacking functional *G2* (*G2* null), which showed no apparent disorders in architecture and behavior. Loss of function of neuron-specific *G2* isoform was compensated by an increase in levels of the *G1* isoform, whose accumulation levels were controlled by a post-transcriptional regulatory mechanism. These findings depict physiological relevance of quantitative V-ATPase activity in brain [Original Paper 3].

The *G2*-null mice provide a useful genetic model for pharmaceutical modification of neuron-specific V-ATPase function. Recently increasing evidence support a link between the lysosomal pH and neurodegeneration including Alzheimer's disease and Parkinson's disease. Furthermore, the neural tissues from the *G2*-null animals are enriched with *G1*-containing V-ATPase complex, providing an enzyme source elucidating the V-ATPase architecture.

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Outlines

The aims of this laboratory are the analysis of intermolecular reactions found in various biological phenomena, and the development of bio-industrially useful technologies by utilizing these reactions. In particular, we are now developing an *in vivo* pinpoint DDS (drug delivery system) nanocarrier (bio-nanocapsule) by mimicking the function of viruses, single cell-related technologies by utilizing an automated single cell analysis and picking up machine, an oriented immobilization technology for various biomolecules, and a bio-missile for selective degradation of pathogenic proteins *in vivo*. And, the active-site structures and catalytic mechanisms of various enzymes are being investigated by site-directed mutagenesis, various spectroscopies, and X-ray crystallography. Furthermore, we are conducting structural and functional analysis of bacterial two-component systems, which are involved in biofilm formation, pathogenicity, and drug resistance, to develop novel antibiotics against bacterial signal transduction.

Current Research Projects

Analysis of intracellular trafficking and payload-releasing mechanism of bio-nanocapsule-liposome complex

Bio-nanocapsules (BNCs) are hollow nanoparticles comprising about 100-nm liposome (LP) and about 110 molecules of hepatitis B virus (HBV) surface antigen L protein as a transmembrane protein. Using the early infection mechanism of HBV that resides in the N-terminal region (pre-S1 region), BNCs have been recently shown to attach onto human hepatic cells specifically and enter cells by endocytosis. Since BNCs are able to form a complex with an LP containing various drugs and genes as payloads, the BNC–LP complexes have been applied to a human hepatic cell-specific drug and gene delivery system *in vitro* and *in vivo*. However, the roles of BNCs in cell entry, intracellular trafficking, and releasing of the payloads remained to be fully clarified.

Thus, in the present study, we aimed to elucidate the mechanisms for these processes in the BNC–LP complex.

Lipid mixing assays demonstrated that low pH-dependent fusogenic activity resides in the N-terminal part of pre-S1 region (NPLGFFPDHQLDPAFG), and that the first FF residues are essential for the activity. In addition, the peptide facilitated membrane fusion between LPs *in vitro*. Moreover, BNC–LP complexes can bind human hepatic cells specifically, enter into the cells *via* clathrin-mediated endocytosis, and release their payloads mostly into the cytoplasm. Taken together, the N-terminal part of the BNC portion in the BNC–LP complexes can induce membrane fusion between LPs and endosomal membranes under low pH conditions, and thereby facilitate the endosomal escape of payloads. Furthermore, the fusogenic domain of the pre-S1 region of the L protein may play a pivotal role not only in the intracellular trafficking of BNC–LP complexes but also in the initial phase (especially in uncoating) of HBV.

X-ray crystallographic structure of semiquinone radical intermediate formed in bacterial copper amine oxidase and the pH-dependency of its formation

Copper amine oxidase from *Arthrobacter globiformis* (AGAO) contains a Cu^{2+} ion and a Tyr-derived quinone cofactor, topa quinone (TPQ). In the initial half-reaction, TPQ is reduced to an aminoresorcinol form (TPQ_{amr}) that is in rapid equilibrium with the TPQ semiquinone radical (TPQ_{sq}) by intramolecular electron transfer to the prosthetic metal ion, Cu^{2+}. We have demonstrated that TPQ_{sq} takes an 'on-copper' conformation, in which the 4-OH group ligated directly to the Cu ion by X-ray crystallography when reduced with 2-phenylethylamine (2-PEA). In the present study, we further determined X-ray crystal structures of TPQ_{sq} formed in AGAO reduced with various amine substrates and elucidated structural basis for the formation of TPQ_{sq}.

AGAO crystals were anaerobically soaked with two different substrates; histamine (HTA) and ethylamine (ETA) (Fig. 1). X-ray crystallographic analyses of these crystals also revealed the TPQ ring taking the on-copper conformation. In the crystals reduced with 2-PEA, the product phenylacetaldehyde remained in the hydrophobic pocket located in the vicinity of TPQ, whereas no aldehyde product was found remaining in the HTA and ETA-reduced crystals presumably because of their low affinities. These results indicated that the binding of aldehyde has no relation with the on-copper conformation of TPQ_{sq} that is requite for its formation. It is found that the transfer of electron from TPQ_{amr} to Cu^{2+} requires the direct interaction between the cofactor and Cu^{2+} through conformational change from off-copper to on-copper.

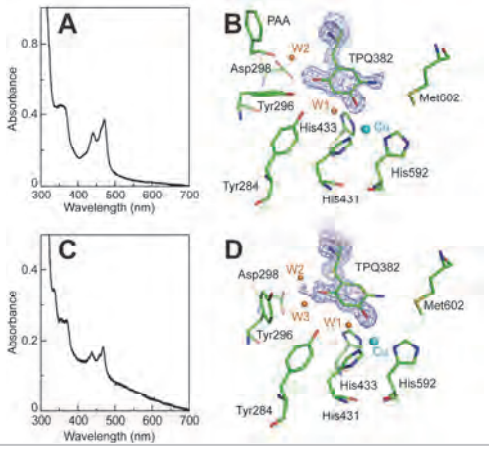

Fig. 1. X-ray crystal structures of TPQ_{sq} formed by anaerobic reduction with 2-PEA and histamine.

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Outlines

Genome annotation identified a considerable number of membrane transporter genes in bacteria. Multidrug-resistant bacteria are now encountered frequently and the rates of multidrug resistance have increased considerably in recent years. We previously identified membrane transporters related with bacterial multidrug resistance and virulence. We are studying on the mechanism of regulation and function of bacterial membrane transporters. 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

Multidrug efflux pumps contribute to *Escherichia coli* biofilm maintenance

Bacterial drug resistance is often associated with multidrug efflux pumps, which can decrease cellular drug accumulation. In gram-negative bacteria, the resistance-nodulation-cell division (RND) family of efflux pumps are particularly effective in generating resistance. In addition to efflux pumps, biofilms are also important for antibiotic resistance. Antibiotics are not efficient in penetrating the biofilm, causing difficulties in treatment.

Both factors are essential for bacteria to survive in severe conditions. Recently, a question has arisen regarding whether there is a correlation between two factors; however,

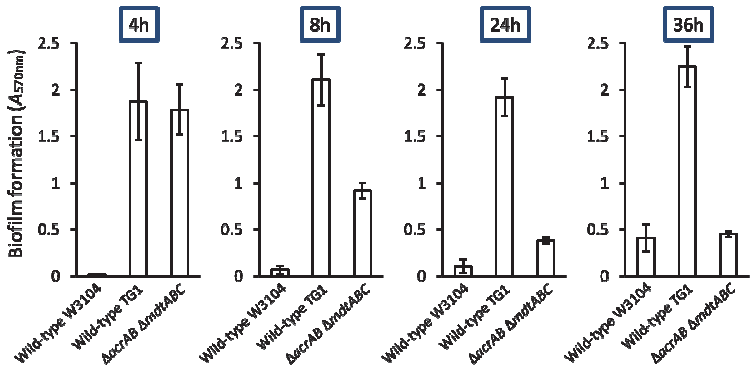

Fig. 1. The time-scale changes of the amount of biofilm

results from different groups have yielded varying results. Maira-Litran *et al*. indicated that ciprofloxacin-resistant *E. coli* biofilms did not correlate with AcrAB efflux pump. On the other hand, Matsumura *et al*. reported that efflux pumps are a clear mechanism by which wild-type *E. coli* produce biofilms. Therefore, to clarify the existence of such a functional interplay, we focused on a correlation between efflux pumps and biofilms in *E. coli*.

We initially tested the abilities of *E. coli* wild-type strains W3104 and TG1 to form biofilms. Although the cell density of W3104 and TG1 were the same, the ability of TG1 to form biofilms was ten times more than that of W3104 (Fig. 1). Among efflux pumps, RND-type pump AcrB possesses the broadest substrate recognition and is constitutively expressed. AcrB forms a complex with outer membrane channel TolC to function. In addition to *acrB*, the genes encoding TolC-dependent pumps, such as *acrD*, *emrKY*, *mdtABC* and *mdtEF* were deleted from the *acrB* mutant. When *acrB* and *mdtABC* were deleted simultaneously, this mutant demonstrated a slight biofilm formation although the growth was normal (Fig. 1). The single deletion mutants Δ*acrB* and Δ*mdtABC* produced biofilm normally. Thus, these data indicate that both of AcrB and MdtABC are related to TG1 biofilm formation. Therefore, it is thought that TG1 demonstrated a slight biofilm formation only after the loss of two efflux pumps. Both are classified in RND family and should have a complementary relationship.

Next, we observed the sequential amount of biofilm formation to examine the stage at which these pumps function. The wild-type TG1 maintained the amount of biofilm over a period of time (4–36 h) (Fig. 1). Interestingly, the Δ*acrB*Δ*mdtABC* strain also had sufficient biofilm at 4 h; however, this biofilm decreased in a time-dependent manner and almost disappeared after 24 h (Figs. 1 and 2). These results indicate that AcrB and MdtABC are not essential for early stage biofilm production, but rather to maintain a sufficient amount of biofilm for longer periods of time. Taken together, it is suggested that the constantly expressed AcrB and subsequently expressed MdtABC contribute to the maintenance of biofilm.

In this study, we investigated the role of efflux pumps on biofilm by sequentially measuring the amount of biofilm. The results showed that AcrB and MdtABC contribute to the maintenance of biofilm. Because the Δ*acrB*Δ*mdtABC* strain can generate biofilm normally, these pumps do not appear to efflux substrates required for biofilm formation, but possibly signalling factors necessary to maintain the biofilm.

If biofilm was decreased by inhibiting efflux pumps, inhibitors could produce a substantial contribution in addition to inhibition of antibiotic efflux. This report contends that focusing on time-dependent changes in the amount of a biofilm is important for determining the relationship between efflux pumps and biofilm. Such studies will promote a deeper understanding of the bacterial multidrug resistance mechanism.

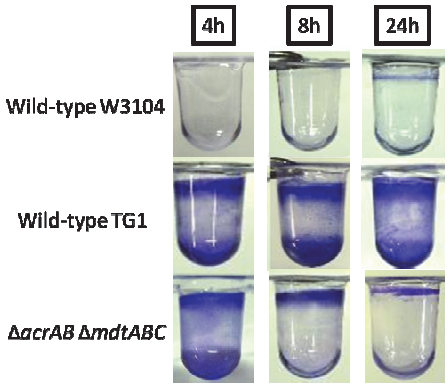

Fig. 2. The photographs present each well, which were washed with water after staining. The blue colour indicates biofilms stained with crystal violet.

Department of Biomolecular Science and Engineering

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Supporting Staffs: Kazuyo SAKAI, Aya HISATOMI

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

Expanded palette of Nano-lanterns for real-time multicolor luminescence imaging

Here, we report the development of bright cyan and orange luminescent proteins by extending our previous development of the bright yellowish-green luminescent protein Nano-lantern (Nat. Comm, 2012). The color change and the enhancement of brightness were both achieved by Förster

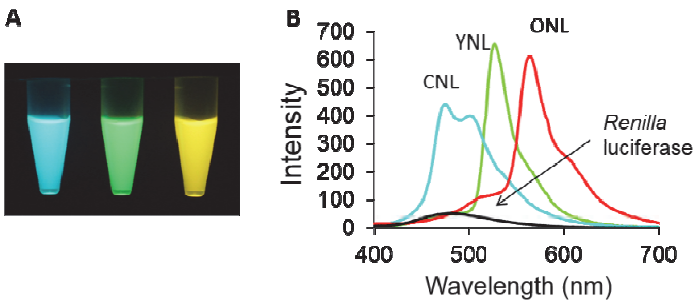


Fig.1 Bright three-color Nano-lanterns
(A) Luminescence of recombinant Nano-lantern proteins. This image was taken by home digital camera (B) Emission spectra of Nano-lanterns and *Renilla* luciferase

resonance energy transfer from enhanced *Renilla* luciferase to a fluorescent protein. The brightness of these cyan and orange Nano-lanterns was ~20 times brighter than wild-type *Renilla* luciferase, which allowed us to perform multicolor live imaging of intracellular submicron structures, multicolor Ca^{2+} imaging, and compatible use of optogenetic tool and chemiluminescence imaging.

Low light superresolution imaging by novel photoswitchable fluorescent protein.

Superresolution imaging enables us to break the diffraction limit of light (2014, Nobel prize for chemistry). For superresolution imaging, reversibly photoswitchable fluorescent proteins (RSFPs) have been widely used. Most of RSFPs can be switched on by UV-light irradiation and fluorescence is observed upon excitation like cyan light that leads to the off-state of RSFPs. This type of RSFPs is called negative-RSFP. Therefore, to obtain enough fluorescence signal, intense excitation light is required, which causes phototoxic effect for live cells. On the other hand, positive-RSFP is excited and switched on by same wavelength that enables us to achieve low light observation. By introducing random mutations to Padron that is previously existing positive-RSFP, we successfully developed novel positive-RSFP which shows 4- and 3- folds faster switching on and off speed, respectively. We named this new postive-RSFP as "Kohinoor". By using Kohinoor, we achieved RESOLFT (Reversible Saturable Fluorescence Transition) nanoscopy with 0.004J/cm that is 1/10,000 ~ 1/375 times lower than the previous RESOLFT methods.

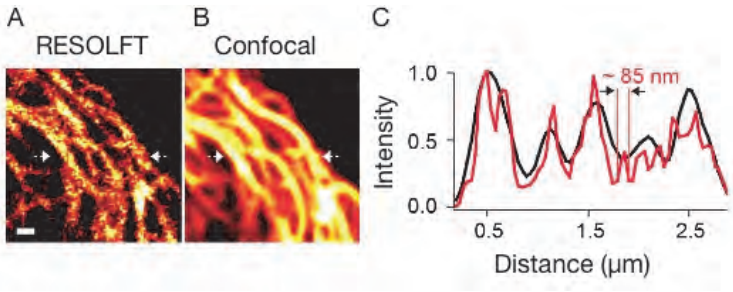


Figure 2: Superresolution imaging by Kohinoor. (A) Image by RESOLFT nanoscopy. (B) Conventional fluorescence microscopy. (C) Line profile of fluorescence intensity. Red solid line indicates the profile by RESOLFT nanoscopy, which beyond the diffraction limit of visible light (~300 nm).

Cavity Reflection Enhanced Absorption Microscopy

Absorption spectrum gives us information about molecular type, concentration, and states. Absorption is proportional to the molar extinction coefficient e, concentration C, and optical path length. Because thin samples such as mammalian cells are less than 10 μm thickness, it is almost impossible to detect absorption at sub-cellular level. To overcome this problem, we used optical cavity system that enables multiple absorption of light, leading to the extension of optical path length and the enhancement of absorption at subcellular levels. We named this microscopy as Cavity Reflection Enhanced Absorption Microscopy (CREAM). CREAM enabled us to visualize non-labeled mammalian cells or frozen tissue samples without any staining.

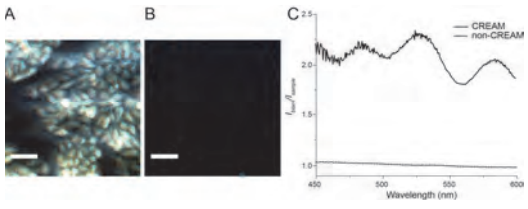


Figure 3 Absorption images (A) Absorption image of HeLa cells by CREAM (B) Non-absorption enhanced image (C) Comparison of absorption spectrum

Division of Next Industry Generation

Outline

Three new research departments have been established in this division since 2005. The goal of this division 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

ISIR, Osaka University (professor Kazuhiko Nakatani, director of ISIR) has executed JSPS Core to Core program.

On June 3rd Conference of SANKEN Core to Core Program and 4th imec Handai Interantional Symposium were held, then on July NTNU seminar was held at Trondheim, Norway, where is one of European core to core cites

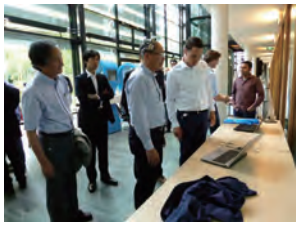
In pararell, in Osaka univ. COI(Center of Innovation) program, the collaboration agreement were as a result contracted between 27companies and 17 research academia, then " Fostering of super-Nipponjin by human power activation" development has been going well under one roof followed by 3rd Handai COI shimposium which was co-held with CiNet symposium on June, then 4th Handai COI sympojium, then annual report meeting on March were held ,respectively.

Results

3rd Conference of SANKEN Core to Core Program, 4th imec Handai International Symposium at Holst Centre, Eindhoven

3rd Conference of SANKEN Core to Core Program was held at Holst Centre/imec-NL, Eindhoven, The Netherlands on June 29. This conference corresponds to 4th imec Handai International Symposium, This conference was 3 oral sessions, in parallel 1 poster session, imec demonstrator networking discussion and Solliance lab. tour. At first welcome words given by Dr. Kazuhiko Matsumoto, professor of SANKEN(ISIR) of Osaka University, Dr. Gyselinckx Bert, Managing director of Holst Centre, imec-NL, and Dr. Ton van Mol, Managing director of Holst Centre TNO. Then 12 oral papers and 3 posters were presented which fields were flexible, organic and bio-sensing technologies and devices. Imec demonstrator networking discussion was composed of 4 kinds of topics of gas sensing devices, EEG systems, stretchable LED devices, and wearable devices. As three year passed, several collaborative topics between Max Planck and imec, NTNU and Osaka univ., imec and Osaka univ., Purdue univ. and Osaka univ., Osaka univ. and Paris Sud. Univ. were presented. Resultantly it has been found that good collaboration/good relationship were being established. With demo devices, very active and fruitful networking discussion was carried out. Finally the concluding remarks was given by professor Jo De Boeck, senior vice president and CTO of imec. The big roll to roll equipment which give the drying process under N2 gas was seen in the Solliance building. Totally 51 participants were joined. Detailed are shown as agenda.

Welcome word given by Ton and Bert, managing directors of Holst Centre, and networking lunch



imec demonstrator networking discussion

Solliance lab. Tour

Memorial snap at the garden of Holst Centre

NTNU Core to Core satellite symposium at Trondheim, Norway
- Printable, Flexible and Wearable Electronic Materials and Mechanics -

NTNU Core to Core satellite symposium was held at Trondheim, Norway on July 1. This symposium on July 1 was 5 oral sessions, and networking discussions, organized by professor Jianying He, a local committee member. At first opening remarks was given by professor Mototsugu Ogura, a steering committee member of SANKEN Core to Core program., and finally closing remarks was given by professor Kazuhiko Matsumoto, the chair person , respectively. PN junction organic photo-voltaic(OPV) cell performance was presented by professor Yoshio Aso which was collaborated with imec Leuven. Professor Helge Kristiansen gave fine pitch interconnect for flexible display applications, then novel ICA(isotropic conductive adhesive) with silver coated polymer particles given by NTNU PhD student. Totally 12 professors and PhD students were participated.

NTNU is No.1 university of science and technology in Norway where they have 20,000 students. During networking discussion, professor Zhiliang Zhang was much interested in how NTNU can collaborate with world wide academia.

NTNU satellite symposium

Networking discussion

Memorial snap at NTNU seminar

Department of Intellectual Property Research

Specially Appointed Professor:	Hirokazu SHIMIZU
Invited Professor:	Akio KOBAYASHI
Specially Appointed Assistant Professor:	Yoshihiro KIMURA
Post-Doctoral Researcher:	Ping LAI

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 a new external grant of consignment study (1). and continued 3 projects (160th committee on plant biotechnology "industry-university cooperation activity strengthening program (2), the Japanese Society of Eucommia / 10th research grant (3), and the Senshu Ikeda Bank / Consortium-based Research & Development Grant Program (4)). These empirical studies were carried out.

Current Research Projects

University-Industry Collaboration of New Business Fields

We have conducted the following university-industry collaboration projects.

-New element technologies to enable the value adding of natural materials
-Symposium about genetically modified plants
-Development of manufacturing technology for tableting mold with low sticking characteristics (supplementary research)

New Element Technologies to Enable the Value Adding of Natural Materials

In order to develop applicable technologies for resolving social and environmental problems, potential abilities of plants were studied in artificial-environmental conditions.

New flower bed was produced in the center of Osaka city, as one of the society implementations of a new hydroponic-cultivation technology developed by our study.

For developing new foods, we studied how to create new “Awaokoshi”, a Japanese cookie made of rice. The new Awaokoshi, which has long shelf life and high calorie suitable for preservative food prepared for disaster, is studied in this project that was managed by making the research consortium cooperated by industry, academia and local government. We have also continued the research on Eucommia tea to develop new technologies to upgrade the usefulness.

Symposium on Genetically Modified Plants

We carried out symposiums to learn plant biotechnology and genetically-modified (GM) plants on August 29th, 2015 and February 11th, 2016, which were supported by the 160th committee of plant biotechnology (Japan Society of the Promotion of Science).

Lectures and scientific-experiments lessons were given to disseminate accurate information about the theme. About 50 people including elementary school students, junior high school students, and teachers participated in each event.

Laboratory of Cellulose Nanofiber Materials

Associate Professor:	Masaya NOGI
Specially Appointed Assistant Professor:	Hirotaka KOGA
Supporting Staff:	Ming-chun HSIEH, Hitomi YAGYU
	Tomoe HORIE

Outlines

Cellulose nanofibers with widths 3-15 nm, mainly originating from higher plants, have attracted much attention due to their excellent properties including high physical strength, high aspect ratios and low thermal expansivity. We have developed a new type of paper based on cellulose nanofibers. The cellulose nanofiber paper, denoted nanopaper, offers high optical transparency and low coefficient of thermal expansion. At present, we are conducting the research and development of printed and flexible nanopaper electronics.

Current Research Projects

Highly thermal resistant nanopaper

By decreasing the carboxylate content in the cellulose nanofibers, the thermal durability of chemically-modified nanopaper was drastically improved, while maintaining high optical transparency, low thermal expansivity, and low power consumption during fabrication. As a result, light emitting diode (LED) lights illuminated on the chemically- modified nanopaper via highly conductive lines, which were obtained by printing silver nanoparticle inks and high-temperature heating (Fig. 1).

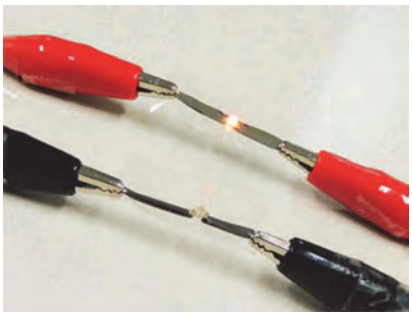


Fig. 1 LED light and silver nanoparticle printed lines on highly thermal resistant nanopaper (top) and original nanopaper (bottom).

Foldable solar cell on nanopaper

Nanopaper containing silver nanowires, which offered optical transparency and conductivity as high as ITO glass, was used for organic solar cells. The foldable ‘nanopaper solar cell’ achieved a power conversion of 3.2%, which was comparable with that of ITO-based solar cells (Fig. 2).

Fig. 2 Foldable solar cell based on nanopaper.

Paper supercapacitor

Flexible paper supercapacitor based on reduced graphene oxide (rGO) and waste pulp fibers was successfully fabricated by well-established scalable papermaking and successive room-temperature, additive-free, millisecond-timescale flash-reduction processes (Fig. 3). The paper supercapacitor had a high specific capacitance up to 212 F g^{-1}, comparable to those of state-of-the-art rGO-based supercapacitor. This work will pave the way for green, flexible, and mass-producible energy-storage paper in future wearable electronics.

Fig. 3 Paper supercapacitor.

Laboratory of Cell Membrane Structural Biology

Specially Appointed Professor: Akihito YAMAGUCHI
Specially Appointed Associate Professor: Ryosuke NAKASHIMA
Specially Appointed Assistant Professor: Keisuke SAKURAI
Supporting Staff: Kimie KITAGAWA, Han JINMIN

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. We had reported the first inhibitor-bound structures of AcrB and MexB in 2013. The pyridopyrimidine derivative (ABI-PP) tightly binds to a narrow pit composed of a phenylalanine cluster located in the distal pocket and sterically hinders the functional rotation. In 2015, to solve whole structure of the AcrAB-TolC efflux system, we constructed the AcrB-AcrA fusion proteins using various linkers.

Current Research Projects

The AcrB-AcrA fusion proteins that act as a multidrug efflux transporter.

We constructed the 1:1 ratio fixed AcrB-AcrA fusion proteins using various linkers. All of these linker proteins showed drug export activity under the acrAB-deficient

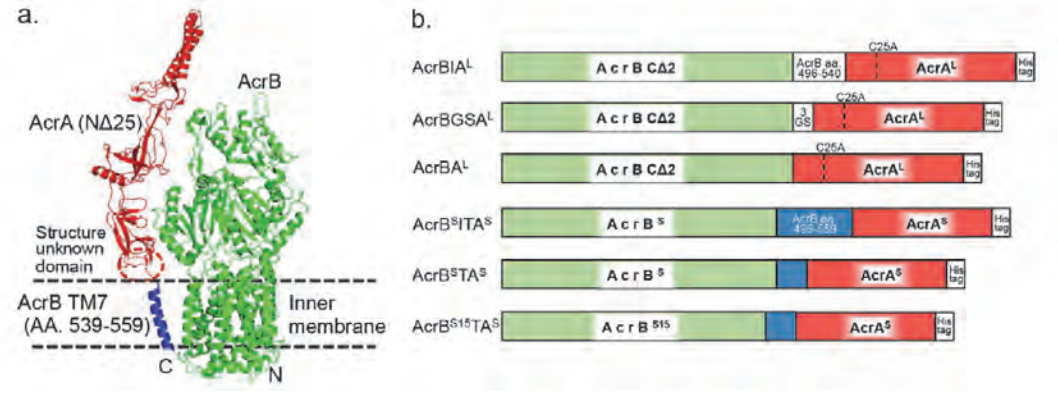


Figure 1. Construction of AcrB-AcrA fusion proteins

a. Ribbon model of a AcrB-AcrA fusion protein, b. Diagram of the construction of AcrB-AcrA fusion protein CΔ2 and NΔ25 indicate deletions of the C-terminal 2 residues and N-terminal 25 residues, respectively.

conditions regardless of the length of the likers [J.Bacteriol., 198 (2015) 332-42]. These results suggest that a complex with equal amounts of AcrA and AcrB is sufficient for drug export function whereas electron microscopy images of AcrAB-TolC suggested a 1:2:1 stoichiometry. In addition, we acquired fusion protein suitable for crystallization successfully by minimizing a cytoplasmic part of the linker.

Activities of Centers

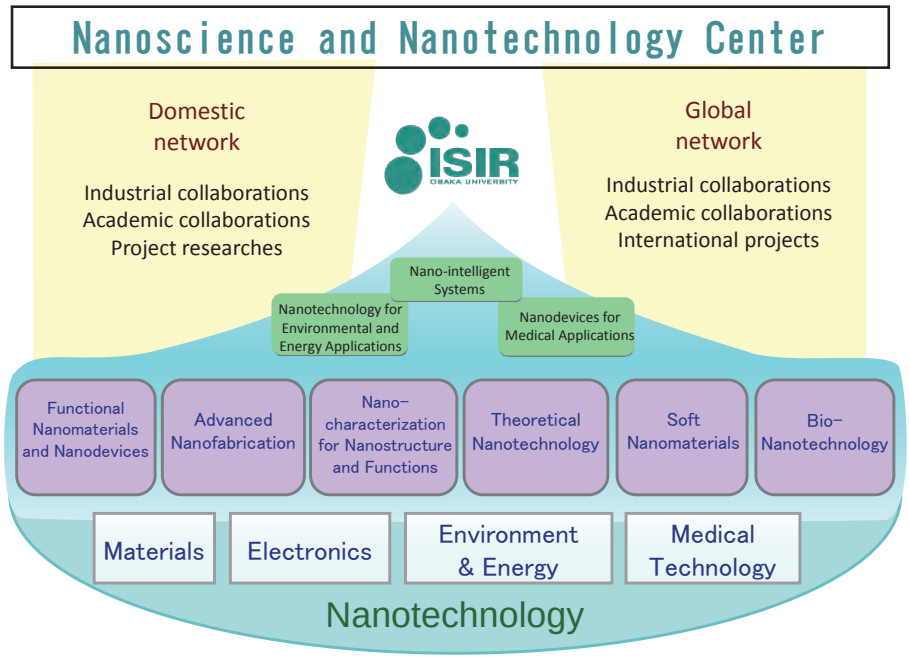
Nanoscience and Nanotechnology Center

Director, Professor: Yoichi YOSHIDA
Supporting Staff: Yuka UMEMOTO

Outlines

Nanoscience and Nanotechnology Center was founded in the Institute of Scientific and Industrial Research (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 fields. Following the reorganization of ISIR in 2009, the Center was enhanced and strengthened by building up a new structure centering on 6 full-time departments.

In the new Center, there are 18 research departments composed of 6 full-time departments, 3 departments concurrently serving as ISIR, 6 departments concurrently serving as Osaka University, and 3 departments headed by domestic and foreign visiting professors. Also, Advanced Nanotechnology Instrument Laboratory is newly opened in order to develop cutting edge researches on nanoscience and nanotechnology. Eliminating the term limit which was primarily set, the Center permanently focuses on the nano-system creation on the research field of a wide variety of materials including hard-, soft-, and bio-materials through the combination of top-down and bottom-up nanoprocess, and promotes the nanotechnology research to the new interdisciplinary science by an innovation through the approaches of theory and evaluation. The Center operatess Nanotechnology Platform Japan Program, Nanotechnology Open Facilities, Osaka University (Nanofabrication Platform Molecule & Material Synthesis Platform) from 2012. Furthermore, the Center aims to be a hub of nanotechnology research by forming broad networks between Japan and oversea countries.



Department of Functional Nanomaterials and Nanodevices

Professor: Hidekazu TANAKA
Associate Professor: Teruo KANKI
Assistant Professors: Azusa HATTORI
Guest Research Fellow: Alexis BOROWIAK（2014.7.15-2015.7.14）
Graduate Students: Hidefumi TAKAMI, NGUYEN Thi Van Anh, WEI Tingting, Shouta YAMASAKI, Tatsuya HORI, Tsubasa SASAKI, Koutarou SAKAI,Takurou NAKAMURA, Yasuko Oe,Satoshi TSUBOTA, Hisoka NAKAZAWA, Li Mingyu, Masashi CHIKANARI
Under Graduate Students: Keiichiro HAYASHI, Yoshiyuki HIGUCHI
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

Electric Field-Induced Transport Modulation in VO_2 FETs with a Hybrid Gate Insulator

Studies on electrostatic carrier doping using a field-effect transistor (FET) structure in correlated electron systems have developed a new branch to realize beyond-CMOS and to probe underlying physics in condensed matter physics. To realize higher resistive modulation, it is necessary to employ a robust dielectric for the gate layer, in order to not only lower interface trap density but also trigger huge sheet carrier density. Thus we used hybrid gate insulator consisting of parylene-C and high-k material Ta_2O_5 in this study. The parylene-C has a role as reduction of interface trap state density. Figure 1(a) and 1(b) display the cross-sectional scanning electron microscopy image and a schematic structure of VO_2 FET, respectively.

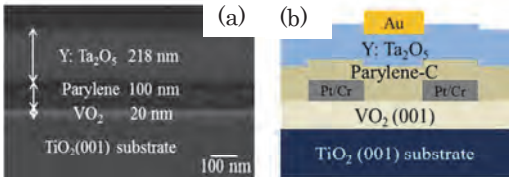


Fig.1 (a) The Cross-sectional SEM image of hybrid gate dielectric/VO_2 FET. (b) Schematic illustration of the FET structure

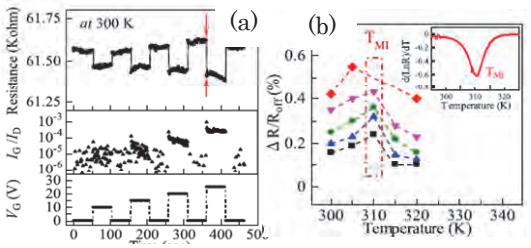


Fig.2 (a) Time-dependent resistance modulation based on gate bias at 300 K. (b) Change ratios in resistance against temperature at a variety of V_G.. Black, blue, green, pink, and red dots were recorded for V_G = 10, 15, 20, 25, 30 V, respectively

As depicted in Fig. 2(a), the device exhibited an excellent reproducibility of rapid resistance responses by applying gate bias at 300 K. Figure 2(b) shows the relationship between the change rates in resistance ($\Delta R/R_{off} = (R_{on} - R_{off})/R_{off} \times 100$ %) and temperature. The maximum $\Delta R/R_{off}$ appears near the phase transition temperature around 310 K. Among these studies on reversible and rapid resistance modulation in VO_2 FETs, our result shows the higher resistance modulation than the others. Our result will contribute to development of oxide thin film-based FETs.

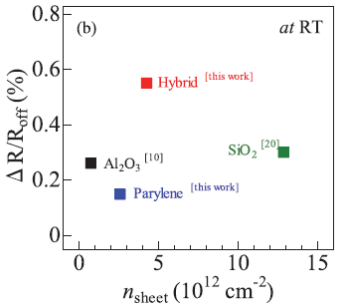


Fig.3 A plot of studies on the VO_2-based FETs with various gate dielectrics, The red and blue solid squares represent our FETs.

Investigation of Nanoscale Electric Domain Property in (La,Pr,Ca)MnO_3

In a typical perovskite manganites (La,Pr,Ca)MnO_3 (LPCMO), the observed colossal magnetoresistivity (CMR) is associated to the huge order-of-magnitude insulator-metal transition (IMT). Since the phase-separated metal and insulator domains coexist around TIM, the CMR in manganites are considered to be dominated by competing nanoscale electronic phases. The 50 nm width LPCMO nanowire (Fig. 4(a)) has been fabricated using 3D nanotemplate PLD. The LPCMO nanowire sample exhibited steep metal-insulator transition properties due to the confinement effect of nanodomains. Additionally, the insulator/metal phases at a scale of 10 nm order were successfully observed by using the cathode luminescence (CL) measurement combined with scanning electron microscopy (SEM), namely energy transfer CL-SEM: ETCL-SEM. ETCL-SEM image showed the arrangement of metal and insulator domains with 70-200 nm in size (Fig.4(b)).

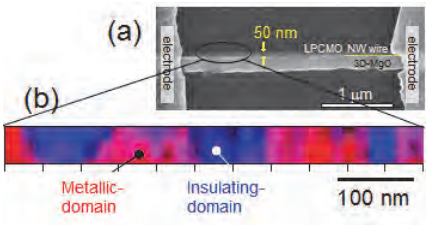


Fig. 4 (a)LPCMO nanowire with 50 nm width. (b) An ETCL-SEM image for LPCMO nanowire at 150 K.

Development of Functional Oxide Nano-Mechanical System (Functional Oxide NEMS) and its application to energy serving device.

We realized construction of 400nm scale freestanding metal oxide nanostructures and demonstrated quite low-power-driven drastic changes of conductivity in the two terminal VO_2 freestanding nanowires, which is derived by efficient local Joule heating. The critical power (P_C) inducing insulator-metal transition was compared with size dependence of clamped and freestanding nanowires. The required P_C in the nanowires with 400 nm in width was 450 nW at just below the transition temperature, which was approximately one order smaller than the freestanding micro wires with 1-μm-width. The device model considering thermal conductivity well explained that the origin of P_C changes is owing to a lower thermal conductivity in air than that in a substrate and small cross-sectional area in nanowires with 400-nm-width. These results will offer guidelines to modify the P_C in two terminal VO_2 phase switching devices.

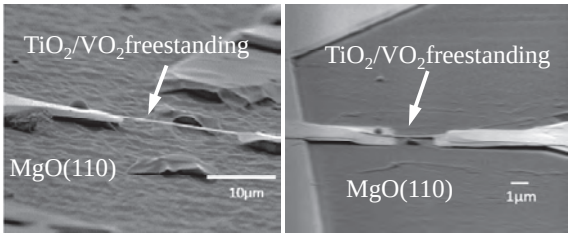


Fig.5 SEM images of VO_2 freestanding nanowires in 1-μm-width (Left) and in 400-nm-width (Right), respectively.

Department of Advanced Nanofabrication

Professor:	Yoichi YOSHIDA
Associate Professor:	Jinfeng YANG
Assistant Professors:	Takafumi KONDOH, Koichi KAN
Specially Appointed Researcher:	Masao GOHDO
Guest Professors:	Atsushi OGATA, Hitoshi KOBAYASHI, Kazumichi NAKAGAWA
Guest Associate Professor:	Hiromi SHIBATA
Graduate Students:	Tomohiro TOIGAWA, Yasushi SASAKI, Itta NOZAWA, Satoshi NISHII, Suguru YAMASO
Under Graduate Students:	Kenshi MOTONAKANO, Ryo ASAKAWA
Supporting Staff:	Kayoko COHLOGI, Yukie TAKAHASHI, Kumiko NAKANO, 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

Measurement of Frequency and Energy of Coherent Transition Radiation

Measurement of frequency and energy of coherent transition radiation (CTR) from femtosecond electron beam was conducted for a detailed analysis of electron beam. First, sensitivity of an interferometer, which is a terahertz (THz) measurement system, was analyzed by using an infrared light source of a filament based on Planck's law. Second, CTR from femtosecond electron beam with a bunch charge of 0.92 nC/pulse from a photocathode RF gun linac was measured using the interferometer. As a result, THz pulse energy of CTR was estimated to be on the order of 10 nJ/pulse. In the future, development of broadband detection system of both THz frequency and energy will be applied to a measurement of attosecond electron beam.

Ultra-Fast Electron Transport and Attachment to Biphenyl in Non-Polar Liquid

Pulse radiolysis study of biphenyl-dodecane solution which is a solution of the non-polar liquid with aromatic scavenger, was carried out. As a result, time-resolved picosecond absorption spectrum around 400 nm was obtained. Ultra-fast electron transport was observed in n-dodecane. Highly mobile electron formed on biphenyl radical anion by electron attachment. Subsequently, formation of biphenyl radical cation and triplet excited state was observed. Despite reports for relatively small electron mobility in dodecane, the presence of short-lived high-mobility electron was revealed in initial process of radiation chemistry. For example, this phenomena influence on the kinetics of electrons to form a latent image by acid generation in the

chemically-amplified polymer resists. In the high efficiency reactions in resist for finer processing, the kinetics of the short-lived high-mobility electrons cannot be ignored. Higher time resolution measurement of the electron behavior in the resist material is desired.

Understanding the Relation of the Geminate Ion Recombination and the Radiolysis Process by Using a Femtosecond Electron-Laser Pulse Radiolysis

In radiolysis of n-dodecane, the excited radical cation which was suggested for the starting point of decomposition has not yet been directly observed despite the search from visible to near infrared. To clarify the role of the excited radical cation in radiolysis of n-dodecane, the radical cation generated by a femtosecond electron beam was re-excited with a femtosecond laser pulse. As a result, the absorbance of dodecane-radical cation was reduced by re-excitation, it was confirmed that the excited radical cation was generated. We aim to observe the alkyl radicals generation by re-excitation in the ultraviolet region, in order to elucidate the relationship of the radical cation and the alkyl radical.

Development of a Relativistic-Energy Femtosecond-Pulse Electron Microscopy

A relativistic-energy ultrafast electron microscopy (UEM) has been developed in our laboratory to study the ultrafast phenomena or structural dynamics in materials. In this year, we produced a new condense lens and improved the UEM prototype. We succeeded to generate a high-brightness 3.1 MeV femtosecond electron beam with emittance of 0.1 mm-mrad that is indispensable for electron microscopy. We investigated the direct influence of the beam emittance on the image contrast in the relativistic-energy UEM. We also constructed a new image measurement system using an EMCCD camera and an improved Tl doped CsI equipped scintillator with fiber optic plates. We have succeeded to observe the TEM images of polystyrene micro- and nano-particles with the diameters of 1.1 micron and 500 nm using 100-femtosecond electron pulses with the electron energy of 3.1 MeV. The number of electrons in the pulse was 10^7. The relativistic-energy single-pulse electron imaging is also available for the low-magnification observation, i.e. 300 times.

Development of a Novel Single Shot Femtosecond Pulse Radiolysis Technique

A novel single-shot pule radiolysis technique, spatially time-resolved single-shot pulse radiolysis was proposed and developed. The new technique requires to introduce probe light pulse which was fs-laser light pulse at the timing of the electron beam passing in the fluid sample with perpendicular angle with the electron beam. The transmitted probe light detected on line-CCD camera. The each element of detector gives us spatial distribution of light intensity. That spatial distribution was converted to the time respect to the electron beam and the time-resolved single-shot transient absorption measurement was successfully achieved.

Department of Nanocharacterization for Nanostructures and Functions

Professor: Seiji TAKEDA
Associate Professor: Hideto YOSHIDA
Assistant Professor: Naoto KAMIUCHI, Ryotaro ASO
Specially Appointed Researcher: Keju SUN
Graduate Students: Tetsuya UCHIYAMA, Kentaro SOMA, Takehiro TAMAOKA, Yosuke AKIYAMA, Yuto TOMITA, Koki HAYANO, Takaaki FUJIMOTO
Supporting Staff: Noriko TAKASE

Outlines

For solving the current global issues in the fields of energy saving, energy harvesting and environmental science and technology, it is indispensable to establish the processes to synthesize novel materials and to fabricate useful devices for mass products. Nevertheless, elaborated and time-consuming “try and error”-type experiments are thought to be mandatory to find the processes. We aim at developing an innovative scientific apparatus combined with a dedicated methodology to characterize various processes at the atomic scale and real time for finding the most efficient processes.

Current Research Project

Development of Atomic Resolution Environmental Transmission Electron Microscopy in Catalysts

We summarize the development of environmental transmission electron microscopy (ETEM) in our research group to characterize the chemical process of solid catalysts in reaction environments *in-situ* and at the atomic scale. We developed a robust, easy-to-use ETEM apparatus for high spatial resolution in well-controlled environments and for quantitative analysis of ETEM data in collaboration with a manufacture of transmission electron microscopy. Atomic resolution has been obtained by installing a spherical aberration corrector (Cs-corrector) on the objective lens of an ETEM apparatus. The technology for controlling the environment around a specimen at the atomic resolution also advanced significantly in ETEM. Furthermore, quantification methodology was established for deriving relevant experimental data in catalytic chemistry from substantial and systematic ETEM observation. This report summarizes the current status of the microscopy technique [Original Paper 1].

Figure 1 demonstrates the performance of a Cs-corrected ETEM apparatus. A real catalyst sample (Au/CeO_2) was observed in a reaction environment for the oxidation of CO at room temperature. In the reaction environment, atomic columns were clearly observed in both a Au nanoparticle and a CeO_2 support. In addition, thanks to the stability of the ETEM apparatus, the systematic change of image contrast at the atomic columns could be observed correctly with the change of imaging condition (Fig. 1) to confirm the sufficient accuracy in the ETEM analysis at the atomic scale. A black dot

of a Au atomic column appeared in the left hand side (defocus values of 10.0 nm in under-focus) while a white one of the same column did in the right hand side (defocus values of 12.5 nm in over-focus).

Figure 2 depicts ETEM data that leaded to structural information on the reaction sites and adsorption sites in reaction environments. In real catalysts, especially metal nanoparticulate catalysts, the structure is heterogeneous at the atomic scale. Therefore, to derive any meaningful conclusions in catalytic chemistry, one needs to confirm that an area that is observed at high magnification and at the atomic scale correlates with the activity of a catalyst sample.

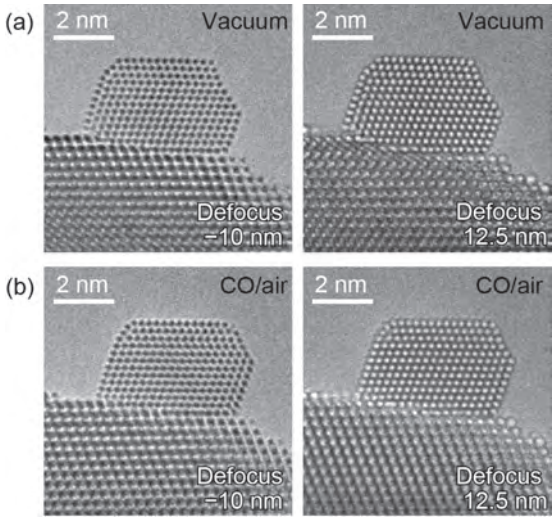


Fig. 1. Real catalyst (Au/CeO_2) observed by ETEM. Images with the Cs corrector in different defocus conditions in vacuum in (a) and in a reaction environment (100 Pa of 1 vol% CO/air at room temperature) in (b).

After observing several Au nanoparticles in various environments followed by both numerical and statistical analyses, we found that the majority of Au nanoparticles change the morphology with the change of environments in Au/CeO_2. Atomic resolution ETEM images in Fig. 2 show the change in morphology of a typical Au nanoparticle that is most likely responsible to the activity of the catalyst sample. It is also noteworthy that electron irradiation during ETEM observation is not an essential cause of the phenomenon. Indeed, the change in morphology is reversible by changing environments. Therefore, we could conclude that the phenomenon of an individual Au nanoparticle directly correlates with the activity of the catalyst sample.

Given the advancement of TEM technology such as fast detection cameras, we pursue the ultimate goal of ETEM that is to observe the atomic dynamics associated with chemical reactions on the surface of solid catalysts.

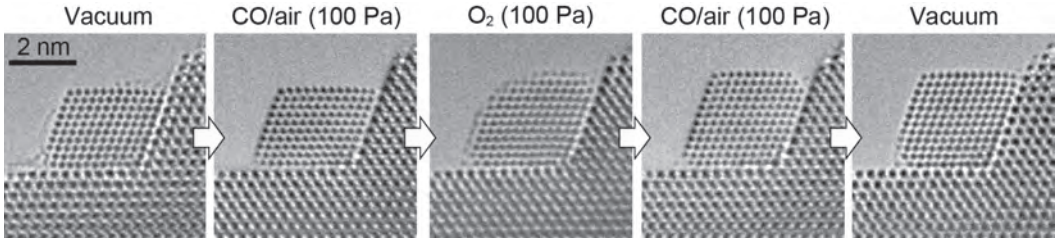


Fig. 2. Reproducible change in the surface structure of a Au nanoparticle supported on CeO_2 with change of environment.

Reference:

[1] “Environmental transmission electron microscopy for catalyst materials using a spherical aberration corrector”, Seiji Takeda, Yasufumi Kuwauchi and Hideto Yoshida, *Ultramicroscopy* **151** (2015) 178–190.

Department of Theoretical Nanotechnology

Professor: Tamio OGUCHI
Associate Professor: Koun SHIRAI
Assistant Professors: Kunihiko YAMAUCHI, Hiroyoshi MOMIDA
Specially Appointed Associate Professor: Tetsuya FUKUSHIMA (2015.12.1~)
Specially Appointed Researcher: Hiroki KOTAKA,
Masayuki TOYODA (~2015.11.30)
Huyen Thi Ngoc VU (2016.2.1~2016.3.31)
Guest Professors: Mitsuhiro MOTOKAWA, Takeo JO, Shigemasa SUGA
Graduate Students: Naoki UEMURA, Takayoshi FUJIMURA,
Masayuki FUKUICHI, Hiromichi HIRANO,
Tetsuo TANAKA, Hiroshi KATSUMOTO,
Motoyuki HAMAGUCHI, Thao Thi Phuong NGUYEN,
Special Auditor: Andreas WEH (2015.9.1~2016.2.29)
Hermeto Dolabella MAMEDE (2015.10.1~2015.10.31)
Trang Thuy NGUYEN (2016.1.20~2016.9.25)
Undergraduate Student: Takumi FUKADA, Kei IZUMI, Masaki TAHARA
Supporting Staffs: Chiaki KURIBAYASHI

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

Data-Science Approach to Magnetic Materials Exploration

Data-science approaches to rapidly growing data have recently brought a new trend of research and development to a variety of fields in science and technology. In materials science, it is now widely called "Materials Informatics (MI)", as often seen in several world-wide projects such as Materials Genome Initiative. The key strategy is to integrate data-science techniques with experimental, theoretical, and computational ones. Especially big data generated by computational simulations together with existing experimental databases are the target of data-science methods such as data mining and machine learning interleaved with appropriate physical modeling and descriptors. In MI, first-principles density-functional-theory calculations among the computational approaches play an important role for supplying data and knowledge on materials complementary to the experimental databases. This is one of the characteristic features of MI contrast to the preceding "Bioinformatics". We pursue some fundamental issues of the data-science approaches for the exploration of magnetic materials.

Theoretical Prediction of Spin-Valleytronic material based on Ferroelectric Oxide

Ferroelectric materials may show the intriguing properties by breaking the space inversion symmetry in the crystal structure. Substitution of Al atom in ferroelectric $BiAlO_3$ by Ir atom results in the strong spin-valley coupling as showing large spin splitting in the band structure. This effect has particular character to the bulk effect instead of the conventional surface effect since the spin polarization in the *k*-space is strongly coupled with the ferroelectric polarization in the real space. Our finding may pave a way to a new device where the applied electric field can control the ferroelectric distortion and the valley Hall conductivity in the system.

Materials Design Utilizing Atom Dynamics

Our group has been studying the phase diagram of boron, which is the last one that the phase diagram is not known. Among many of the allotropes, α-tetragonal boron was not well studied, and even the existence was suspected. We have demonstrated the detailed structure by DFT calculation and thermodynamic method, from which experimental data were assessed. Moreover, we have found in this crystal a new type of frustration (Fig.1), which contributes a new development to fundamental physics.

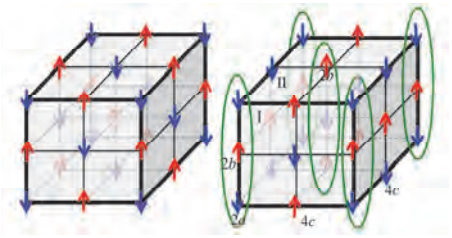


Fig.1 Geometrical frustration of tetragonal boron.

Charge and Discharge Reaction Mechanisms in Sodium-Ion Secondary Batteries

Iron disulfide (FeS_2) with the pyrite structure is a candidate for high-capacity cathode material. In Na/FeS_2 batteries, conversion-type reactions have been considered to be the dominant mechanisms. However microscopic structure changes associated with Na charging/discharging have been not yet fully clarified and several types of reaction formulae have been proposed experimentally. We perform the first-principles calculations of several Na–Fe–S materials that are possibly generated in battery reactions, and estimate theoretical voltage values to understand discharge reaction mechanisms comparing with the experimental values. The calculated formation energies show the two-step discharge reaction formula $4Na + FeS_2 \rightarrow 2.5Na + Na_{1.5}FeS_2 \rightarrow 2Na_2S + Fe$ in Na/FeS_2 batteries. The calculated voltage–capacity curve is consistent with the experimental first-discharge curve, showing a step-wise voltage–capacity profile with generating Na_xFeS_2 intermediate products. Furthermore, we calculate x-ray absorption spectra (XAS) at S-K and Fe-K edges of Na–Fe–S materials to understand the experimentally observed spectral changes. Calculated results are consistent with the experiments especially near the absorption-edge energy regions, supporting the predicted reaction formulae with Na_xFeS_2 intermediate products.

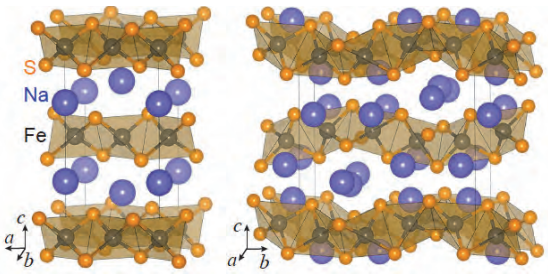


Fig.2 Crystal structures of $NaFeS_2$ (left) and $Na_{1.5}FeS_2$ (right).

Department of Soft Nanomaterials

Professor: Yoshio ASO
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Specially Appointed Researcher: Shreyam CHATTERGEE
JSPS Postdoctoral Researcher: Shunsuke TAMBA
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Nana KAWAGUCHI, Koki MORIKAWA
Keitaro YAMAMOTO
Research Student: Shuzhan CHEN (2015.8-)
Supporting Staff: Keiko YAMASAKI
Technical Assistant Staffs: Takuji SEO, Yumi HIROSE

Outlines

The main subject in the Department of Soft Nanomaterials is the development of novel molecular-based materials with promising electronic and photoelectronic properties for organic electronics. The research is based on the design and synthesis of nano-scale π-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 π-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 organic photovoltaics (OPVs). Though poly(3-hexylthiophene) (P3HT) is routinely employed as a donor for bulk-heterojunction (BHJ)-type OPVs, development of novel donors has been accomplished in recent years. In contrast, only a limited series of fullerene derivatives represented by [6,6]-phenyl-C_{61}-butyric acid methyl ester ($PC_{61}BM$) are employed as acceptors. However, fullerene derivatives have an unfortunate drawback such as weak absorption in the visible region, which results in a limited light-harvesting efficiency. Under this situation, we have engaged in the development of non-fullerene acceptors by the use of electron-accepting π-conjugated systems. To fine-tune the interfaces between donor and acceptor in the BHJ structure, a series of electron-accepting π-conjugated compounds based on benzo-thiadiazole and arenedicarboximides were systematically synthesized to investigate the impact of structural modification on molecular orientation at donor–acceptor interfaces. BHJ solar cells prepared with our π-conjugated compounds as acceptors and P3HT as a donor. As a result, a strong correlation was found between the short-circuit current density of OPV and London dispersion (γ_d) of acceptors. The findings provide novel information for the development of non-fullerene

acceptors for OPVs [Original Paper 1] (Fig. 1).

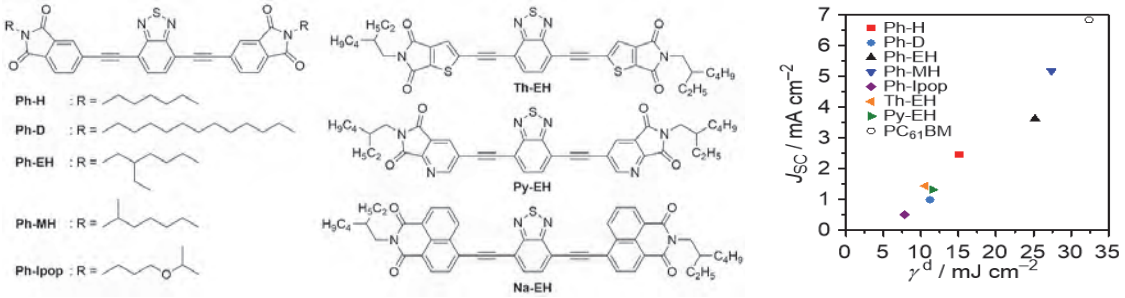


Fig. 1 Chemical structures of acceptors and plot of γ^{d} vs. J_{SC} values for acceptor materials

Next we focused on naphtho[1,2-*c*:5,6-*c*']bis[1,2,5]thiadiazole (NTz) as a key electron-deficient central unit and synthesized a new electron-accepting π-conjugated compound (NTz-Np), whose structure is based on the combination of NTz and the fluorene-containing imide-annelated terminal units (Np). OPV devices based on NTz-Np under the blend with P3HT show high photovoltaic performance with a PCE of 2.81%, which is the highest class among the P3HT/non-fullerene-based OPVs with the conventional device structure [Original Paper 2].

On the other hand, in the collaboration research with a company, several fulleropyrrolidine derivatives were newly synthesized and their potentials for OPV n-type materials were evaluated. As a result, it was found that electron-donating groups introduced to *N*-phenylfulleropyrrolidine contribute to increasing the V_{oc}'s of the OPVs (Fig. 2).

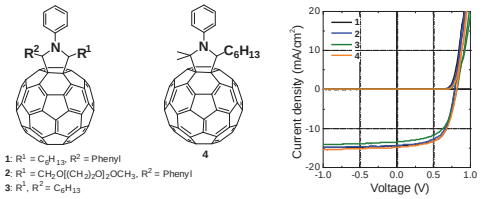


Fig. 2 Chemical structures of fulleropyrrolidines and *J*–*V* curves of their OPV cells.

Molecular electronics materials

Single-molecule electronics have attracted much interest in terms of the bottom-up construction and potential for ultimate miniaturization. Molecule-metal junctions are inevitable for the realization of these devices. We developed new tripodal anchors with electron-rich thiophene rings to achieve robust contact with gold electrodes, an effective hybridization of the π orbital with gold electrodes (π channel), and hole transport through π-channel hybridization. Cyclic voltammetry and X-ray photoelectron spectroscopy measurements of the monolayers indicated that the thiophene-based tripodal molecule exhibits expected characteristics. The Seebeck coefficient of 3Th-Ph-3Th estimated from thermoelectric voltage measurements was determined to be a positive value, which indicates that the charge carriers are holes [Original Paper 3] (Fig. 3).

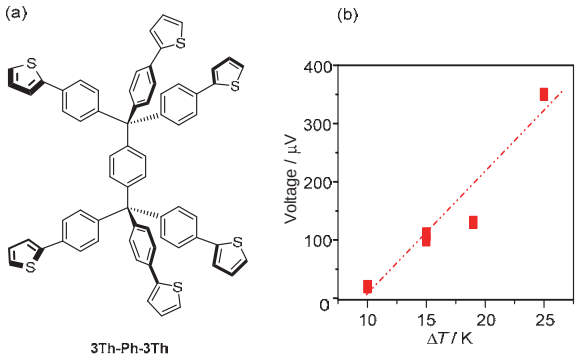


Fig. 3 (a) Chemical structure and (b) TEV characteristics of 3Th-Ph-3Th.

Department of Bio-Nanotechnology

Professor: Masateru TANIGUCHI
Associate Professor: Makusu TSUTSUI
Assistant Professor: Hiroyuki TANAKA, Kazumichi YOKOTA
Specially Appointed Professor: Tomoji KAWAI
Specially Appointed Assistant Professor: Takahito OHSHIRO(2015.10.1-2016.3.31), Yuko ESAKI
Specially Appointed Researcher: Sanae MURAYAMA, Masaki KANAI, Hiroe OWADA, Chie HOTEHAMA
Post Doctoral Fellow: Yuhui HE(2015.4.1-2015.8.31)
Graduate Students: Akihide ARIMA, Takanori MORIKAWA, Sachie TANIMOTO
Supporting Staff: Noriko FUJIBAYASHI(2015.10.1-2016.3.31)

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

Low Thickness-to-Diameter Aspect Ratio Pores for Single-Particle Shape Analysis

Nanopore analysis is a powerful method for detecting and discriminating single particles by their size in liquid. It uses a hole drilled in a solid membrane to measure a temporal drop in the cross-membrane ionic current during electrophoretic translocation of a particle through the pore channel. In our group, we aim to use a low thickness-to-diameter aspect ratio pore structure to enhance the sensor spatial resolution for single-particle shape analysis.

In this year, we performed resistive pulse analysis of microparticles using a low-aspect-ratio SiN micropore and found that the line shapes, including the height, of ionic spike signals reflects not only the size of the particles but also the translocation

dynamics. We also demonstrated discrimination of two bacteria of similar shape and size by exploiting machine learning algorithm to compare and identify the difference in the resistive pulse wave patterns measured, thereby proved the potential of low-aspect-ratio pore sensors for single-particle tomography in liquid.

Bacteria Detection by Low-Aspect Nanopore Devices

Solid-state nanopores are considered as a promising sensing device for environmental monitoring and bioanalytical applications. It consists of a nanometer-sized hole formed in a thin membrane made of SiO_2 or SiN.

Especially, we focus our attention to low-aspect nanopore devices, which possess a small thickness in contrast to a diameter of the pore, aiming to develop shape-sensitive sensor devices.

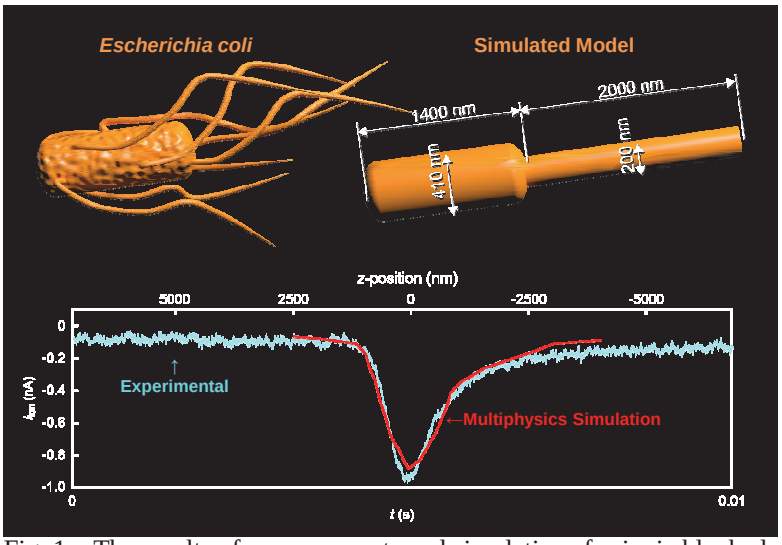


Fig. 1 The results of measurements and simulations for ionic blockade currents regarding a translocation of E. coli by using a low-aspect nanopore device. The obtained change of blockade currents corresponds to the shape of E. coli.

Figure 1 shows the result of detection for Escherichia coli (E. coli) in phosphate buffered saline (PBS) by using a nanopore device of which diameter and thickness are 1.2μm and 50 nm. By the translocation of E. coli, the ionic current via the nanopore decreases. As the value of current blockade corresponds to the exclusive volume of electrolyte within the nanopore, the cross-sectional area of E. coli at each time can be obtained from the trace of current. By the fitting based on the finite element method simulation including electric field, ion convection, and fluidics, the model shape of E. coli with flagella is obtained.

Together with chemical physics analysis, we now proceed the analysis based on informatics by the collaboration with Department of Reasoning for Intelligence (Washio Laboratory) to demonstrate precise identification for various species of bacterium.

Preparation of Atomically Flat Ni(111) Substrates for Graphene Growth

Graphene has attracted attention as an electrode and the substrate for DNA sequencing. When using a metal supported graphene, Ni (111) substrate makes almost no moire or wrinkles because of small lattice mismatch.

However, it is not generally easy to obtain an atomically flat and clean Ni(111) surface by cleaning a bulk single crystal due to the impurities such as sulfur. Therefore, instead of starting from a bulk single crystal, it was examined to obtain an atomically clean and flat Ni(111) by deposition of nickel on a synthetic mica.

As a result, an atomically flat Ni(111) thin film was heteroepitaxially formed. In addition to the small rms surface roughness achieved (< 1 nm), the surface morphology appears to be comparable to that of commercially available gold mica.

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 spintronic 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 $Bi_{2-x}Sb_xTe_{3-y}Se_y$ which has the lowest residual bulk conductivity among known topological insulators.

Current Research Project

Basic research of topological insulators for spintronic 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 (this is also called spin-momentum locking). 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 $Bi_{2-x}Sb_xTe_{3-y}Se_y$, 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. As a step toward this goal, we fabricated a back-gate field-effect device (Fig. 1) using a small exfoliated piece of $Bi_{2-x}Sb_xTe_{3-y}Se_y$, where the type of the carriers can be tuned from n- to p-type.

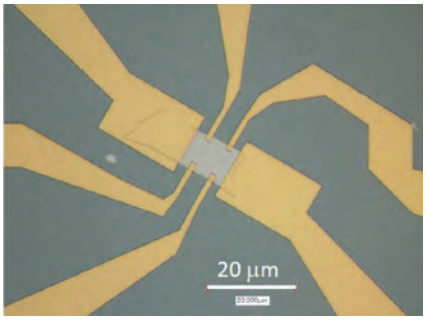


Fig. 1 Optical microscope picture of a back-gate field-effect device made of exfoliated $Bi_{2-x}Sb_xTe_{3-x}Se_x$ single crystal and Pd electrodes fabricated with *e*-beam lithography.

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. Following the last year, we worked on the development of an extended method to cover the detection of phase anomalies of entangled quantum states.

Current Research Projects

We employed the following formula to decompose an observed state density matrix $\hat{\rho}_k$ into its normal component θ and anomalous component ω_k.

$$\min_{\theta,\omega_k\,(k=1,\ldots,K)} \sum_{k=1}^{K} \frac{1}{2} \left\| \hat{\rho}_k - \theta - \omega_k \right\|_F^2 + \gamma \sum_{k=1}^{K} \sqrt{\sum_{i,j=1}^{d} s_{ij}^2 \omega_{k,ij}^2}$$

However, this formula does not allow to detect the phase anomalies which are reflected to the complex elements but not to their absolute values, since it evaluates the change of the absolute values only. Following the last year, we extended this formula to take the complex elements into account. Its performance evaluation for the anomaly detection is currently underway by using some numerical simulations and real world experiments.

Department of Nanodevices for Medical Applications

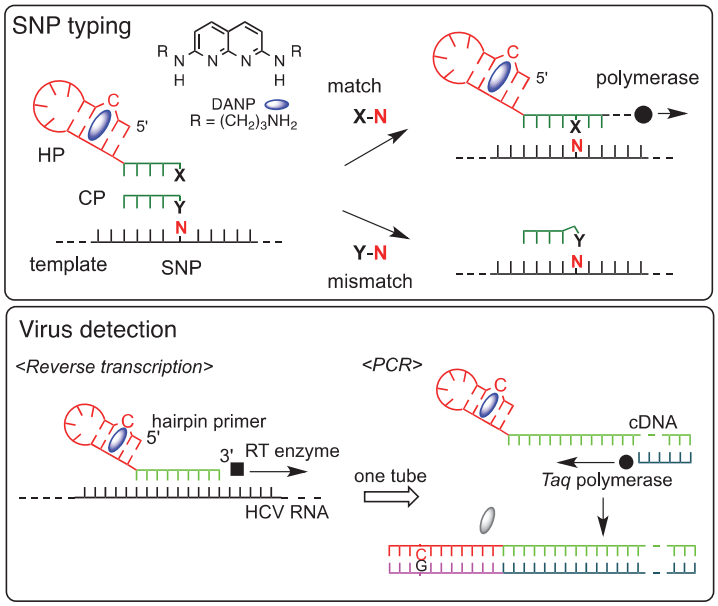
Professor: Kazuhiko NAKATANI

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 Simple and Practical Method for Virus Detection



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. 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 optimizing a PCR conditions. In addition, we developed a novel single step virus detection system using the fluorescent molecule with a hairpin primer on the reverse transcription polymerase chain reaction (RT-PCR).

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

Department of Nanotechnology for Industrial Applications

Guest Professor: Asokendu MOZUMDER (2015.2.15-2015.7.3)

Outlines

An understanding of radiolysis of water is important to evaluate and control the radiation effects in various research fields such as nuclear engineering, radiological science and so on. Irradiation of ionizing radiation upon water immediately induces ionization and excitation, which leads to formation of secondary electron. It will undergo energy loss, thermalization, and trapping process, resulting in formation of solvated electrons in a spur. In this work, first attempt was made to calculate the spur size in liquid water at room temperature from fundamental interactions, by taking electron trapping, elastic scattering and positive-ion back attraction effect into account.

Achievements

Secondary electron ejected by interaction between the ionizing radiation and solvent molecules (water) will subsequently undergo electron energy loss and scattering. It may be enumerated as sub-excitation (<5eV) , sub-vibration (<0.0375 eV) and trapping, thermalization and post-thermal trapping. In addition to diffusion and inelastic scattering, elastic scattering and positive-ion back attraction effect were also considered to estimate the initial spur size. We found that the diffusional spread of sub-excitation and sub-vibration electron to be 38.4 A and 41.2 A, leading to overall diffusional broadening to be 41.2 A. However, the radius is significantly attenuated by the positive-ion back attraction effect as much as 24.0 A, resulting in a so-defined spur size of 17.2 A. This is the first attempt to calculate the spur size from fundamental interactions. This collaboration work has been published in Chem. Phys. Lett. (Y. Muroya, A. Mozumder, Chem. Phys. Lett., 657, 102-106, 2016.)

Department of Nanotechnology for Industrial Applications

Guest Professor: CHANG Shan (2015.12.15-2016.1.29)

Outlines

Silicon nanoparticles possess wide band-gaps due to the quantum size effect and high activity for surface reaction. Professor Kobayashi's laboratory has developed a simple method to form Si nanoparticles from Si swarf by use of a beads milling technique. In the present study, hydrogen evolution by the reaction of the swarf-derived Si nanoparticles and water is investigated. The relationships between the physical properties of the Si nanoparticles, such as their size distribution and shape, and the amount and rate of hydrogen generated via the reaction are examined.

Achievements

Si nanoparticles have been fabricated from Si swarf by the beads milling method with 0.5-mm zirconia beads. By varying the milling conditions, the size distribution, shape, and surface characteristics of the Si nanoparticles were controlled. The relationships between the physical properties of the Si nanoparticles, pH of water, and the amount and rate of hydrogen evolution were investigated in detail. In addition, the transition of the Si surface characteristics were examined by XPS, FT-IR, and SEM observation, and an insight into the mechanism of the reaction between Si and water was obtained.

Department of Nanotechnology for Industrial Applications

Guest Associate Professor:
Mohamed Almokhtar Mohamed Mahmoud Abdel-Mola (2015.9.-)

Outlines

Graphene is suitable material for spintronics and related applications because of weak spin-orbit interaction and low hyperfine interaction of electrons with carbon nuclei. Recently graphene spintronics devices have been reported, for example electron spin injection to graphene, graphene quantum dot devices and graphene Cooper pair splitters. Kondo effect is one of the phenomena related with electron spins and recently has been reported in quantum dot devices. In this study, we detected Kondo effect in a single graphene quantum dot.

Current Research Projects

Kondo effect in graphene quantum dots

We synthesized monolayer graphene on a cupper foil by chemical vaper deposition. Synthesized Graphene was transferred on Si/SiO_2 substrate from the cupper foil. We fabricated graphene quantum dots with sidegates by electron-beam lithography and reactive-ion etching. Figure 1 shows SEM image of a graphene quantum dot device with a sidegate. The size of graphene quantum dot is about 150 nm. The distance between the quantum dot and sidegate is about 200 nm. We fabricated source-drain electrodes (Ti/Al 5nm/80nm) by electron -beam lithography and electron-beam evaporation. The graphene quantum dot devices were measured at T ~ 20 mK by a dilution refrigerator.

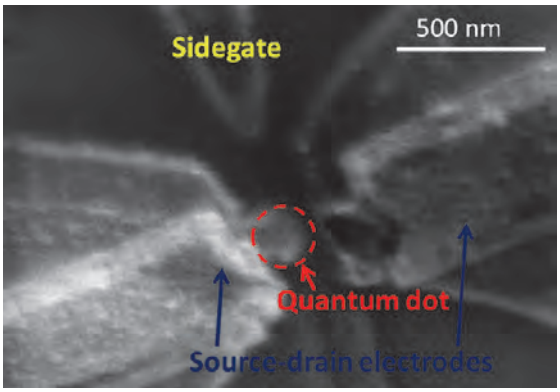


Fig.1, SEM image of a single graphene quantum dot with a sidegate.

Figure 2 shows G as a function of V_{sd} in Coulomb blockade regime. Although zero-bias conductance is normally suppressed in Coulomb blockade regime, a zero-bias conductance peak is observed. To investigate the zero-bias anomaly, we measured magnetic field dependence. As the magnetic field increase, the zero-bias conductance was suppressed. From this result, the zero-bias conductance peak can be explained by Kondo effect.

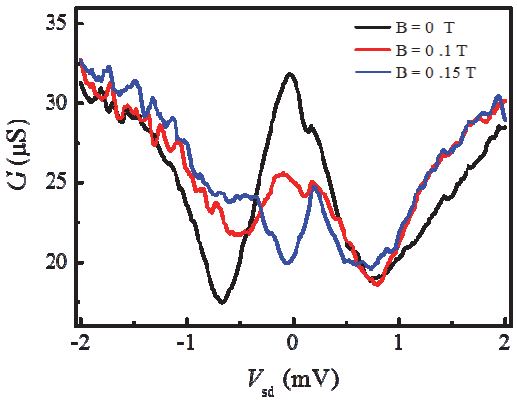


Fig.2, V_{sd} - G characteristics at B = 0, 0.1 and 0.15 T, respectively.

Department of Nanodevice Characterization

Guest Professor: Bog G. KIM (2015.3.9-2015.5.8)

Outlines

Recently, there has been considerable interest of first-principles study on many systems, including functional perovskite oxides, polar oxides, and topological insulators. With the everlasting increase of computing capability and improvement of accuracy of first-principles codes, the first-principles calculation has been applied not only for the understanding of existing experimental results but also for the predicting of new material concepts. In this short stay at Sanken of Osaka University, I have initiated the collaboration activity among the members of Oguchi's laboratory as well as other faculty members in Osaka University.

Achievements

A. With the help of group members in Oguchi's Laboratory and other faculty members, I have finished the calculations such as:

1. Structural phase transition of $ScFeO_3$ perovskite oxide: The low temperature trigonal structure can be understood by two modes coupling from high temperature trigonal phase. Also the magnetic structure and the pressure dependent phase transition can be understood by GGA+*U* calculations.
2. Calculation of Z_2 topological invariance: The topological phase of topological insulator can be characterized by Z_2 topological invariances. The calculation of Z_2 topological invariances with/ without inversion symmetry has been performed.
3. Various structural phase transitions in polar oxides: We have successfully finished the calculation of phase transitions in functional oxide systems, such as $BaAlO_4$, Bi_2SiO_5, Bi_2GeO_5, $Ba_2TiSi2O_8$, and $Sr_2TiSi_2O_8$.

B. I also have arranged the visit of two of my students from Pusan National University and initiated the collaborative network between Osaka University and Pusan National University. My students and I presented the open seminars.

C. I have trained two students in Oguchi's laboratory and attended numerous discussions with staff members in Oguchi's Laboratory for the future collaboration.

Department of Nanodevice Characterization

Visiting Professor: AL-SHEIKHLY, Mohamad Ismail (2015.6.30 – 2015.7.30)

Outlines

It is well known that the acrylate-based polymer material, widely used in various fields, can be obtained by radiation induced polymerization of the monomers. However, the starting point of the radiation induced polymerization of acrylate monomers is still unknown. Secondly, radiation induced initial reaction of a leuco-malachite green dye derivative which is expected as a high-performance dosimeter also do not well known. The starting point of the radiation chemistry in these useful materials, even if well used in various fields, has not been revealed. By understanding the initial process of radiation chemistry, guidelines for material design and reaction process can be obtained. Pulse radiolysis experiments was conducted with the study about these two basic challenges.

Achievements

Femtosecond pulse radiolysis studies about 2 issues of the following, were conducted. Transient absorption of 2-ethyl-hexyl-acrylate was measured by the femtosecond electron pulse radiolysis. It was very difficult because of the monomer was polymerized very quickly in the measurement by 10Hz electron beam irradiation. Transient absorption was obtained successfully by using high flow rate to avoid this serious issue. Secondly, the leuco-malachitegreen dye derivative was exhibited a vivid blue color by electron beam irradiation. Electron beam induced solvated electron in dimethylformamide (DMF) lead to the structural change from the leuco-type to malachite green chromophore by dissociative electron attachment. However, it was also found that this bule colored solution was quenched by so many irradiations of the electron beam. This is considered that malachite green chromophore was reduced to leuco-type structure by the reducing of the solvated electron in DMF. By the solvated electrons generated by electron beam, the forward reaction and the reverse reaction was occurred simultaneously. Further study is desired for more information.

Department of Nanodevice Characterization

Guest Associate Professor: Shih-kang Lin (2015.7.31～2015.8.28)

Outlines

Wide band gap semiconductors such as SiC and GaN have attracted much attention recently due to their excellent power conversion performance compared with the conventional Si power devices. One of the essential requirements for WBG devices is the high temperature operation exceeding 200 ˚C. The conventional interconnection materials such as solders cannot be used in this high temperature range. Suganuma Laboratory has worked on high temperature interconnection materials and developed Ag sinter joining technology. By using the Ag sinter paste, WBG dies can be bonded even at 250 ˚C in air. Usually, sintering of metallic materials requires high temperature to activate atomic diffusion. The expected sintering temperature for Ag is to be beyond 400 ˚C based on a normal sintering mechanism. Our microstructural observation indicates sintering of Ag can occur even at 200 ˚C, which is far lower than the expected sintering temperature. With Prof. Lin, we performed theoretical approach for understanding the low temperature sintering mechanism.

In his stay as a visiting associate professor of ISIR, we also exchanged our knowledge on the advanced technology both for flexible/wearable electronics as well as WBG power devices and had a discussion on the mutual collaboration in these fields.

Achievements

For the low temperature sintering of Ag materials, we found the absorption of oxygen in Ag, especially along grain boundaries, has a key role. Ag films and Ag flakes, for which we found the low temperature sintering ability, oxygen can be absorbed in grain boundaries of Ag materials in air at around 200 ˚C. Actually, diffusion of Ag along grain boundaries in Ag is extremely fast. From CALPAHD simulation, we got a phase diagram of Ag-O, which indicated partial pressure of oxygen reduces melting temperature drastically. If oxygen is concentrated in grain boundaries, Ag-O liquid will be formed along grain boundaries. If a slight stress is applied as thermal expansion mismatch effect, the Ag-O liquid will be spilled out from grain boundaries to the free surface. The erupted Ag-O will immediately decompose into metallic Ag and oxygen. From high resolution TEM revealed the formation of Ag amorphous on the Ag. Amorphous Ag is unstable at 200 ˚C and it will form Ag nanoparticles resulting in low temperature sintering. From this result, we have submitted one IP and journal paper

recently.

Also, Prof. Lin, towards the laboratory of students and staffs, introduced the research activities, student life and university study-abroad-policy in National Cheng Kung University. The development and research direction of new materials has been presented in detail by Prof. Lin. It can be said that the joint research between Osaka University and National Cheng Kung University will be continuously carried out on the new material research field.

Department of Nanodevice Characterization

Guest Professor: JUNG Jae Pil (2015.9.1-2015.9.30)

Outlines

With the development of next generation of electronics devices such as flexible and wearable and wide band gap power devices, the requirements of printed electrodes have been an urgent issue in these days. Nanomaterials such as nanoparticles, nanowires as well as larger scale printable materials have been studied as new alternative to the conventional materials such as ITO films and wire bondings. Prof. Jae is one of the most pronounced researchers on advanced electronics in Korea as well as in the world. In his stay as a visiting professor of ISIR, we exchanged our knowledge on the advanced technology both for flexible/wearable electronics and for WBG power devices and had a discussion on the mutual collaboration in these field.

Achievements

For the interconnection of flexible and wearable devices, we agreed the main bonding method being adhesives such as isotropic or anisotropic conductive adhesives. Nevertheless, these adhesives also have weak points such as the robustness in humid atmosphere. Nanomaterials such as Ag nanoparticles and Ag nanowires are attractive printable materials, which can be cured also at low temperature. Ag was found to be improved about the chemical reaction in moisture. Chemical migration is one of the major concerns for Ag nano-inks. Low temperature solders such as Sn-Bi can be the alternative to conductive adhesives. We have discussed about the potentials of these low temperature bonding methods for flexible and wearable devices.

Also, Prof. Jae, towards the laboratory of students and staffs, introduced the research activities, student life and university study-abroad-policy in Korean University. The development and research direction of joining materials has been presented in detail by Prof. Jae. It can be said that a great deal to contribute to the joint research of both of Osaka University and Seoul City University in the future.

Department of Nanotechnology Characterization

Visiting Research Scholar (Professor): Jungkweon CHOI (2015.10.1-2015.11.2)

Outlines

Although the redox reaction in DNA has been extensively investigated in the fields of biomedical science and nano-biotechnology, the proton transfer (deprotonation and protonation) of radical cations of four nucleotides are still unclear. Recently, time-resolved resonance Raman (TR^3) spectroscopic measurements combined with pulse radiolysis has been constructed for the structural and mechanistic studies of various radial ion species. Here, we have studied the oxidation of G, which has the lowest oxidation potential among four nucleotides (A, T, G, and C), by using the transient absorption and TR^3 spectroscopies combined with pulse radiolysis.

Achievements

The transient absorption spectral change herein shows that the $G^{\bullet+}$ formed by one-electron oxidation rapidly releases the imino proton, N1-H, into water within an 8 ns electron pulse, resulting in the formation of $G^{\bullet}(-H^{+})$. In addition, the $G^{\bullet}(-H^{+})$ is converted to another G protonated radical cation ($(G^{\bullet+})'$) with a rate constant of 8.1×10^6 s^{-1}: $G^{\bullet}(-H^{+}) + H^{+} \rightarrow (G^{\bullet+})'$. In $G^{\bullet}(-H^{+})$, N7 is considered as a protonation site, but not N1 and N3. The formation of this species shows the pH-dependence, suggesting that it is the G radical cation $(G^{\bullet+})'$ formed from the protonation at the N7 of $G^{\bullet}(-H^{+})$. On the other hand, Raman signals of G radical ions $(G^{\bullet+})'$ generated upon pulse radiolysis were measured, for the first time, in the present study. The TR^3 bands for 5′-dGMP are assigned to those of $(G^{\bullet+})'$. The $(G^{\bullet+})'$ exhibited the characteristic CO stretching mode at ~1266 cm^{-1} corresponding to a C-O single bond.

The result presented herein demonstrates that $(G^{\bullet+})'$ exists as $(G^{\bullet+})'$-I with a C-O single bond due to an unpaired electron localized on oxygen atoms of the pyrimidine ring. Considering the structure of $(G^{\bullet+})'$ and Tomasz's proposal, the $(G^{\bullet+})'$ may act as a precursor for the formation of 8-oxo-$G^{\bullet}$ by OH addition in aqueous solutions. The results provided herein can help understand the oxidative DNA damage occurring in cell through the reactions with the reactive oxygen species.

This project research has been published in the following papers.

1) Proton Transfer of Guanine Radical Cation Formed upon One-Electron Oxidation Studied by Time-resolved Resonance Raman Spectroscopy Combined with Pulse Radiolysis

J. Choi, C. Yang, M. Fujitsuka, S. Tojo, H. Ihee, and T. Majima

J. Phys. Chem. Lett. **2015**, 6(24), 5045-5050.

2) Reply to the Comment on "Proton Transfer of Guanine Radical Cations Studied by Time-resolved Resonance Raman Spectroscopy Combined with Pulse Radiolysis"

J. Choi, C. Yang, M. Fujitsuka, S. Tojo, H. Ihee, and T. Majima

J. Phys. Chem. B **2016**, *120*(11), 2987-2989.

Department of Nanosystem Design

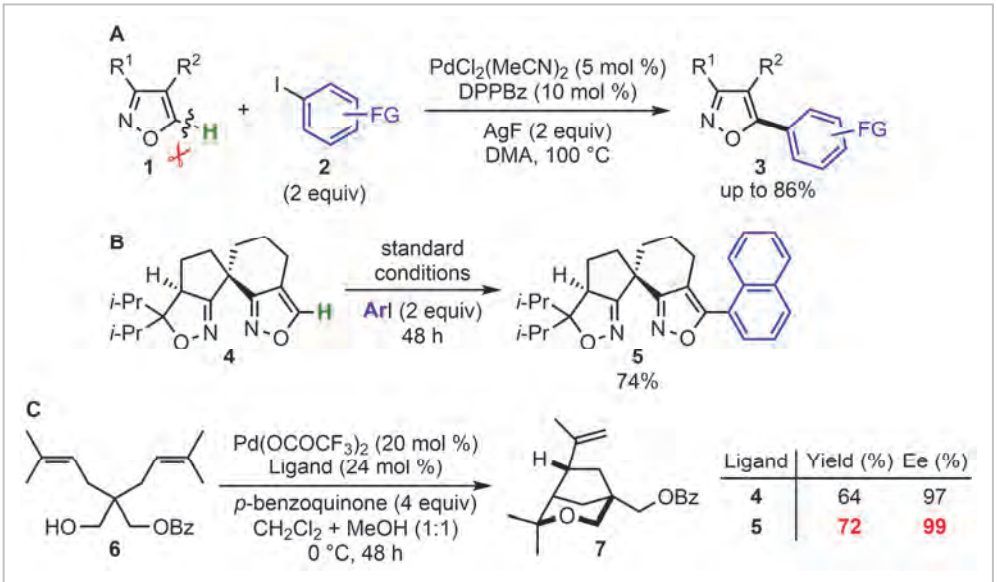
Guest Professor: Fumitoshi KAKIUCHI (2015.4.1-2016.3.31)

Outlines

Isoxazoles, a major class of five-membered heterocycles bearing an N–O single bond, are embedded in a variety of natural products and pharmaceutically important compounds. Continuing efforts are therefore being made to further develop more efficient synthetic methods of isoxazoles. Over the past decade, direct functionalization of ubiquitous C–H bonds promoted by a transition metal catalyst has emerged as a straightforward and atom-economical synthetic route. In particular, Pd-catalyzed C–C bond formation through the activation of C–H bonds is employed as an environmentally-benign cross coupling reaction. Hence, the direct arylation would provide a versatile protocol for functionalization of isoxazoles.

Achievements

We have succeeded in the development of an unprecedented Pd-catalyzed direct arylation of the isoxazole ring at the 5-position. Thus, the reaction of isoxazoles **1** with an excess amount of aryl iodides **2** in the presence of 5 mol % of $PdCl_2(MeCN)_2$, 10 mol % of 1,2-bis(diphenylphosphino)benzene (DPPBz), and 2 equivalents of AgF in *N*,*N*-dimethylacetamide (DMA) at 100 °C proceeded to give the desired coupling product **3** in up to 86% yield (Scheme 1A). The utility of this direct C5 arylation of isoxazoles was examined in the derivatization of spiro-type chiral ligand **4**. When **4** was treated with 1-iodonaphthalene under the standard conditions, new arylated ligand **5** was obtained in 74% yield, which exhibited better results in asymmetric catalysis compared to unmodified ligand **4**. (Schemes 1B and 1C).



Scheme 1. Palladium-catalyzed Direct C-H Arylation of Isoxazoles at the 5-Position

Department of Nanosystem Design

Guest Professor: Shigeki TAKEUCHI(2015.4.1 - 2016.3.31)

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. In this year, we worked on the development of a new method based on our latest research outcome in collaboration with Department of Nano-Intelligent Systems. 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. Following the last year, we worked on the development of an extended method to cover the detection of phase anomalies of entangled quantum states.

Achievements

We developed a method to decompose an observed state density matrix into its normal component and anomalous component in the former years. However, this method does not allow to detect the phase anomalies which are reflected to the complex elements but not to their absolute values, since it evaluates the change of the absolute values only. In this year, we extended this formula to take the complex elements into account. We will continue to collaborate with Department of Nano-Intelligent Systems to further introduce data mining and machine learning techniques to quantum information science.

Department of Nanosystem Design

Guest Researcher: Kazumasa OKAMOTO (2015.8.1-2016.3.31)

Outlines

Lithography using ultraviolet light and radiation sources has been widely used for nano and micro process. Developments of the integration process technology enable semiconductor processing less than 30 nm. Introduction of ionizing radiation such as extreme ultraviolet (EUV) light with a wavelength of 13.5 nm and electron beam (EB) as exposure sources to the lithography has been recently expected. In the EUV and EB lithography, reaction mechanism after the exposure onto resist materials is based upon radiation chemistry. Therefore, elucidation of the radiation-induced reaction in resist molecules has been a very important issue. Moreover, nanofabrication using self–assembly and inorganic resist materials has attracted attention for the semiconductor processing. Therefore, we investigated on the mechanism of EUV and EB-induced reaction mechanism of the resist material and inorganic nanostructure formation by quantum beam elucidation.

Achievements

In chemical amplified EUV resist, fluorinated compounds have been applied to enhance the energy deposition efficiency. However, the reaction mechanism has still be unclear. To clarify the effect on the acid generation mechanism by fluorination of EUV resist, we studied radiation chemical reaction of the fluorinated benzenes with 2-hydroxyhexafluoroisopropyl group (HFABs). It is suggested that an increase of number of 2-hydroxyhexafluoroisopropyl group decreases stability of the radical anion of HFABs and deprotonation efficiency of the radical cation of HFABs increases. The acid generation efficiency in films was also estimated. And we found that the efficiency in poly (4-hydroxystyrene) film with HFABs was decreased. Similarly, pulse radiolysis studies on polyoxstyrenes and Si-containing polymers have also conducted.

Furthermore, metal oxide crystals such as ZnO and CuO were submersed using γ-ray irradiations (^{60}Co) in ultrapure water. As a result, we found the growth of nano-micro size crystals. This new method is surfactant-free and non-thermal technique for metal oxide crystallites fabrication.

Department of Nanosystem Design

Guest Researcher: Satoshi TSUKUDA (2015.11.1-2016.3.31)

Outlines

Au nanoparticles (NPs) demonstrate widespread applicability in several fields, such as catalysis, electronics, chemical and biological sensing and imaging, because of their high chemical stability, oxidation resistance, and good biocompatibility. The size, shape, and composition of the Au NPs are important parameters in determining and enhancing their physical and chemical properties. Polymers, which patterned by top-down technologies such as electron beam lithography, have been used as template to fabricate metal NPs arrays. The combination of lithography and NPs fabrication technique is very useful in the manufacture of NP devices and sensors. In this study, hydrogel 2-D patterns based on poly(vinylpyrrolidone) (PVP) were fabricated by EB lithography. In addition, the direct formation of Au NPs on the PVP patterns by photoreduction in a solution was investigated.

Achievements

PVP was dissolved in 2-propanol at 1.0 wt %. *N*, *N*-methylenebis(acrylamide) was added to solution as the cross-linking agent at 15 wt % against dissolved PVP. PVP films were prepared on Si substrate by spin-coating. The films were exposed to 75 kV EB to fabricate the 2-D line pattern (ELIONIX INC. ELS-7700T). Furthermore, for fabricating Au NPs on PVP patterns, the samples were immersed in $HAuCl_4$-containing MeOH solutions. After immersing the samples for 10 min, the solutions were irradiated by UV light (Fig. 1). Au NPs were successfully formed on PVP patterns by the photoreduction of Au ions (Fig. 2). The Au NPs were preferentially and rapidly formed on PVP patterns because these patterns, which consisted of 3-D gel networks, serve as a reduction site and affected particle formation. In addition, the size and number of Au NPs could be easily controlled by reduction condition such as reduction time.

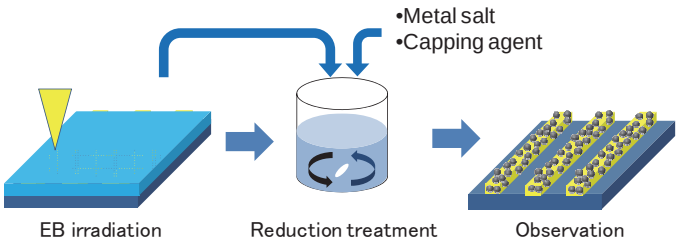


Fig.1 Formation process of Au NPs on PVP patterns.

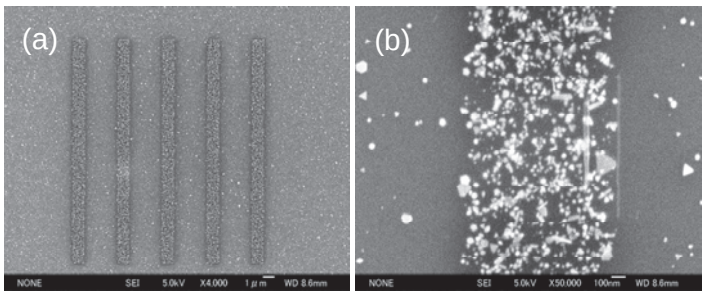


Fig.2 SEM images of Au NPs on PVP line patterns fabricated by EB irradiation (75 keV, 50 μC/cm^2). (b) is enlarged view of (a).

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 and develops micro-nano 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. We received 96 fabrication requests from 14 laboratories in 2015. Figure 1 shows the transit of requests since 2005. Though there are abrupt changes in the number of requests which accompanied the increase and decrease of the major client, we wish to aim at the number of 100 requests from 10 laboratories.

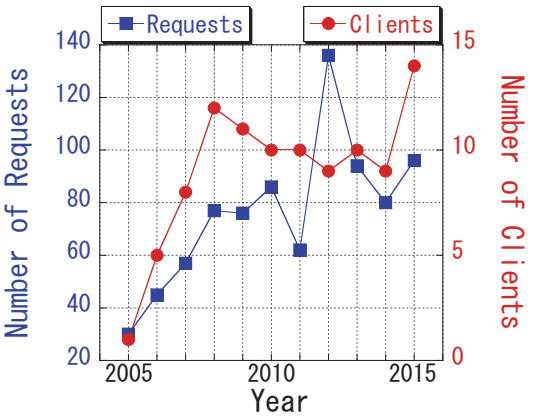


Fig.1 The transit of requests since 2005.

As a new request, we made penetration structure of metal plates and used them for vapor deposition masks. We performed trial-and-error approaches that searched photo resist which have the tolerance for penetration etching of the metal plate. And also we performed a device to protect rear side of the plate, it was able to obtain that 50μm through line structures on the nickel plate of thickness 20μm.

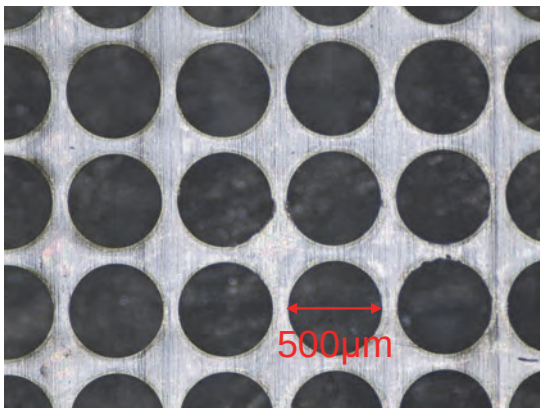


Fig.2 Through holes 500μm in diameter on the nickel plate of thickness 20μm.

Participation in “nanotech 2016”

We demonstrated a thin silicon film and a hologram, showed a panel introducing our activity in the booth of Nanotechnology Center in the international nanotechnology exhibition and conference “nanotech 2016” which was held on 27th to 29th of January in 2016.

Advanced Nanotechnology Instrument Laboratory

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

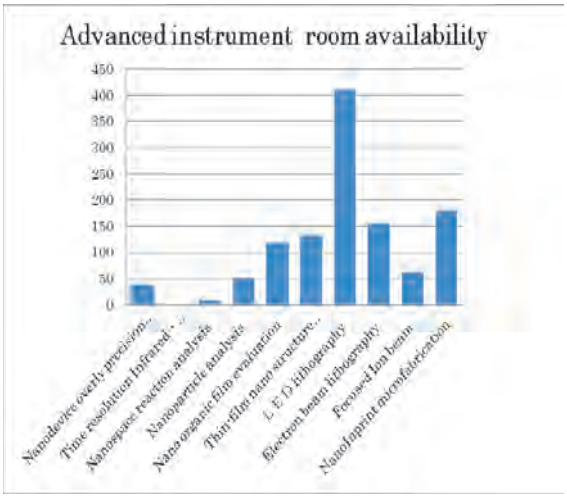
Outlines

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. The nano-device fabrication system and nano-device characterization systems on structure and electrical properties of nano device have been 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

The use situation of the each equipments in the Advanced Instrument Laboratory is shown in the right figure.

The number of total use is 1156, increased 162 comparisons with last year. Thin-film nano structure analyzer, LED lithography system and NanoInprint microfabrication system were much used.



Nanotechnology Open Facilities

Director, Professor:	Hidehiro YASUDA
Professor:	Yoichi YOSHIDA
	Hidekazu TANAKA
	Masateru TANIGUCHI
Specially Appointed Professor:	Hirotarou MORI
Assistant Professor:	Keita KOBAYASHI
Specially Appointed Assistant Professor:	Akira KITAJIMA
	Kimihiro NORIZAWA (2015.10.1-)
Specially Appointed Researcher:	Miki KASHIWAKURA
	Kouji HIGUCHI
	Takashi TANIGUCHI
	Kazumi KONDA
Technical Supporting Staff:	Yoshimi MAEGAWA (2015.4.1-)
Supporting Staff:	Kyoko SHIMOMITSU
	Keiko ENMI
	Chieko UETANI (-2016.2.15)
	Masanobu YAMAZAKI (2015.11.9-)

Outlines

Nanotechnology Open Facilities (NOF) was founded in mission of Nanotechnology Platform Program, supported by Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan. The purpose to start up is to establish platforms for supporting nanotechnology research and development, especially, for researchers outside of Osaka University. NOF started from July 2012, and our efforts resulted in supporting 173 research themes in 2015.

The mission of Nanotechnology Platform Program 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 has 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 173 research themes (except for technical consulting and non-publish the fruits) have been supported in the program in 2015. 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 equipments such as electron beam lithography, photolithography, focused ion beam / chemical vapor deposition, pulse laser deposition, etcher and so on, are in operations. 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: Nobuo KATO
Associate Professor: Takeyuki SUZUKI
Assistant Professor: Da-Yang ZHOU, Kaori ASANO
Assistant Professor (concurrent): Kazuhiro TAKENAKA, Shinji NITANI, Ryotaro, ASO, Tomoyo GOTO, Mitsuko NISHINO
Technical Staff: Takanori TANAKA, Tsuyoshi MATSUZAKI, Hitoshi HANEOKA, Yosuke MURAKAMI
Technical assistant Staff: Takeshi ISHIBASHI, Mitsuru FUJISAKI
Support Staff: Etsuko TANI

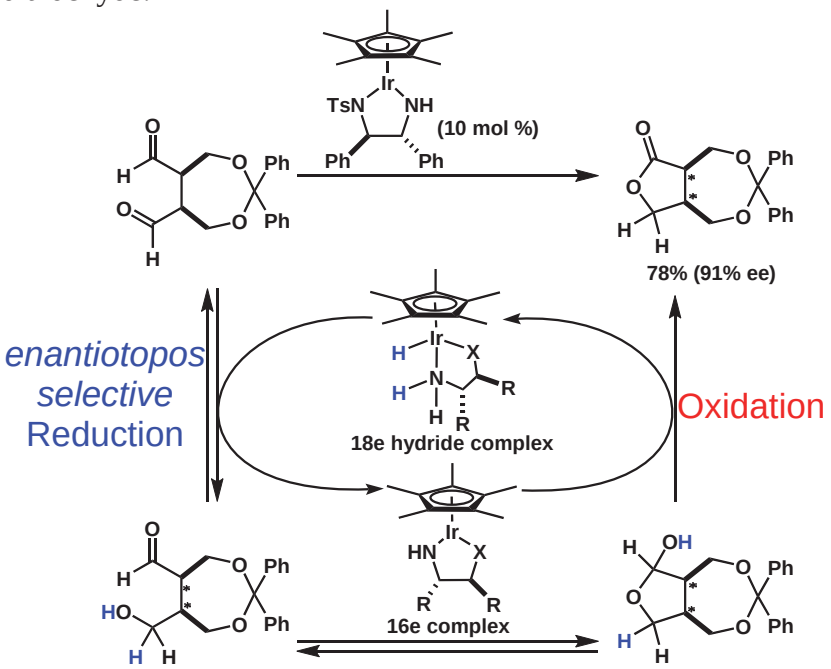
Outlines

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

Development of iridium-catalyzed asymmetric Tishchenko-type reacrion

Tishchenko reaction is known as the synthetic method of the dimeric ester from the corresponding aldehydes. This reaction is redox neutral reaction which includes oxidation step and reduction step, so the reaction system is environmentally friendly process. This time we have achieved the first asymmetric Tishchenko-type reaction using *meso*-dialdehyde.



Catalytic asymmetric Tishchenko-type reaction using chiral Ir complex

Research Laboratory for Quantum Beam Science

Professor, Director: Tetsuro MAJIMA
Associate Professor: Yoshihide HONDA
Assistant Professor: Sachiko TOJO
Technical Staff: Kazuya FURUKAWA
Supporting Staff: Akira TOKUCHI, Kumiko KUBO, Hiromasa KITA
(Concurrent members)
Professors Goro ISOYAMA, Yoichi YOSHIDA, Takahiro KOZAWA
Associate Professors: Mamoru FUJITSUKA, Kiyohiko KAWAI, Jinfeng YANG, Yusa MUROYA,
Assistant Professors: Kazuo KOBAYASHI, Keigo KAWASE, Takafumi KONDO, Akinori IRIZAWA, Hiroki YAMAMOTO, Koichi KAN, Yasuko OSAKADA
Specially Appointed Assistant Professors: Kim Sooyeon

Outline

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 three ^{60}Co γ-ray sources as the representative facilities for joint use. 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, RF-Gun S-band linac, ^{60}Co γ-ray sources)

The results of operation for L-band linac: total score 3,874 hours, 276 days, 37 themes.

L-band linac was operated for 230 days, 2,951 hours (Fig.1). A serious trouble arose in DC power source of the modulator due to breakdown. During the repair, the alternative power source could fortunately be borrowed from KEK, reducing the shutdown period to 3 days. The replacement of PLC modules used for controlling modulator was carried out. As one of the main AVRs was downed due to the damage of IGBT, the new IGBT was equipped, meanwhile the other AVR was used. The safety circuit for surge current in the modulator was broken, then repaired. As the contact of cathode socket was not enough, the new contact finger was equipped. A new high voltage source was tested as a high voltage source of electron

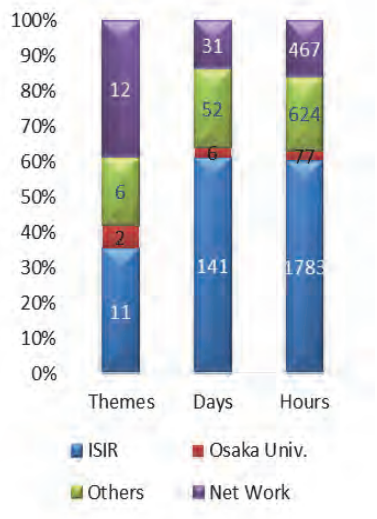


Fig.1 Operation of the L-band linac

gun instead of current induction system, and found to be suitable. The temperature regulation system could not be worked well due to the less performance of compressor, then it was replaced with new one. The new ionizing chamber detectors was additionally equipped in the current interlock system and their performance was confirmed, since the current system lasts about 40 years, so the electric parts would not be worked well in near future.

RF-gun S-band linac: The RF-gun S-band linac was moved to Cobalt building safely and was operated for 46 days and 923 hours except maintenance use.

Cobalt-60 facility: This facility was used in 94 times, 1,951 hours, for 23 subjects and the users were not only the member of ISIR but also the researchers of other faculties, as shown in Fig.2.

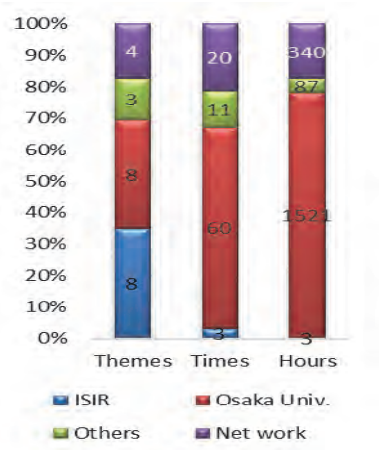


Fig.2 Operation of the cobalt-60 facility

Management (Joint use & Radiation safety management)

Accepted subjects relating from the joint-users are 48 in total (Fig.3). Specially programmed academic meetings were held twice (July. 29th, 2015/ Dec, 2nd, 2015) and the annual debrief session was held on March, 2nd in 2016.

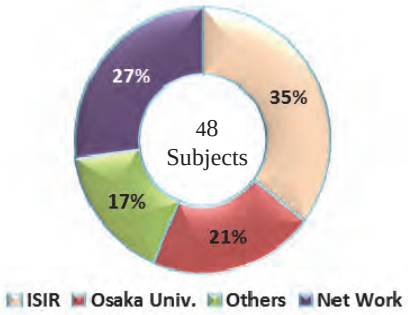


Fig.3 Accepted subjects.

Visitors were more than 184. Consultation on joint use was made for Graduate School of Medicine radiation cancer therapy group, 17 people. The training regarding radiation safety management was carried out for the registrants in May 7th 2015. Special self-inspection was carried out twice a year for the radiation facilities.

Pulse Radiolysis Resonance Raman Investigation

The time-resolved vibrational spectroscopic technique such as nanosecond time-resolved resonance Raman spectroscopy (TR^3) is useful to characterize the structural and electronic properties of short-lived intermediates during pulse radiolysis. The reaction of $OH^\bullet$ radical with aromatic molecules species in aqueous solutions was studied by TR^3 measurement during the pulse radiolysis. The $OH^\bullet$ addition to the aromatic ring was observed between 500 and 1700 cm^{-1}.

Application of positron annihilation spectroscopy

Characterization of defects and localized potential in montmorillonite, which is a representative 2:1 cray mineral, relevant with cation trapping, was tried for six samples, using positron annihilation spectroscopy (PAS). The PAS-related parameters such as the lifetimes of positron and the Doppler broadened energy spectrum of annihilation γ-rays showed that the dominant annihilation was a free-annihilation taken place in octahedral layer due to higher negative site. The ortho-positronium was thought to be formed in the vicinity of interlayer between tetrahedral layers, and was trapped and annihilated in the hexagonal defects.

Center for Collaborative Research Education and Training

Director:	Professor Yoichi YOSHIDA
Head of Educational Affaires Board:	Professor Kazunori KOMATANI
Board Members:	Professor Hidekazu TANAKA
	Associate Professor Jyunichi KANASAKI
	Associate Professor You WADA
Head of International Affaires Board:	Professor Katsuaki SUGANUMA
Board Members:	Professor Takeharu NAGAI
	Assistant Professor Ryuu TAKEDA
	Associate Professor Yutaka IE

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 counties 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 counties. Currently ten 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

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. TiO_2 photocatalysts
2. Visible-light responsible photocatalysts
3. Artificial photosynthesis by photocatalysts

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

CNU-AMR lab.

College of Natural Sciences (CNS), Chungnam National University (CNU), Korea, and the Institute of Scientific and Industrial Research (ISIR), Osaka University, Japan, based on the agreement on academic exchange between CNS and ISIR, established a collaborative laboratory on each side on advance materials research between both institutions.

1. Synthesis of advanced materials
2. Properties of advanced materials
3. Functionalization of advanced materials

KAERI-QBS lab.

The Advanced Radiation Technology Institute of the Korea Atomic Energy Research Institute and ISIR have established a cooperative research laboratory on quantum beam science between both institutions. Its studies focus on generation and applications of quantum beams for advanced studies.

1. Studies on radiation chemistry by means of pulse radiolysis.
2. Generation and application of quantum beams using accelerators.
3. Materials science using quantum beams.

CU-ICT lab.

Department of Computer Engineering, faculuty of Engineering Chulalongkorn University (CU), and ISIR have established a cooperative research laboratory on information and communication technology (ICT) between both institutions. Its studies focus on Artificial Intelligence.

1. Artificial Intelligence
2. Machine Learning
3. Data Mining

SMU-EMGRL lab.

College of Engineering (COE), Sun Moon University (SMU), and ISIR have established a cooperative grobal research laboratory on eco-materials science and technology (GRL) between both institutions. Its studies focus on the design, development and analysis of advanced environmental and energy eco-materials.

1. Photocatalysts for environmental protection and recovery systems.
2. Wide-wavelength photo-responsible nanomaterials.
3. Photon-management functionalization for advanced inorganic materials.

SU-ESR lab.

School of Environmental and Chemical Engineering (SEC), Shanghai University (SU), China, and ISIR have established a cooperative research laboratory on environmental science between both institutions. Its studies focus on environmental science research (ESR).

1. Environmental science of material transformation
2. Environmental compatible catalysts
3. Enviromental compatible materials

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 (G1) Next-generation electronics, (G2) Energy materials and devices, (G3) Medical materials, devices, and system, and (G4) 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 five member Institutes. The Committee members of FY2015 from ISIR were Prof. H. Tanaka (Vice Chair), Prof. K. Nakatani, Prof. T. Nagai, and Prof. T. Oguchi. Our members of this Alliance as of April 2015 were as follows:

(G1) Next-generation electronics research group (9 members)
Prof. K. Matsumoto (Group Leader), Prof. Y. Aso, Prof. Y. Ando, Prof. T. Oguchi, Prof. H. Tanaka, Prof. T. Washio, Prof. A. Oiwa, Prof. T. Sekitani, Assoc. Prof. M. Nogi

(G2) Energy materials and devices research group (7 members)
Prof. H. Kobayashi (Group Leader), Prof. K. Suganuma, Prof. S. Takeda, Prof. M. Numao, Assoc. Prof. Y. Honda, Assoc. Prof. T. Suzuki, Assoc. Prof. J. Kanasaki

(G3) Medical materials, devices, and system research group (9 members)
Prof. T. Nagai (Group Leader), Prof. N. Kato, Prof. M. Taniguchi, Prof. K. Nakatani, Prof. K. Komatani, Prof. K. Nishino, Prof. S. Kuroda, Prof. Y. Yagi, Specially Appointed Prof. A. Yamaguchi

(G4) Environmentally benign materials and devices research group (6 members)
Prof. Y. Yoshida (Group Leader), Prof. T. Majima, Prof. H. Sasai, Prof. G. Isoyama, Prof. T. Kozawa, Prof. T. Sekino

Next Generation Electronics Research Group

Professors: Kazuhiko MATSUMOTO (Group Leader),
Akira OIWA, Yoshio ASO, Hidekazu TANAKA, Yoichi ANDO,
Tsuyoshi SEKITANI, Tamio OGUCHI, Takashi WASHIO,
Masaya NOGI

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:

To realize the quantum state conversion from single photons to single electron spins using quantum dots, we pursue the efficient electric field control of electronic states in the quantum dots and the design of optical transition enabling the quantum state conversion. (Oiwa)

Using the graphene as a treating material, the quantum functional device, field effect transistor, FET type bio sensor, electrochemical biosensor are developed. Also, the fundamental growth processes are investigated. The virus detection, 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)

We have successfully developed ultra-thin and ultra-flexible organic amplifier, which can amplify bio-signals from the order of micro-volts to mill-volts. The key technology for realizing the amplifier is organic thin-film transistors manufactured on 1-micrometer thickness, that exhibits mobility exceeding 1 cm^2/Vs and On/off ratio exceeding 10^8 on 2 volt-operation. (Sekitani)

First-principles studies to clarify the electronic mechanism for various materials properties are performed. Magnetic crystalline anisotropy of transition-metal multilayers and reaction mechanisms in several cathode materials of sodium secondary batteries are investigated. (Oguchi)

A novel machine learning approach has been developed to sensitively detect and remove anomalous quantum states by monitoring the states in quantum information processing. (Washio)

Flexible resistive random access memory based on silver nanoparticle-decorated cellulose nanofiber paper was successfully developed by collaboration with Prof. Takeshi Yanagida. (Nogi)

Current Research Projects

Efficient electric field control of electronic states in self-assembled InAs quantum dots and design of (110)GaAs quantum wells

The sidegate electrodes laterally coupled to the InAs self-assembled quantum dots can asymmetrically modify the potential of the quantum dots and provide novel controllability of electronics states of the quantum dots. We successfully demonstrated the efficient sidegate tuning by reducing the screening of the electric field due to the metallic source-drain electrodes. We also studied the design and fabrication of GaAs quantum wells grown on (110) substrates for the quantum state conversion from single photons to single electron spins.

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 ~2nm, the FET showed 34times higher transconductance than measured from the backgate electrode. By modulating the surface of the graphene by the sugar chain, and fragment antibody, influenza virus and antigen/antibody reaction was successfully detected electrically for the first time.

Molecular Electronic Materials

We have developed a new tripodal π-channel anchor with electron-rich thiophene rings. The thermoelectric voltage measurements of bistripodal molecules indicate that the charge carriers are holes. On the other hand, the corresponding molecules with electron-deficient pyridine anchor units showed electron transport. These results reveal the versatility of π-channel tripodal anchors for the control of charge-carrier type in single-molecule electronics. We have also developed a series of long (~ 10 nm) oligothiophenes having homogeneously substituted encapsulating units. Single-molecule conductance measurements revealed characteristic properties in the hopping transport regime

Construction of Transition Metal Oxide Nano Structured Devices

We discovered micro-scale phase separation in VO_2 thin films on 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. In collaboration with IMRAM, Tohoku University, we successfully observed nano-scale metallic domains by transmission electron microscope, and constructed new directed self-assemble nanostructures on Si substrate.

Basic Research of Topological Insulators and Superconductors

We discovered a highly bulk-insulating topological insulator compound $Bi_{2-x}Sb_xTe_{3-x}Se_x$, 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 $Cu_xBi_2Se_3$ 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.

Sheet-type ultrathin organic amplifier

High-performance, ultrathin organic transistors have been developed with highly-purified organic semiconductors. The organic thin-film transistors were manufactured on 1-micrometer thickness, that exhibited mobility exceeding 1 cm^2/Vs and On/off ratio exceeding 10^8 on 2 volt-operation. Taking full advantages of the thin-film transistor technologies, we have successfully developed ultra-thin and ultra-flexible organic amplifier, which can amplify bio-signals from the order of micro-volts to mill-volts. We are now collaborating with medical doctors to realize new-generation medical instruments for opening up new medicine (Sekitani)

First-principles Studies on Materials Properties

We have investigated the spin-orbit driven magnetic crystalline anisotropy of transition-metal multilayers such as Fe-based and Co-based thin films, on the basis of first-principles calculations. We have also elucidated the phase stability and microscopic reaction mechanisms involved in several cathode materials of Na secondary batteries such as Na/S, Na/FeS_2, and Na/rhodizonic acids.

Quantum Anomaly Detection Methods for Quantum Information Processing

Quantum information processing has potential to enable revolutional computations and measurements overcoming the classical limitations. However, to achieve these epochs, highly controlled generation and preservation of the quantum states are needed by detecting and removing their anomalous states under given criteria. In this study, we develop machine learning approaches to this goal. Particularly, we established a generic anomaly detection method for any deviations of the quantum states from the normal state.

Flexible Nonvolatile Memory using cellulose nanofiber paper

We developed flexible resistive random access memory based on cellulose nanofiber paper. The paper memory achieved the stable nonvolatile memory effects with ON/OFF resistance ratio and the long data retention time. In addition, the memory performance of the paper ReRAM remained almost unchanged when being bent down to the radius of 0.35 mm, indicating the excellent flexibility. Thus the paper memory is expected as a highly flexible nonvolatile memory, and breaks new ground in creating next-generation information recording paper.

New Energy Material・Devices Research Group

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

Outlines

Precursor inks are developed that can be formed nanostructured thin films at low temperature by metal organic decomposition (MOD) method. Precursor ink with the MOD method will be applied to several electronic devices. (Suganuma).

Understanding the dynamical process of the excitation and de-excitation of the electron and lattice in condensed-matter is a key issue to develop not only the electronic device of the new generation but also the renewable power generation. We study the dynamics of the electronic excitation and de-excitation by using multiple spectroscopic methods including the high-resolution angle-resolved photoelectron spectroscopy combined with the synchrotron radiation, the high-resolution electron-energy-loss-spectroscopy, and the time-resolved two-photon photoelectron spectroscopy combined with the fs-pulsed laser. (Kanasaki)

In order to elucidate the catalytic mechanism of Au nanoparticles supported on CeO_2, 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)

Relating with cation trapping in cray minerals, the annihilation process of positron in cray mineral was investigated with positron annihilation spectroscopy. The technique can be applicable for battery electrode. (Honda)

A method to fabricate nanocrystalline Si/crystalline Si structure has been developed by using the surface structure chemical transfer method (SSCT), which offers remarkably low reflectivity (3%). By applying the low-reflectivity surface to crystalline Si solar cells, the conversion efficiency of 18% together with a high photocurrent density of 39.2 mA/cm^2 is achieved even without anti-reflection coating. (Kobayashi)

Current Research Projects

Formation of Nano-structural Metal and Oxide Thin Films Applying for Electrnic Devices by Metal Organic Decomposition Method

Metal Organic Decomposition (MOD) Method is one of the attractive attention method to form the metal and oxide fine thin films as low energy consumption for sintering/curing. Precursor (inks) which are melted the starting material of metal salt and complex agent as stabilizer with solvent are decomposed by using thermal heat or alternative heating method with printing technique for next generation electronics devices, and are formed the thin films. Oxide precursor inks are developing in this study and are fabricated nanostructural metal oxide thin films by printing method for several electronics devices such as gas sensors and organic photo voltaic (OPV) solar cells.

Probing of the electron-phonon scattering in carbon nanomaterials by using the angle-resolved photoelectron spectroscopy

The electron-phonon interaction in condensed matter is one of the most import phenomena which rules the properties of the solid device. However, the experimental method to evaluate its elemental process has been so far very limited. We study this, i.e., the electron-phonon scattering in carbon nanomaterials. By utilizing the high-resolution angle-resolved photoelectron spectroscopy combined with the synchrotron radiation, and the high-resolution electron-energy-loss-spectroscopy, we directly analyse the scattering amplitude of the valence electron by the phonon in graphene and graphite.

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 CeO_2 depends on the partial pressures of CO and O_2. Adsorption of CO molecules stabilizes the gold nanoparticles with faceted shape. On the other hand, Au nanoparticles become rounded in O_2. 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 succeeded in the catalytic asymmetric synthesis of catalponol in 99% ee, which is a natural product isolated from Kisasage.

Study of cray minerals with positron annihilation spectroscopy

Relating with cation trapping in cray mineral, the annihilation process of positron was investigated for 6 different montmorillonites. The results showed that the dominant annihilation of positron took place in octahedral layer due to electric negativity caused by the presence of substituted impurity cations. Ortho-positronium was thought to be formed in the interlayer between tetrahedral layers, and trapped and annihilated in the hexagonal defects.

Ultralow reflectivity surfaces by formation of nanocrystalline Si layer for crystalline Si solar cells

We have developed a simple method to form a nanocrystalline Si layer, which simply involves contact of Pt catalysts with Si wafers immersed in an H_2O_2 plus HF solution. The reflectivity becomes less than 3% after the formation of the nanocrystalline Si layer of ~150 nm thickness. With surface passivation using the deposition method, the p-type single crystalline Si-based solar cell with the nanocrystalline Si layer generates a high photocurrent density of 39.2 mA/cm^2, resulting in the conversion efficiency of 18.2%.

Medical Treatment Materials, Devices, and System Research Group

Professors: Takeharu NAGAI (Group Leader), Kazuhiko NAKATANI, Nobuo KATO, Shun'ichi KURODA, Masateru TANIGUCHI, Kazunori KOMATANI, Kunihiko NISHINO, Yasushi YAGI, Akihito YAMAGUCHI

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. (Kuroda)

An organic molecule that stabilizes a binary complex of 14-3-3 protein and a Gab2 model peptide has been synthesized from a natural diterpene glucoside. (Kato)

A method of drug susceptibility estimation by analyzing micro-channel microscopy image has been developed. (Yagi)

A novel network topology representing phrase information in acoustic signals on deep neural network (DNN) has been developed to improve the sound source localization function on humanoid robots. (Komatani)

We succeeded to determine the world-first crystal structure of the inhibitor-binding bacterial multidrug efflux transporters and revealed the structural basis of inhibitor specificity. On the basis of these structures, we are now developing the clinically-useful wide-spectrum inhibitors for multidrug efflux transporters. (Yamaguchi)

By using the –1 programmed ribosomal frameshifting, we have succeeded in modulating expression of two proteins coded in a different frame as a fusion protein with small molecule binder to RNA. (Nakatani)

Nanopore devices enable us to identify nano/micro-particles in solution without labeling. We demonstrated that the trajectory and translocation of particles near and within a nanopore can be precisely detected by employing low-aspect nanopore structure. (Taniguchi)

By random mutagenesis based on error-prone PCR and DNA shuffling on photoswitchable fluorescent protein followed by bacterial colony based screening, wwe found a positively-switchable fluorescent protein that enables biocompatible superresolution imaging. (Nagai)

Bacterial drug resistance is often associated with multidrug efflux pumps, which can decrease cellular drug accumulation. We newly found the physiological role of efflux pumps on *Escherichia coli* biofilm maintenance. (Nishino)

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 (Kuroda)

Bio-nanocapsule (BNC) is a virus-like empty nanoparticle made of phospholipids and envelope proteins derived from hepatitis B virus, and is now being developed as a novel gene and drug delivery carrier with high transfection efficiency. BNC can alter its targeting specificity when the pre-S1 region is replaced with an appropriate bio-recognition molecule. Next-generation BNC has also been developed 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. These BNCs possess a broad spectrum of Igs, significantly improving the prospects for BNCs as active targeting-based DDS nanocarriers.

Stabilization of the 14-3-3/Gab2 Protein–Protein Interaction (PPI) Interface by a Semi-synthetic Diterpene Derivative (Kato)

Small-molecule modulation of protein–protein interactions (PPIs) is one of the most promising new areas in drug discovery. We have found that a semi-synthetic natural product derivative, ISIR-005, stabilizes the cancer-relevant interaction of the adaptor protein 14-3-3 and Gab2. The crystal structure of ISIR-005 in complex with 14-3-3 and the binding motif of Gab2 comprising two phosphorylation sites (Gab2pS210pT391) showed how the stabilizing molecule binds to the rim-of-the-interface of the protein complex.

Drug susceptibility estimation by analyzing micro-channel microscopy image (Yagi)

Drug Susceptibility Testing Microfluidic (DSTM) is a promising device for highly reliable drug susceptibility test. In order to make it more accurate and objective, we developed an automatic testing system with it. We proposed drug susceptibility estimation by support vector machine (SVM) and by analysing temporal image sequences. We conducted experiments to estimate from a single image as well as temporal image sequence, and confirmed that the proposed automatic method yielded the same accuracy as the standard manual method (the accuracy is from 80 to 90 %).

Sound source localization on humanoid robots (Komatani)

We have developed a method to localize sound sources by deep neural network (DNN) via multiple microphones equipped on humanoid robots. Our experiment revealed that network topology representing phrase information of acoustic signals is effective for improving sound source localization accuracy. We also designed and developed an apparatus to semi-automatically measure acoustic transfer functions of robot microphones, which enables us to measure them precisely with much less labor.

Determination of the world-first inhibitor-binding structures of bacterial multidrug efflux transporters and the development of wide-spectrum inhibitors. (Yamaguchi)

We determined the world-first crystal structures of inhibitor-binding bacterial

multidrug efflux transporters and revealed the structural basis of the inhibitor specificity. On the basis of these structures, we are developing the clinically-useful wide-spectrum inhibitors for bacterial multidrug efflux transporters by virtual screening of the compound library and the structure-based drug design (SBDD).

Development of Ligand-Induced –1 Programmed Ribosomal Frameshifting System (Nakatani)

We have succeeded in developing ligand-induced expression of fusion protein of two different proteins that were coded in a different frame. The –1 programmed ribosomal frameshifting (PRF) is known to express two proteins induced by the presence of RNA secondary structure that stall the ribosome. We have found small molecules that bound to RNA and induced a ligand-stabilized structure on it. The ligand-bound structure is stable enough to stall ribosome to induce –1 PRF. This study is the first describing ligand-induced –1PRF and could be used to modulate gene expression by small ligand.

Nano/Micro-Particle Detection by Nanopore Devices (Taniguchi)

Application of nanopore devices is a promising way to develop rapid and easy testing methodology for medical diagnosis and environment monitoring, because these devices enable us to identify nano/micro-particles in solution at a single-particle resolution without labeling. Based on the systematic evaluation for the design of device structures and the size of target particles, we demonstrated that the trajectory and translocation of particles near and within a nanopore can be precisely detected by employing low-aspect nanopore structure.

Low light superresolution imaging by novel photoswitchable fluorescent protein (Nagai)

Superresolution imaging enables us to break the diffraction limit of light (2014, Nobel prize for chemistry). For superresolution imaging, reversibly photoswitchable fluorescent proteins (RSFPs) have been widely used. Here, we developed novel positive-RSFP which shows 4- and 3- folds faster switching on and off speed, respectively. We named this new positive-RSFP as “Kohinoor”. By using Kohinoor, we achieved RESOLFT (Reversible Saturable Fluorescnece Transition) nanoscopy with 0.004J/cm that is 1/10,000 ~ 1/375 times lower than the previous RESOLFT methods.

Multidrug efflux pumps contribute to *Escherichia coli* biofilm maintenance (Nishino)

Bacterial drug resistance is often associated with multidrugefflux pumps, which can decrease cellular drug accumulation. In addition to efflux pumps, biofilms are also importantfor antibiotic resistance. Antibiotics are not efficient in penetratingthe biofilm, causing difficulties in treatment. Both factors are essential for bacteria to survive in severe conditions. Recently, a question has arisen regarding whether there is acorrelation between the two factors. We newly found that the constantly expressed AcrB and subsequently expressed MdtABC contribute to the maintenance of biofilm. If biofilm was decreased by inhibiting efflux pumps, inhibitors could produce a substantial contribution in addition to inhibition of antibiotic efflux.

Environmental Harmonized Materials and Devices Research Group

Professors: Yoichi YOSHIDA (Group Leader),
Tetsuro MAJIMA, Goro ISOYAMA, Hiroaki SASAI、
Takahiro KOZAWA, Tohru SEKINO

Study of the charge transfer processes and functions of the new optical functional materials using quantum beam (YOSHIDA)

Naphthalene bis-imide derivatives are attracting attention as an optical functional material, and it is necessary to clarify the relationship between charge transfer states, accumulated radical anion and a structural change, mechanical effects. For the purpose, transient absorption has to be measured a wide time region from femtosecond to seconds. In the nanosecond pulse radiolysis system, measurement region has been extended up to 20 μs. With the photo cathode RF gun LINAC, it was succeeded in generating and observing the 10 fs electron pulse. Femtosecond pulse radiolysis system can be expanded to further early time domain. Secondary electrons generated by the ionizing radiation formed a solvated electron in a polar solvent such as THF or DMF. And then, the solvated electron was converted to the NDI radical anions. Thereafter, formation of the long lived NDI dimer radical anion has been suggested.

Collaboration research projects: We collaborated with Dr. Goto (Kyushu Univ.) who provided the naphthalene bis-imide derivatives sample. This material shows color change and deformation by irradiation of the ultraviolet. Not only NDI radical anion by the electron transfer but also NDI radical cation should be generated by the direct ionization in the case of thin film. We tried the generation and observation of NDI radical anion and NDI radical cation using the typical method of radiation chemistry. It was suggested that NDI radical anion and NDI dimer radical anion are generated in the anion generating solvent. However, in the cation generating solvent, observation of NDI radical cation in the nanosecond range might be negative.

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, TiO_2 photocatalyst, charge transfer in plasmonic Au nanoparticles for photocatalytic hydrogen evolution, energy and charge transfer in supramolecules, and synthesis of fluorescene probe molecules for the high-sensitive detection of singlet oxygen.

Collaboration research projects: We have carried out the collaboration with the research group of Prof. Shinmyozu in Kyushu University. They synthesized cyclophane compounds, while we have studied the intramolecular charge delocalization in them using γ-radiolysis in the rigid matrix at 77 K, pulse radiolysis at room temperature, and fs-laser flash photolysis. This year, we found the photoinduced multi-step electron

transfer process through the cyclophane linker in [2.2]- or [3.3]paracyclophane substituted by two aromatic groups.

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 time domain structure of micropulses by electro-optic (EO) cross-correlation method using Ti:Sapphire laser. The evolutions of THz FEL in the amplification process is clearly observed in detail. As user experiments we examined the nonlinear responses of solids using THz FEL in aspects of a laser and an intense THz wave. As a result, a novel nonlinear response by the low energy photoexcitation is detected for a single crystal semiconductor Si under focal conditions.

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 Direct Arylation of Isoxazoles at the 5-Position (SASAI)

Direct transformation of ubiquitous C–H bonds promoted by a transition metal catalyst has emerged as a straightforward and atom-economical functionalization method. This time, we have succeeded in the development of an unprecedented Pd-catalyzed direct arylation of the isoxazole ring at the 5-position because such heterocyclic compounds are found in a variety of bioactive compounds and used as a synthetic intermediate in organic chemistry.

Collaboration research projects: We have collaborated with the research group of Prof. Nagashima at Institute for Materials Chemistry and Engineering in Kyushu University about the environmentally benign rare-metal-free catalytic process.

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 effects of photodecomposable quenchers was investigated, using a Monte Carlo simulation code developed on the basis of their reaction mechanisms clarified the pulse radiolysis method. A material design strategy was obtained by analyzing the details of effects.

Collaboration research projects: The collaboration partner is being wanted due to the retirement of the previous partner.

Structure and Function Tuning of Low-dimensional Oxide Nanotubes for Advanced Environmental and Energy Application (SEKINO)

Based on the facile solution chemical processing, titania nanotube (TNT) has been synthesized, and its nanostructure and properties have been tuned using various methodologies. Novel CNT-TNT core-shell nanocomposites could be successfully synthesized, and it exhibited excellent environmental cleaning performance for

elimination molecules from water. In addition, visible-light responsible TNT photocatalyst was synthesized using lattice-structure tuning protocol.

Collaboration research projects: Collaboration researches on the fabrication of various oxide nanomaterials and performance analysis of titania nanotubes have been carried out with Prof. Kakihana, Assoc. Prof. Yin (Sato Lab.), and Assoc. Prof. Shinoda (Suzuki Lab.). Also development of TNT-polymer nanohybrid has started with Assist. Prof. Tsukuda (former Tanaka Lab.), and unique formation route has been firstly confirmed.

Activities of Facilities

Workshop

Director Professor: Hiroaki SASAI
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, and a 5-axis machine was introduced in 2013, and a 5 axis milling machine was introduced in 2014 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

By the increase employee, we were able to do our best 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: 172 jobs (191 jobs in the previous year).
Glassworks: 82 jobs (117 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 ^{3}H, ^{14}C, ^{32}P, ^{33}P or ^{35}S. The main equipments are liquid scintillation counters and a bio-imaging 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.

This laboratory was closed at the end of this year.

Electronic Processing Laboratory

Professor:	Kazunori KOMATANI
Professor:	Kazuhiko MATSUMOTO
Professor:	Akira OIWA
Associate Professor:	Shigehiko HASEGAWA
Associate Professor:	Koichi SUDOH
Assistant Professor:	Haruki KIYAMA
Assistant Professor:	Ryu TAKEDA

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. This laboratory also has an anechoic chamber that can be used for acoustic measurement, psychological experiments, etc.

The equipment and systems are 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 crystal cleaving system, a wire bonding system, and a small-size clean room. The anechoic chamber measures 4.0x7.2 meters (4.0 meters in height) and the sound pressure level in it is designed to be blow 30dB.

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. In the year of 2015, the equipment and systems were used from 5 laboratories.

Library

Professor: Masayuki NUMAO
Librarian: Shizuka OGASAWARA
Supporting Staff: Katsuko TAKADA

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, 2016)

	Number of books	Journals	Newspapers
Japanese	5,079	161 titles	5 titles
Foreign	19,452	498 titles	1 title

Facilities Management Office

Professor: Takahiro KOZAWA
Staff: Kayoko OHASHI

Outlines

Facilities Management Office works for the following matters:

1. Operation and maintenance of rooms belonging to Open Laboratory
2. Process of application procedure for Open laboratory.
3. Control of standard spaces of ISIR laboratories
4. Support of facility operation which ISIR Facilities Committee plans
5. Other facility issues

Current Research Projects

On 2015, the following 14 researchers used Nanotech Open Laboratory.

Prof. Yusuke MORI	Graduate School of Engineering
Prof. Keisuke MORISHIMA	Graduate School of Engineering
Prof. Kohji MINOSHIMA	Graduate School of Engineering
Prof. Kazuyuki YOSHIZAKI	Graduate School of Engineering
Prof. Yasufumi FUJIWARA	Graduate School of Engineering
Assoc. Prof. Yukio TAKAHASHI	Graduate School of Engineering
Prof. Takeshi FUKUDA	Graduate School of Engineering
Assoc. Prof. Katsuhisa KITANO	Graduate School of Engineering
Prof. Kazuyoshi ITOH	Office for University-Industry Collaboration
Prof. Hikaru KOBAYASHI	Institute of Scientific and Industrial Research
Prof. Kazuhiko MATSUMOTO	Institute of Scientific and Industrial Research
Prof. Akihito YAMAGUCHI	Institute of Scientific and Industrial Research
Prof. Hidekazu TANAKA	Nanotechnology Open Facilities
Prof. Masateru TANIGUCHI	Nanotechnology Open Facilities

Office of Information Network

Professor, Director:	Yoichi YOSHIDA
Professor:	Takashi WASHIO
Professor:	Katsumi TANIMURA
Professor:	Hiroaki SASAI
Professor:	Tamio OGUCHI
Associate Professor:	Koji KOZAKI
Associate Professor:	Shohei SHIMIZU
Technical Staffs:	Senjin AIHARA

Outline

Office of Information Network was inaugurated in March, 1999, to organize the operation of the information network in ISIR, which had been started with support by volunteers, because of the rapid spread of the information network and the growth of its importance in the research environment. The information network was constructed as a prototype by the departments in the division of Intelligent System Science in the late 1980's and has been expanded to the whole of ISIR with the development of ODINS (Osaka University Information Network System). Recently it has played an important role in ISIR to release/access the information available in the Internet. Office of Information Network is now supporting researchers and students in the variety areas.

Activities

Office of Information Network have supported conference organizers by creating the web page, providing the on-line registration system, and on-line abstract submitting system. Total number of conferences was 3.

And we have offered poster printing services for ISIR researchers. Total number of poster printing was 495.

And we issued ISIR CARD (access control card).

And we managed business servers (ex. Web, Mail, DNS, ..).

And we introduced LabVIEW (Graphical programing software) and provided a campus license for Osaka University researchers and students.

Network Planning and Design
ODINS Wireless LAN

Academia Industry Relations Office

Director, Professor:	Takeharu NAGAI
Professors:	Kazuhiko MATSUMOTO, Hikaru KOBAYASHI Tamio OGUCHI
Specially Appointed Professors:	Hirokazu SHIMIZU, Mototsugu OGURA

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 industry-university cooperation events. 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

Promotion of Industry-University Cooperation

1) SANKEN Techno-Salon

Ordinal	Date	Number of Participants
1st	May 15, 2015	91
2nd	July 31, 2015	75
3rd	Nov. 6, 2015	44
4th	Feb. 5, 2016	81

2) Introduction of new technologies through the web site

3) Publication of a booklet "Research 2015"for introduction of ISIR's research activities to industry sectors

4) Publicity of ISIR's technologies at exhibitions etc.: 2 exhibitions and l lecture-meeting

Use of Company Research Park

Number of Use: 21 companies (33 rooms) [new use: 5 companies]

Coordination of Joint Research etc.

3 joint researches were established.

Support for External Funding Applications

Support for New Industry Creation Study Groups

3 study groups

Public Relations Office

Director, Professor:	Yoichi YOSHIDA
Professors:	Goro ISOYAMA (-2015.9.30), Tetsuro MAJIMA (-2015. 9.30), Akira OIWA, Yoshio ASO, Thorh SEKINO(2015.10.1-), Shun'ichi KURODA (2015.10.1-)
Associate Professors:	Kenichi FUKUI (-2015.9.30), Jinfeng YANG (-2015.9.30), Shijo NAGAO(-2015.9.30), Masakazu TANE,Toshihide OKAJIMA Teruo KANKI(2015,10.1-)
Assistant Professors:	Yusuke HIGUCHI (-2015.9.30), Mahito SUGIYAMA,Kazumichi YOKOTA, Fumio OKURA(2015.10.1-), George HASEGAWA (2015.10.1-), Seiji YAMASAKI(2015.10.1-)
Staff:	Noriko MATSUMOTO,
Technical Staff:	Yuka OKUMURA

Outlines

The Public Relations Office was opened in 2006 to provide various information on SANKEN for the public widely, and was strengthened in 2012 by the merge with the Public Relation Committee.

The major activities are:

1) Building of the strategy on the public information
2) Information gathering
3) Support of the issue of the annual report and other reports
4) Web authoring and maintenance
5) Support of the press release
6) Receiving of field tour
7) Others

Especially, the monthly press meeting had been started in 2013 in the collaboration with other offices of SANKEN.

Current Research Projects

The number of visitors in ICHO Festival:	473
The number of visits and visitors:	20 visits and 640 visitors
Press release:	19
Regular Press conference:	22
The number of coverages:	254

Planning Office

Director, Specially Appointed Professor :	Yoshihiko HIROTSU
Vice Director :	Yoshikazu TANAKA
Staff :	Aya NISHIDA

Outlines

The Planning Office of ISIR was set up in 2009. The mission of this office is to support the following operations of our institute aiming at their high level achievement with efficiency.

1.Planning and information gathering on the middle-term objectives and management, annual projects, and self- and external-evaluations which are implemented under the evaluation committee of ISIR.

2. Planning and information gathering on international programs, publicity, financial affairs and research facilities under cooperation with the corresponding vice-directors.

3. Planning and information gathering on other subjects as necessary.

Technical Division

Director:	Takanori TANAKA
Group Leaders:	Masayoshi OHNISHI, Noriyuki OGAWA
Chiefs:	Senjin AIHARA, Shouichi SAKAKIHARA, Tsuyoshi MATSUZAKI, Yuka OKUMURA
Staff:	Yuki MATSUSHITA, Kazuya FURUKAWA, Hitoshi HANEOKA, Yosuke MURAKAMI, Kumiko BABA, Kimiaki TANIHATA, Hiroaki MATSUKAWA

Outlines

The Technical Division is research supporting group, which is the first organization in all research institutes attached to universities in Japan (April, 1982). We provide following professional matters for researchers:

- Making experimental apparatuses and samples by machines.
- Analysis of samples.
- Operation, maintenance and development of experimental facilities.
- Network and Server management.
- To create and update websites.
- Public relations activities.

In addition, we go to technical training and give guidance about expert technical instruction for researchers and students. Furthermore we are in charge of the following matters:

- Activities of safety and security (e.g. holding safety seminars, radiation protection management, self-defense firefighting, PCB management, and management of medicine and gas control systems)
- Outreach activities (e.g. craft lecture for children)
- Support some symposiums (e.g. video and live-streaming etc.)

Activities

- Holding safety and security seminar (50 participants).
- Holding craft lecture for children (120 participants).
- Holding joint technical report meeting with Institute for Protein Research (40 participants).
- Participating in 39 trainings and conferences.

Licenses

Staffs have 71 licenses.

Administrative Office （31-March , 2016）

Director : Yoshikazu TANAKA

General Affairs Division

Staffs: Tadashi NAKAGAWA
Yutaka KUROKUI
Takashi FUJIMORI
Tomoko SAWADA
Takahiro FUKUI
Kazumi HAYASHI

Supporting Staffs: Mie SHIMOE
Ayano KOMAI
Noriko SASAKAWA

Research Cooperation Division

Staffs: Otoji TANI
Takashi MATSUDO
Takeshi SHIODA
Mai SHIMURA
Kaoru NAKAMURA
Shingo TABATA
Naoko MASAKI
Yasuko MUTSUI
Hideaki KIMURA
Misato KUBO
Mayu ESAKA
Momoko SAKAI
Masako MORITA
Etsuko UNO

Supporting Staffs: Syouko YAMOTO
Yumi WADA
Kazune OTANI
Kuniko NISHIMOTO
Yasuhiro UCHIDA
Naoko MEKARU

List of Achievements

Department of Photonic and Electronic Materials

Original Papers

[1]Superconducting transport in single and parallel double InAs quantum dot Josephson junctions with Nb-based superconducting electrodes, S. Baba, J. Sailer, R. S. Deacon, A. Oiwa, K. Shibata, K. Hirakawa, and S. Tarucha: Appl. Phys. Lett., 107 (2015) 222602 1-4.

[2]Cooper pair splitting in parallel quantum dot Josephson junctions, R. S. Deacon, A. Oiwa, J. Sailer, S. Baba, Y. Kanai, K. Shibata, K. Hirakawa, and S. Tarucha : Nature communications, 6 (2015) 7446 1-6.

[3]Spin-dependent current through a quantum dot from spin-polarized nonequilibrium quantum Hall edge channels, H. Kiyama, T. Nakajima, S. Teraoka, A. Oiwa, and S. Tarucha : Phys. Rev. B, 91 (2015) 155302 1-8.

[4]Growth evolution of γ'-Fe4N films on GaN(0001) and their interfacial structure, M. Kimura and S. Hasegawa: Japanese Journal of Applied Physics, 55 (2016) 05FD02-1 − 05FD02-4.

[5]Structural and magnetic characterization of Sm-doped GaN grown by plasma-assisted molecular beam epitaxy, K. Dehara, Y. Miyazaki, and S. Hasegawa: Japanese Journal of Applied Physics, 55 (2016) 05FE03-1 − 05FE03-4.

[6]4π-periodic Josephson supercurrent in HgTe-based topological Josephson junctions, J. Wiedenmann, E. Bocquillon, R. S. Deacon, S. Hartinger, O. Herrmann, T. M. Klapwijk, L. Maier, C. Ames, C. Brüne, C. Gould, A. Oiwa, K. Ishibashi, S. Tarucha, H. Buhmann, and L. W. Molenkamp: Nature communications, 7 (2016) 10303 1-7.

[7]Fluorescence Extended X-Ray Absorption Fine Structure Study on Local Structures of Rare-Earth-Doped InGaGdN, S. N. M. Tawil, S. Emura, D. Krishnamurthy, and H. Asahi : Advanced Materials Research, 1133 (2016) 429 – 433.

[8]Electron states of uniaxially strained graphene, H. Shioya, S. Russo, M. Yamamoto, M. F. Craciun, and S. Tarucha : Nano Letters, 15 (2015) 7943-7948.

[9]Raising the metal-insulator transition temperature of VO2 thin films by surface adsorption of organic polar molecules, H. Shioya, Y. Shoji, N. Seiki, M. Nakano, T. Fukushima, and Y. Iwasa : APEX, 8 (2015) 121101.

International Conferences

[1]Conversion from single photons to single electron spins in quantum dots (invited), A. Oiwa: E-IMR/ICC-IMR/TFC/ERATO SQR International Workshop 2015, Spin Energy Materials,.

[2]Transport though InAs self-assembled quantum dots controlled by sidegate voltages (oral), A. Oiwa: International Symposium on Advanced Nanodevices and Nanotechnologes.

[3]Photon-electron spin coupling via angular momentum conversion in a gate-defined GaAs double quantum dot (invited), A. Oiwa: International Symposium on Nanoscale Transport and Nanotechnology (ISNTT2015).

[4]Effect of electrode-geometries on the transport properties of InAs self-assembled quantum dots (poster), H. Kiyama: International Symposium on Nanoscale Transport and Nanotechnology (ISNTT2015).

[5]Photon-electron spin coupling using gate-defined GaAs double quantum dots (invited), A. Oiwa: SpinTech VIII.

[6]Single shot readout of electron spins in a quantum dot using spin filtering by quantum Hall edge states (poster), H. Kiyama: SpinTech VIII.

[7]Single-shot readout of electron spins in a quantum dot using spin filtering by quantum Hall edge states (poster), H. Kiyama, A. Oiwa, and S. Tarucha: Symposium on New Perspectives in Spintronics and Mesoscopic Physics (NPSMP2015).

[8]Conversion from single photons to single electron spins using GaAs-based double quantum dots (invited), A. Oiwa, T. Fujita and S. Tarucha: Symposium on New Perspectives in Spintronics and Mesoscopic Physics (NPSMP2015).

[9]Transport properties of InAs self-assembled quantum dots with different electrode geometries (poster), R. Shikishima, H. Kiyama, S. Baba, T. Hirayama, N. Nagai, K. Hirakawa, S. Tarucha, and A. Oiwa: 21st International Conference on Electronic Properties of Two-Dimensional Systems (EP2DS-21).

[10]Selective Injection of Single Electron Spins into a Quantum Dot using Spin-polarized Non-equilibrium Quantum Hall Edge Channels (poster), H. Kiyama, T. Nakajima, S. Teraoka, A. Oiwa, and S. Tarucha: 21st International Conference on Electronic Properties of Two-Dimensional Systems (EP2DS-21).

[11]Photoelectron s pin d etection using a quantum point (poster), Panin Pienroj, Haruki Kiyama, and Akira Oiwa: 19th SANKEN International Symposium.

[12]One-Dimensional Quantum Wires with Strong Spin-Orbit Interaction Using InSb Quantum Wells (poster), Masaki Tada, Haruki Kiyama, Kouich Akahane, Akira Oiwa: 19th SANKEN International Symposium.

[13]Effect of electrode-geometries on the transport properties of InAs self-assembled quantum dots (poster), H. Kiyama, R. Shikishima, S. Baba, T. Hirayama, N. Nagai, K. Hirakawa, S. Tarucha and A. Oiwa: 19th SANKEN International Symposium.

[14]Effect of dimensionality reduction on magnetic properties in dilute magnetic semiconductor GaGdN (invited), S. Hasegawa: The 5th International Workshop on Epitaxial Growth and Fundamental Properties of Semiconductor Nanostructures (SemiconNano2015).

[15]Characterization of polymorphism in boron nitride films prepared by Reactive Plasma-Assisted Coating (poster), S. Hasegawa, M. Noma, M. Yamashita, K. Eriguchi: The 19th SANKEN International Symposium, The 14th SANKEN Nanotechnology International Symposium, The 3rd KANSAI Nanoscience & Nanotechnology International, Symposium, The 11th HANDAI Nanoscience & Nanotechnology International Symposium.

[16]Studies of strained graphene with thin film shrinkage methods (invited), H. Shioya, M. F. Craciun, M. Yamamoto, S.Russo, S.Tarucha: the 2015 Energy Materials Nanotechnology (EMN) Istanbul Meeting.

[17]Photon-electron spin coupling using gate-defined GaAs double quantum dots (invited), A. Oiwa, T. Fujita and S. Tarucha: SpinTech VIII.

[18]Photon-electron spin coupling via angular momentum conversion in a gate-defined GaAs double quantum dot (invited), A. Oiwa, T. Fujita, and S. Taruch: International Symposium on Nanoscale Transport and Nanotechnology (ISNTT2015).

[19]Effect of electrode-geometries on the transport properties of InAs self-assembled quantum dots (poster), H. Kiyama, R. Shikishima, S. Baba, T. Hirayama, N. Nagai, K. Hirakawa, S. Tarucha, and A. Oiwa: International Symposium on Nanoscale Transport and Nanotechnology (ISNTT2015).

[20]Single shot readout of electron spins in a quantum dot using spin filtering by quantum Hall edge states (poster), H. Kiyama, A. Oiwa, and S. Tarucha: SpinTech VIII.

[21]Growth Evolution of γ'-Fe4N Films Grown on GaN(0001) and Their Interfacial Structure (poster), M. Kimura and S. Hasegawa: The 6th International Symposium on Growth of III-Nitrides (ISGN-6).

[22]Structural and Magnetic Characterization of Sm-doped GaN Grown by Plasma-Assisted Molecular Beam Epitaxy (poster), K. Dehara, Y. Miyazaki, and S. Hasegawa: The 6th International Symposium on Growth of III-Nitrides (ISGN-6).

Review Papers

Optoelectronic spin transfer from single photons to single electron spin, Takafumi Fujita, Akira Oiwa, andSeigo Tarucha, Solid State Physics, Agne Gijustu Center, 50 (2015), 685-696.

Books

[1]Transition metal and rare earth doping of semiconductors material for room temperature spintronics applications(Volkmar Dierolf, Ian Ferguson, John M. Zavada) H. Asahi, Y.K. Zhou, S. Emura and S. Hasegawa, "Rare Earth and Transition Metal Doping of Semiconductor Materials: Synthesis, Magnetic Properties and Room Temperature Spintronics", Woodhead Publishing, (371-394) 2016.

Contributions to International Conferences and Journals

A. Oiwa	9th International Conference on Physics and Applications of Spin-Related Phenomena in Solids (Chair of organizing committee)
A. Oiwa	2015 International Conference on Solid State Devices and Materials (Program Committee)
A. Oiwa	21th Internatoonal Conference on Electronic Properties of Two-Dimensional Systems (Program Committee)
S. Hasegawa	The 18th International Conference on Crystal Growth and Epitaxy (ICCGE-18) (Session Chairs, Program Committee)

Publications in Domestic Meetings

JPS 2015 Autum Meeting	1 paper
Summer Schoool on Smeiconductor Quantum Effect abd Quantum Information	2 papers
2015 Annual Report Meeting of Nano Spin Conversion Science	2 papers
2015Annual Report Meeting of SANKEN Quantum Beam Facility	1 paper
The 78th SANKEN Technosalon	1 paper
JSAP Workshop of Applied Electric Properties, "Basic properties and applications of narrow gap materials"	1 paper
The 20th Physics and Applications of Spin-Related Phenomena in Semicodnuctors (PASPS20)	1 paper
The 76th JSAP Autumn Meeting, 2015	5 papers
The 63rd JSAP Spring Meeting, 2016	5 papers

Academic Degrees

Master Degree for Engineering T. Hirayama	Single electron charge sensing in InAs self-assembled quantum dots
Master Degree for Science K. Dehara	Growth and Characterization of Dilute Magnetic Semiconductor GaSmN
Bachelor Degree for Engineering Y. Kurokawa	Formation of isolated GaN nanorods by plasma-assisted molecular beam epitaxy
Bachelor Degree for Engineering M. Tada	Fabrication and evaluation of side-gate type quantum point contact
Bachelor Degree	Fabrication and Characterization of Photoelectron Spincurrent Detectors based

for Engineering	on Quantum Point Contact	
P. Pienroj		
Grant-in-Aid for Scientific Research		
A.Oiwa	Optical spin conversion	¥13,650,000
A.Oiwa	Quantum state conversion from photons to spins using quantum dots and generation of entanglements	¥7,800,000
A.Oiwa	Realization of high-quality one-dimensional wire and exploring of Majorana particle using InSb quantum wells	¥1,040,000
H.Kiyama	Spin detection and control of spin relaxation process in InAs quantum dot	¥780,000
S. Hasegawa	Study of optimization methodologies for boron nitride films by controlling an ion-energy distribution function during plasma processing	¥1,300,000
S. Hasegawa	Complementary accumulation of spin and charge in hydride bipolar conductors	¥390,000
A. Oiwa	Novel solid state phyics via spatial controls of quantum pairs	¥3,432,000
A. Oiwa	Steering committee of Nano Spin Conversion Science	¥1,040,000

Entrusted Research			
A.Oiwa	Japan Science and Technology Agency	Creation of a Poincaré interface through the convergence of electronics and photonics	¥1,950,000
A.Oiwa	Japan Science and technology Agency	Development of novel solar cells with high conversion efficiency (~70%) based on new principle	¥1,412,000

Contribution to Research		
A.Oiwa	The Asahi Glass Foundation Director Tetsuji Tanaka	¥2,000,000

Cooperative Research		
S. Hasegawa	Hyogo Prefectural Institute of Technology	¥0,000

Department of Semiconductor Electronics

Original Papers

[1]Carbon nanotube single-electron transistors with single-electron charge storages, Kohei Seike, Yasushi Kanai, Yasuhide Ohno, Kenzo Maehashi, Koichi Inoue and Kazuhiko Matsumoto: Japanese Journal of Applied Physics, 54 (6S1) (2015) 06FF05-1-4.

[2]Graphene-FET-based gas sensor properties depending on substrate surface conditions, Masatoshi Nakamura, Yasushi Kanai, Yasuhide Ohno, Kenzo Maehashi, Koichi Inoue and Kazuhiko Matsumoto: Japanese Journal of Applied Physics, 54 (6S1) (2015) 06FF11-1-4.

[3]Utilizing research into electrical double layers as a basis for the development of label-free biosensors based on nanomaterial transistors, Kenzo Maehashi, Yasuhide Ohno, Kazuhiko Matsumoto: Nanobiosensors in Disease Diagnosis, 5 (2015) 1-13.

[4]Acoustic carrier transportation induced by surface acoustic waves in graphene in solution, Satoshi Okuda, Takashi Ikuta, Yasushi Kanai, Takao Ono, Shinpei Ogawa, Daisuke Fujisawa, Masaaki Shimatani, Koichi Inoue, Kenzo Maehashi and Kazuhiko Matsumoto: Applied Physics Express, 9 (4) (2016) 045104-1-4.

[5]Cooper pair splitting in parallel quantum dot Josephson junctions, R. S. Deacon, A. Oiwa, J. Sailer, S. Baba, Y. Kanai, K. Shibata, K. Hirakawa & S. Tarucha: NATURE COMMUNICATIONS, 6 (7446) (2015) 1-6.

[6]Giant Dirac point shift of graphene phototransistors by doped silicon substrate current, Masaaki Shimatani, Shinpei Ogawa, Daisuke Fujisawa, Satoshi Okuda, Yasushi Kanai, Takao Ono and Kazuhiko

Matsumoto: AIP Advances, 6 (35113) (2016) 1-6.

International Conferences

[1]Direct Graphene Synthesis on Polymer Films and its Application to Flexible Devices (poster), Y. Ishibashi, Y. Kanai, T. Ono. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: 73rd Device Research Conference.

[2]Control of charging energy in carbon nanotube single electron transistor by electric-double-layer gate with ionic liquid (oral), K. Kamada, Y. Kanai, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: Advanced Materials World Congress.

[3]Sensor devices using graphene-based 2D heterostructures (invited), Kazuhiko Matsumoto: 1st EU-Japan Workshop on Graphene and Related 2D Material.

[4]Electrical Detection of Polymerase Chain Reaction Using Graphene Field-Effect Transistors (oral), M. Okano, S. Norhayati, V. Rajiv, T. Ono, Y. Kanai, Y. Ohno, K. Maehashi, K. Inoue, F. Takei, K. Nakatani and K. Matsumoto: 28th International Microprocesses and Nanotechnology Conference.

[5]Polythiophene-Molecular-Based Transistor with Graphene Nanogap Electrodes (oral), T. Ikuta, S. Tamba, Y. Kanai, T. Ono, Y. Ohno, K. Maehashi, K. Inoue, Y. Ie, Y. Aso, K. Matsumoto: 28th International Microprocesses and Nanotechnology Conference.

[6]Position-Controlled Graphene Growth Using Micropatterning on Catalytic Copper Surface (oral), Y. Mori, T. Ikuta, T. Ono, Y. Kanai, Y. Ohno, K. Maehashi, K. Inoue and K. Matsumoto: 28th International Microprocesses and Nanotechnology Conference.

[7]Selective Detection of Human & Bird Influenza Virus by Sugar Chain Modified Graphene FET (oral), Kazuhiko Matsumoto, Ryota Hayashi and Ono Takao: International Symposium on Advanced Nanodevices and Nanotechnology.

[8]Memory effect of redox state on graphene/Al2O3 bilayer (poster), K. Kamada, T. Ikuta, T. Ono, Y. Kanai, Y. Ohno, K. Maehashi, K. Inoue, N. Kawaguchi, Y. Ie, Y. Aso, and K. Matsumoto: International Workshop on Molecular Architectonics.

[9]Molecular characterization using current noise measurement of carbon nanotubes deviceat room temperature (poster), A. Setiadi, H. Fujii, M. Akai-Kasaya, S. Kasai, Y. Kanai, K. Matsumoto, Y. Kuwahara: International Workshop on Molecular Architectonics.

[10]Laser annealing technique for graphene synthesis on polymer and its application for strain sensor (poster), Y. Ishibashi, Y. Kanai, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: The 19th SANKEN International Symposium.

[11]Graphene memory utilizing redox molecules (poster), K. Kamada, N. Kawaguchi, Y. Kanai, T. Ikuta, T. Ono, Y. Ie, Y. Ohno, K. Maehashi, K. Inoue, Y. Aso, and K. Matsumoto: The 19th SANKEN International Symposium.

[12]Electrical observation of DNA amplification based on graphene FETs (poster), M. Okano, V. Rajiv, S. Norhayati, T. Ono, F. Takei, Y. Kanai, Y. Ohno, K. Maehashi, K. Inoue, K. Nakatani, and K. Matsumoto: The 19th SANKEN International Symposium.

[13]Position-controlled graphene growth using micropattern of Oxidation film on catalytic copper (poster), Y. Mori, T. Ikuta, T. Ono, Y. Kanai, Y. Ohno, K. Maehashi, K. Inoue, and K. Matsumoto: The 19th SANKEN International Symposium.

[14]Detection of hemagglutinin using sialoglycan-functionalized graphene FET toward influenza diagnosis (poster), R. Hayashi, T. Ono, T. Ikuta, Y. Kanai, Y. Ohno, K. Maehashi, K. Inoue, Y. Watanabe, T. Kawahara, Y. SUzuki, S. Nakakita, and K. Matsumoto: The 19th SANKEN International Symposium.

Patents

[1]K20110044 Carbon nanowall array body and method of manufacturing the carbon nano Wall, 2011-149002

[2]KP2014028 Thin film transistors and method for manufacturing the same, 2014-531457

[3]G20120011CN Carbon nanowall array body and method of manufacturing the carbon nano Wall, 201280032880.X

[4]G20120026US Thin film transistors and method for manufacturing the same, 14/422002

Publications in Domestic Meetings

The 63rd JSAP spring meeting	9 papers
The 3rd alliance networking event of young reseachers	1 paper
The 6th molecular archi tektronix conference	2 papers
The 2nd JSAP Kansai afiliate meeting	2 papers
The 76th JSAP autumn meeting	11 papers

Academic Degrees

Master Degree for Engineering Y. Ishibashi	Direct Graphene Synthesis on Polymer Films and its Application to Flexible Devices
Master Degree for Engineering M. Okano	Electrical Detection of Polymerase Chain Reaction using Graphene Field-Effect Transistors
Bachelor Degree for Engineering R. Okazaki	Transfer-free Graphene Synthesis on h-BN
Bachelor Degree for Engineering T. Kawata	Functionalization of graphene surface using porphyrin derivative and its biosensing application

Grant-in-Aid for Scientific Research

K.Matsumoto	Molecular Architectonics: Orchestration of Single Molecules for Novel Functions	¥30,810,000
Y.Kanai	Realization of nanocarbon spin ransistor and developments for quantum devices	¥1,300,000

Entrusted Research

K.Matsumoto	JST	Develop Super Japanese by Human Power Activation/Enhancement of Industrial Competitiveness/Rich Society	¥162,423,000
K.Matsumoto	JST	Construction of two dimensional biological model platform using sugar chain modified graphene	¥2,600,000

Contribution to Research

Y.Kanai	The Murata Science Foundation	¥980,000
Y.Kanai	THE AMADA FOUNDATION	¥1,000,000

Cooperative Research

K.Matsumoto	TOSHIBA CORPORATION	¥2,616,000
K.Matsumoto	Mitsubishi Electric Corporation	¥500,000
K.Matsumoto	TOSHIBA CORPORATION	¥2,616,000

Other Research Fund

K.Matsumoto	JSPS	¥15,830,000

Department of Advanced Electron Devices

Original Papers

[1]Laser-induced forward transfer of high-viscosity silver precursor inks for non-contact printed electronics, Tetsuji Inui, Rajesh Mandamparambil*, Teppei Araki*, Robert Abbel, Hirotaka Koga, Masaya Nogi, Katsuaki Suganuma: RSC Advances, 5 (2015) 77942-77947.

[2]Facile Fabrication of Stretchable Ag Nanowires/Polyurethane Electrode based on High Intensity Pulsed Light Technique, Yang Yang, Su Ding, Teppei Araki*, Jinting Jiu, Tohru Sugahara, Jun Wang, Jan Vanfleteren*, Tsuyoshi Sekitani, and Katsuaki Suganuma: Nano Research, 9 (2016) 401-414.

[3]Correlation between Thermal Fluctuation Effects and Phase Coherence Factor in Carrier Transport of Single-Crystal Organic Semiconductors, T. Fukami, H. Ishii, N. Kobayashi, T. Uemura, K. Sakai, Y. Okada, J. Takeya, and K. Hirose: Appl. Phys. Lett., 106 (2015) 143302-1-4.

[4]Microscopic Hole-Transfer Efficiency in Organic Thin-Film Transistors Studied with Charge-Modulation Spectroscopy, K. Miyata, S. Tanaka, Y. Ishino, K. Watanabe, T. Uemura, J. Takeya, T. Sugimoto, and Y. Matsumoto: Phys. Rev. B, 91 (2015) 195306-1-10.

[5]On the Extraction of Charge Carrier Mobility in High-Mobility Organic Transistors, T. Uemura, C. Rolin, T.-H. Ke, P. Fesenko, J. Genoe, P. Heremans, and J. Takeya: Adv. Mater., 28 (2016) 151-155.

[6]Gradual improvements of charge carrier mobility at ionic liquid/rubrene single crystal interfaces, Y. Yokota, H. Hara, Y. Morino, K. Bando, S. Ono, A. Imanishi, Y. Okada, H. Matsui, T. Uemura, J. Takeya: Appl. Phys. Lett., 108 (2016) 083113-1-4.

[7]The emergence of charge coherence in soft molecular organic semiconductors via the suppression of thermal fluctuations, K. Sakai, Y. Okada, T. Uemura, J. Tsurumi, R. Häusermann, H. Matsui, T. Fukami, H. Ishii, N. Kobayashi, K. Hirose, and J. Takeya: NPG Asia Mater., 8 (2016) e252-1-5.

[8]Enhancement of the Exciton Coherence Size in Organic Semiconductor by Alkyl Chain Substitution, S. Tanaka, K. Miyata, T. Sugimoto, K. Watanabe, T. Uemura, J. Takeya, and Y. Matsumoto: J. Phys. Chem. C, 120 (2016) 7941-7948.

[9]Ultraflexible organic amplifier with biocompatible gel, Tsuyoshi Sekitani, Tomoyuki Yokota, Kazunori Kuribara, Martin Kaltenbrunner, Takanori Fukushima, Yusuke Inoue, Masaki Sekino, Takashi Isoyama, Yusuke Abe, Hiroshi Onodera and Takao Someya: Nature Communications, 7 (2016) 11425.

International Conferences

[1]A 298-fJ/writecycle 650-fJ/readcycle 8T Three-Port SRAM in 28-nm FD-SOI Process Technology for Image Processor, : , (2015) 1-4.

[2]Void Formation by Shape Transformation of Hole Patterns on Si(001) (invited), K. Sudoh: 5th International Workshop on Epitaxial Growth and Fundamental Properties of Semiconductor Nanostructures.

[3]Wearable Resistance Type Strain Sensor Based on Long Silver Nanowires Synthesized by One Step Polyol Method (poster), Teppei Araki, Katsunari Sato, Tohru Sugahara, Jinting Jiu, Tsuyoshi Sekitani, Katsuaki Suganuma: 2015 Materials Research Society (MRS) Spring meeting & exhibit.

[4]Synthesis of long silver nanowires for flexible applications fabricated at low temperature (oral), Teppei Araki, Jinting Jiu, Tsuyoshi Sekitani, and Katsuaki Suganuma: BIT's 4th Annual World Congress of Advanced Materials (WCAM) -2015.

[5]Silver Nanowires Based Stretchable and Transparent Electrodes (oral), Teppei Araki, Tsuyoshi

Sekitani: BIT's 2nd Annual World Congress of Smart Materials-2016 (WCSM-2016).
[6]Organic transistors and stretchable conductors for ultra-flexible bio-sensors (invited), Teppei Araki, Tsuyoshi Sekitani: The 3rd international conference on advanced electromaterials (ICAE) 2015.

[7]Recent Developments in High-Mobility Organic Field-Effect Transistors (invited), T. Uemura: IEEE Custom Integrated Circuits Conference 2015.

[8]Top Contact Lithography for High-Mobility Organic Transistors (invited), T. Uemura: MRS Fall Meeting.

[9]High-Mobility Short-Channel Organic Transistors with Photolithography-Patterned Top Electrodes (invited), T. Uemura and T. Sekitani: THE 22ND INTERNATIONAL DISPLAY WORKSHOPS (IDW '15).

Review Papers
[1] Stretchable Wiring Materials and Process Technology, Teppei Araki, Tsuyoshi Sekitani, Katsuaki Suganuma, Material Stage, Technical Information Institute, Co., LTD, 15[9] (2015), 9-15.

[2]Recent Progress in Solution-Processed Organic Field-Effect Transistors, T. Uemura, AAPPS Bulletin, Association of Asia Pacific Physical Societies, 26[2] (2016), 20-24.

Books
[1] Development and Its Appliation for the Elastic Conductive Material Using Silver Flake / Polyurethane Paste, Teppei Araki, Masaya Nogi, Katsuaki Suganuma, “Regarding the Conductive Filler / Conductive Auxiliary Material”, Technical Information Institute, Co., LTD, 1820 (469-473) 2015.

[2]Transparent and stretchable electrodes fabricated with long silver nanowires, Teppei Araki, Tsuyoshi Sekitani, Katsuaki Suganuma, ”Improved Technology in Miniaturization and Thinner Elastic Wearable Devices”, Technical Information Institute, Co., LTD, 1844 (17-122) 2015.

Patents
[1]K20150189 Bio-signal measurement instruments, 2016-003958

[2]K20150318 Base Materials and Manufacturing Method for Fabricating Metalic Nanowire Layer, 2016-055502

Publications in Domestic Meetings

Mechanical Engineering Congress	1 paper
The 30th Spring Lecture of The Japan Institute Of Electronics Packaging	1 paper
The Chem-Bio Informatics Society (CBI) Conference 2015	1 paper
Yoshimoto, The 28th Circuit and Systems Workshop	1 paper
The63rd JSAP Spring Meeting	2 papers

Grant-in-Aid for Scientific Research

T.Sekitani	Fabrication and circuit application for high mobility organic transistors with nano-hetero structure organizing self-assembled monolayer	¥2,340,000
T.Sekitani	Development of flexible spectral sensitivity sensor to facilitate in agriculture IT	¥2,340,000
T.Araki	Print formation of performance and flexible electronic devices integrated with stretchable conductors and organic transistors	¥2,990,000
S.Yoshimoto	Thin-film Integration for flexible organic ADC, Memory, and Logic circuits	¥1,560,000
T.Uemura	Study on low contact resistance in organic transistors and development for high speed devices	¥6,110,000

Entrusted Research

T.Sekitani	(National Reserch and Development Agency) Japan Science and Technology Agency	Manufacturing and evaluation of bio-harmonized electronics devices	¥6,500,000
T.sekitani	(National Reserch and Development Agency) Japan Agency for Medical Reserch and Development	Development of brain signal monitoring system for a marmoset using ultra-thin flexible sensor sheet with built-in body-implantable integrated circuit	¥49,702,000
T.Sekitani	(National Reserch and Development Agency) National Institute of Information and Communications Technology	Large capacity wireless communication technology of internal-external body, and reserch and development for very large scale brain information processing technology and their application to BMI	¥3,300,000
T.Sekitrani	Automotive & Industrial Systems Company of Panasonic Corporation	Test production of flexible electrodes for ficial lifting up	¥3,000,000

Contribution to Research

T.Sekitani	Public Interest Incorporated Foundation, TEPCO Memorial Foundation, Chief Director, Shigemi Tamura	¥7,000,000
T.Sekitani	TANAKA Holding Co., Ltd. President and Representative Director, Corporate Executive Officer	¥500,000
T.Sekitani	Japan Association for Chemical Innovation	¥1,000,000
	Sekisui Chemical Co., Ltd., Director, Senior Corporative Executive Officer, Director of R&D Center	¥2,000,000
T.Sekitani	Tokyo Electric Power Services Co., Ltd., President and Representative Director	¥1,000,000
T.Sekitani	Tokyo Electric Power Services Co., Ltd., President and Representative Director	¥2,000,000
T.Sekitani	Public Interest Incorporated Foundation, Casio Science Promotion Foundation	¥5,000,000
T.Sekitani	Public Interest Incorporated Foundation, Shorai Foundation For Science and Technology, Chief Director	¥1,000,000
T.Sekitani	Public Interest Incorporated Foundation, The Noguchi Institute, Chief Director, Tsutomu Inada	¥2,200,000
T.Sekitani	Public Interest Incorporated Foundation, Secom Science and Technology Foundation, Director Representative, The Chief Director	¥10,000,000
T.Sekitani	Public Interest Incorporated Foundation, TEPCO Memorial Foundation, Chief Director, Shigemi Tamura	¥3,000,000

Cooperative Research

T.Sekitani	Nippon Shokubai Co., Ltd.	¥1,050,000
T.Sekitani	Tokyo Ink SC Holdings Co., Ltd., Group Technology Center	¥1,000,000
T.Sekitani	Murata Manufacturing Co., Ltd.	¥2,000,000
T.Sekitani	JSR Corporation, Research and Development	¥2,496,000
T.Sekitani	Daikin Industries, Ltd.	¥1,050,000
T.Sekitani	Showa Denko K.K.	¥9,000,000
T.Sekitani	JSR Corporation, Kobe University	¥4,000,000
T.Sekitani	Screen Holdings Co., Ltd.	¥0,000
K.Sudo	Incorporated Educational Institution, Konan Gakuen	¥0,000

Department of Intelligent Media

Original Papers

[1]Effective Part-Based Gait Identification using Frequency-Domain Gait Entrophy Features, M. Rokanujjaman, M.S. Islam, M.A. Hossain, M.R. Islam, Y. Makihara, Y. Yagi: Multimedia Tools and Applications, 74 (9) (2015) 3099-3120.

[2]Similar Gait Action Recognition using an Inertial Sensor, T.T. Ngo, Y. Makihara, H. Nagahara, Y. Mukaigawa, Y. Yagi: Pattern Recognition, 48 (4) (2015) 1289–1301.

[3]Cross-View Gait Recognition by Fusion of Multiple Transformation Consistency Measures, D. Muramatsu, Y. Makihara Y. Yagi: IET Biometrics, 4 (2) (2015) 62-73.

[4]Onboard Monocular Pedestrian Detection by Combining Spatio-Temporal HOG with Structure from Motion Algorithm, C. Hua, Y. Makihara, Y. Yagi, S. Iwasaki, K. Miyagawa, B. Li: Machine Vision and Application, 26 (2-3) (2015) 161-183.

[5]Individuality-preserving Silhouette Extraction for Gait Recognition, Y. Makihara, T. Tanoue, D. Muramatsu, Y. Yagi, S. Mori, Y. Utsumi, M. Iwamura, K. Kise: IPSJ Trans. on Computer Vision and Applications, 7 (2015) 74-78.

[6]Depth-based Gait Authentication for Practical Sensor Settings, T. Ikeda, I. Mitsugami, Y. Yagi: IPSJ Trans. on Computer Vision and Applications, 7 (2015) 94-98.

[7]Detection of Elderly Gait Impairment by Patch-GEI, C. Zhou, I. Mitsugami, Y. Yagi: IEEJ Transactions on Electrical and Electronic Engineering, 10 (S1) (2015) S69-S76.

[8]Calibration of Multiple Kinects with Little Overlap Regions, M. Nakazawa, I. Mitsugami, H. Habe, H. Yamazoe, Y. Yagi: IEEJ Transactions on Electrical and Electronic Engineering, 10 (S1) (2015) S108-S115.

[9]Multiplex Communication with Synchronous Shift and Weight Learning in 2D Mesh Neural Network, T. Kamimura, Y. Yagi, S. Tamura, Y.-W. Chen: Automation, Control and Intelligent Systems, 3 (5) (2015) 63-70.

[10]Construction of Multi-quality Multi-modal Biometric Score Database and Its Performance Evaluation on Score-level Fusion, T. Kimura, Y. Makihara, D. Muramatsu, Y. Yagi: The Trans. of the Institute of Electronics, Information and Communication Engineers. A, J98-A (12) (2015) 646-658.

[11]Multi-modal Veri cation System of Gait, Head, and the Height, T. Kimura, D. Muramatsu, Y. Makihara, Y. Yagi: The Trans. of the Institute of Electronics, Information and Communication Engineers. A, J98-A (12) (2015) 659-663.

[12]Unifying color and texture transfer for predictive appearance manipulation, F. Okura, K. Vanhoey, A Bousseau, A. A. Efros, G. Drettakis: Computer Graphics Forum, 34 (4) (2015) 53-63.

International Conferences

[1]Multi-view Discriminant Analysis with Tensor Representation and Its Application to Cross-view Gait Recognition, Y. Makihara, A. Mansur, D. Muramatsu, Z. Uddin, Y. Yagi: Proc. of the 11th IEEE Conf. on Automatic Face and Gesture Recognition (FG 2015), (2015) 1-8.

[2]Gait Regeneration for Recognition, D. Muramatsu, Y. Makihara, Y. Yagi: Proc. of the 7th IAPR Int. Conf. on Biometrics (ICB 2015), (2015) 1-8.

[3]Single Sensor-based Multi-quality Multi-modal Biometric Score Database and Its Performance Evaluation, T. Kimura, Y. Makihara, D. Muramatsu, Y. Yagi: Proc. of the 7th IAPR Int. Conf. on Biometrics (ICB 2015), (2015) 1-8.

[4]Recovering Inner Slices of Translucent Objects by Multi-frequency Illumination, K. Tanaka, Y. Mukaigawa, H. Kubo, Y. Matsushita, Y. Yagi: Proc. of the 28th IEEE Conf. on Computer Vision and Pattern Recognition (CVPR 2015), (2015) 5464-5472.

[5]Gait Analysis of Simulated Left Knee Disorder, T. Ogawa, H. Yamazoe, I. Mitsugami, Y. Yagi: Proc. of the 9th EAI International Conference on Bio-inspired Information and Communications Technologies, (2015) 1-4.

[6]Gait Video Analysis and Its Applications, Y. Yagi: The 2nd The IEEE International Conference on Identity, Security and Behavior Analysis (ISBA 2016), (2016) .

[7]BEHAVIOR UNDERSTANDING BASED ON INTENTION-GAIT MODEL, Y. Yagi: The 4th International Conference on Informatics, Electronics & Vision (ICIEV), (2015) .

[8]Gait Video Analysis and Its Applications, Y. Yagi: The 12th International Conference on Ubiquitous Robots and Ambient Intelligence, (2015) .

[9]Gait Video Analysis and Its Applications, Y. Yagi, I. Mitsugami: International Workshop on Human Behavior Analysis in the Real World, (2015) .

[10]3-D Gait Measurement and Analysis, I. Mitsugami: The 4th International Conference on Informatics, Electronics & Vision (ICIEV2015), (2015) .

[11]Automatically Acquiring Walking-Related Behavior of 100,000 People, F. Okura, T. Kimura, M. Niwa, I. Mitsugami, A. Suzuki, Y. Makihara, C. Aoki, D. Muramatsu, Y. Yagi: International Workshop on Human Behavior Analysis in the Real World, (2015) .
[12]Detection of Gait Impairment in the Elderly Using Patch-GEI, C. Zhou: International Workshop on Human Behavior Analysis in the Real World, (2015) .

[13]Estimating the Elderly People’s Cognitive Functions from the Dual Task Gait, M. Niwa: International Workshop on Human Behavior Analysis in the Real World, (2015) .

[14]Human Motion Analysis for Intention-Gait Modeling, I. Mitsugami: The International Conference of Information and Communication Technology for Embedded Systems (ICICTES 2016), (2016) .

[15]Gait Video Analysis and Its Applications, Y. Yagi: The 19th Sanken Int. Symposium, (2015) .

Books

[1]Gait Recognition: Databases, Representations, and Applications(Mihai Peterca) Y. Makihara, D.S. Matovski, M.S. Nixon, J.N. Carter, Y. Yagi, “Wiley Encyclopedia of Electrical and Electronics Engineering”, John Wiley & Sons, Inc., (1-15) 2015.

[2]Augmented Reality: AR Y. Fujimoto, T. Aoto, Y. Uranishi, F. Okura, M. Koeda, Y. Nakashima, G. Yamamoto, “OpenCV 3 Programming Book”, Mynavi Publishing Corporation, (103-130) 2015.

Patents

[1]G20150097WO, METHOD FOR EVALUATING DUAL-TASK PERFORMANCE AND SYSTEM FOR EVALUATING DUAL-TASK PERFORMANCE, PCT/JP2016/058353

[2]G20100118CN Moving Object Detection Device, 201180030287.70001

[3]K20080025 3D Shape Measurement Method and Program, K20080025

Contributions to International Conferences and Journals

Y. Yagi The 13th Asian Conference on Computer Vision (ACCV 2016) (Steering

	Committee)
Y. Yagi	The 4th International Conference on Informatics, Eletronics & Vision (ICIEV 2015) (Honorary General Chair)
Y. Yagi	The 10th International Workshop on Robust Computer Vision (IWRCV 2015) (Program Chair)
Y. Yagi	The 8th IAPR International Conference on Biometrics (ICB 2015) (Reviewer)
Y. Yagi	IEEE International Conference on Information and Automation 2015 (ICIA 2015) (Program Committee)
Y. Yagi	The 7th IEEE International Conference on Biometrics: Theory, Applications and Systems (BTAS 2015) (Program Committee)
Y. Yagi	IEEE/RSJ International Conference on Intelligent Robots and Systems 2015 (IROS 2015) (Associate Editor)
Y. Yagi	The 15th International Conference on Computer Vision (ICCV 2015) (Reviewer)
Y. Yagi	The 29th IEEE Conferenec on Computer Vision and Pattern Recognition (CVPR 2016) (Program Committee)
Y. Makihara	The 11th IEEE Conf. on Automatic Face and Gesture Recognition (FG 2015) (Program Committee Member)
Y. Makihara	The 3rd IAPR Asian Conf. on Pattern Recognition (ACPR 2015) (Program Committee Member)
Y. Makihara	The 28th IEEE Conf. on Computer Vision and Pattern Recognition (CVPR 2015) (Reviewer)
Y. Makihara	The 7th Pacific-Rim Symposium on Image and Video Technology (PSIVT 2015) (Reviewer)
Y. Makihara	2015 ACM Int. Conf. on Multimedia Retrieval (ICMR 2015) (Program Committee Member)
Y. Makihara	The 26th British Machine Vision Conf. (BMVC 2015) (Reviewer)
Y. Makihara	IEICE Trans. on Information and Systems (Associate Editor)
Y. Makihara	3D Vision 2015 (3DV 2015) (Reviewer)
Y. Makihara	The 10th Int. Conf. on Signal Image Technology and Internet-based Systems (SITIS 2015) (Program Committee Member)
Y. Makihara	IEEE International Conference on Robitics and Biomimetics 2015 (ROBIO 2015) (Program Committee Member)
Y. Makihara	The 2nd IEEE International Conference on Identity, Security and Behavior Analysis (ISBA 2016) (Publicity Chair)
Y. Makihara	The 2nd IEEE International Conference on Identity, Security and Behavior Analysis (ISBA 2016) (Reviewer)
Y. Makihara	The 28th IEEE Conf. on Computer Vision and Pattern Recognition (CVPR 2016) (Reviewer)
Y. Makihara	The 27th British Machine Vision Conf. (BMVC 2016) (Reviewer)
Y. Makihara	2016 ACM Int. Conf. on Multimedia Retrieval (ICMR 2016) (Program Committee Member)
Y. Makihara	The 14th European Conf. on Computer Vision (ECCV 2016) (Reviewer)
Y. Makihara	The 23rd Int. Conf. on Pattern Recognition (ICPR 2016) (Technical Member)
Y. Makihara	The 2nd workshop on Pattern Recognition for Multimedia Content Analysis (PR4MCA 2016) (Program Committee Member)
D. Muramatsu	The 2nd IEEE International Conference on Identity, Security and Behavior Analysis (ISBA 2016) (Local chair)
D. Muramatsu	The 2nd IEEE International Conference on Identity, Security and Behavior Analysis (ISBA 2016) (Reviewer)
D. Muramatsu	The 3rd IAPR Asian Conf. on Pattern Recognition (ACPR 2015) (Reviewer)
D. Muramatsu	The 9th IAPR International Conference on Biometrics (ICB 2016) (Reviewer)
I. Mitsugami	The 3rd IAPR Asian Conf. on Pattern Recognition (ACPR 2015) (Program Committee Member)
I. Mitsugami	The 4th International Conference on Informatics, Eletronics & Vision (ICIEV 2015)

	(Program Committee Member)
I. Mitsugami	3D Vision 2015 (3DV 2015) (Reviewer)
I. Mitsugami	The 23rd Int. Conf. on Pattern Recognition (ICPR 2016) (Technical Member)
I. Mitsugami	The 10th Int. Conf. on Signal Image Technology and Internet-based Systems (SITIS 2015) (Program Committee Member)
I. Mitsugami	International Workshop on Human Behavior Analysis in the Real World (Organizing Chair)

Publications in Domestic Meetings

The 18th Meeting on Image Recognition and Understanding	13 papers
Information Processing Society of Japan, Special Interest Group on Computer Vision and Image Media	10 papers
The Institute of Electronics, Information and Communication Engineering, Technical Group on Pattern Recognition and Media Understanding	1 paper
The Institute of Electronics, Information and Communication Engineering, Technical Group on Biometrics	2 papers
The Vertual Reality Society of Japan, Special Interest Group on Telexistence	1 paper
The 5th Symposium on Biometrics, Recognition, and Authentication	3 papers
Kansai-section Joint Convention of Institute of Electrical Engineering	1 paper
Regular Meeting of Working Group on Next-generation Image Input Vision System	1 paper
Special Interest Group on Particle Filter	1 paper

Academic Degrees

Master Degree for Information Science T. Ikeda	Performance evaluation of gait authentication methods using 3-D gait database
Master Degree for Information Science S. Ikemoto	Normal distribution analysis based on the reflected light measurement of metallic coating and hairline processing
Master Degree for Information Science K. Kikuchi	Drug susceptibility estimation by analyzing micro-channel microscopy image
Master Degree for Information Science T. Kimura	Quality-dependent Multi-modal Biometrics from a Walking Image Sequence
Master Degree for Information Science T. Hashimoto	Improvement of Group Detection Accuracy with Gesture Timing
Bachelor Degree for Engineering T. Isokane	Simulation of incident light for a vine pruning support system
Bachelor Degree for Engineering G. Ogi	Extraction of Pedestrian Trajectory by Piecewise Linear Approximation for Gait Recognition
Bachelor Degree for Engineering Y. Okinaka	Gaze Estimation Based on Eyeball-Head Dynamics
Bachelor Degree for Engineering Y. Miyazaki	Detection of Abnormal Lesion Areas on a Small Intestine from Capsule Endoscopy Images by using Convolutional Neural Network
Bachelor Degree for Engineering S. Sunagawa	(Confidential)

Grant-in-Aid for Scientific Research

Y. Yagi	Multi-modal gait recognitoin in the wild and its application to criminal investigation	¥15,990,000

Y. Makihara	High-accuracy gait recognition by fluctuation analysis		¥0,000
D. Muramatsu	Person recognition from data pair without common region		¥834,000
I. Mitsugami	Motion Extraction for Gait Analysis		¥1,430,000
F. Okura	Estimating and visualizing health condition of dairy cows using 4D spacetime sensing		¥1,430,000
Entrusted Research			
Y. Yagi	Japan Science and Technology Agency	Behavior Understanding based on Intention-Gait Model	¥49,043,000
I. Mitsugami	Osaka University, the president's discretionary budget	International Collaborative Research of Human Sensing	¥5,852,000
Cooperative Research			
Y. Yagi	Aida Engineering, Ltd.		¥1,200,000
Y. Yagi	Mitsubishi Electric Corp., Information Technology R&D Center		¥12,000,000
Y. Yagi	the National Institute of Information and Communications Technology		¥0,000

Department of Reasoning for Intelligence

Original Papers

[1]Data Mining as a Powerful Tool for Creating Novel Drugs in Cardiovascular Medicine: the Importance of a “Back-and-Forth Loop” between Clinical Data and Basic Research, M. Kitakaze, M. Asakura1, A. Nakano, S. Takashima, T. Washio: Cardiovascular Drug and Therapy, 29 (3) (2015) 309-315.

[2]Half-space mass: a maximally robust and efficient data depth method, B. Chen, K. M. Ting, T. Washio, G. Haffari: Machine Learning, 100 (2015) 677-699.

[3]Toxicogenomic prediction with group sparse regularization based on transcription factor network information, K. Nagata, Y. Kawahara, T. Washio, A. Unami: Fundamental Toxicological Sciences, 2 (4) (2015) 161-170.

[4]An Estimation Method of Cross-Correlation Function using Spatio-Temporal Attenuation Model for Photovoltaic Generation Power Fluctuation Analysis, K. Yasunami, T. Washio: IEEJ Transactions on Power and Energy, 135 (10) (2015) 613-623.

[5]Particle Trajectory-Dependent Ionic Current Blockade in Low-Aspect-Ratio Pores, M. Tsutsui, Y. He, K. Yokota, A. Arima, S. Hongo, M. Taniguchi, T. Washio, T. Kawai: ACS Nano, American Chemical Society, 10 (1) (2015) 803-809.

[6]Toxicogenomic prediction with graph-based structured regularization on transcription factor network, K. Nagata, Y. Kawahara, T. Washio, A. Unami: Fundam. Toxicol. Sci., 3 (2) (2016) 39-46.

[7]New monitoring technique for detecting buckling in the continuous annealing line using canonical correlation analysis, T. Hirata, Y. Kawahara, T. Yairi, K. Asano, I. Maeda, T. Sasaki, K. Machida: SICE Journal of Control, Measurement, and System Integration, 8 (3) (2015) 214-220.

[8]Genome-Wide Detection of Intervals of Genetic Heterogeneity Associated with Complex Traits, F. Llinares-López, D.G. Grimm, D. A. Bodenham, U. Gieraths, M. Sugiyama, B. Rowan, K. M. Borgwardt: Bioinformatics, 31 (12) (2015) i240-i249.

International Conferences

[1]Half-space Mass: A maximally robust and efficient data depth method, B. Chen, K. Ming Ting, T. Washio, G. Haffari: Proc. of PKDD/ECML2015:Machine Learning and Knowledge Discovery in Databases, (2015) XXIX.

[2]Beyond tf-idf and cosine distance in documents dissimilarity measure, S. Aryal, K. M. Ting, G. Haffari, T.i Washio: Information Retrieval Technology of the series Lecture Notes in Computer Science, 9460 (2015) 400-406.

[3]On approximate non-submodular minimization via tree-structured supermodularity, Y. Kawahara, R. Iyer, J. Bilmes: Proc. of the 18th Int'l Conf. on Artificial Intelligence and Statistics (AISTATS'15), (2015) 444–452.

[4]A fault detection technique for the steel manufacturing process based on a normal pattern library, T. Hirata, Y. Kawahara, M. Sugiyama, K. Asano: Proc. of the 9th IFAC Symp. on Fault Detection, Supervision and Safety of Technical Processes (SafeProcess'15), (2015) 871-876.

[5]Higher Order Fused Regularization for Supervised Learning with Grouped Parameters, K. Takeuchi, Y. Kawahara, T. Iwata: Proc. of the 2015 European Conf. on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML-PKDD'15), (2015) 577-593.

[6]Skill Grouping Method: Mining and Clustering Skill Differences from Body Movement BigData, S. Yamagiwa, Y. Kawahara, N. Tabuchi, Y. Watanabe, T. Naruo: Proc. of the 2015 IEEE Int'l Conf. on Big Data (IEEE BigData 2015), (2015) 2525-2534.

[7]A Non-Gaussian Approach for Causal Discovery in the Presence of Hidden Common Causes, S. Shimizu: Advanced Methodologies for Bayesian Networks, (2015) 222-233.

[8]Significant Subgraph Mining with Multiple Testing Correction, M. Sugiyama, F. Llinares-López, N. Kasenburg, K. M. Borgwardt: Proc. of the 2015 SIAM International Conference on Data Mining, (2015) 37-45.

[9]Fast and Memory-Efficient Significant Pattern Mining via Permutation Testing, F. Llinares-López, M. Sugiyama, L. Papaxanthos, K. M. Borgwardt: Proc. of the 21st ACM SIGKDD Conference on Knowledge Discovery and Data Mining, (2015) 725-734.

[10]Halting in Random Walk Kernels, M. Sugiyama, K. M. Borgwardt: Advances in Neural Information Processing Systems, 28 (2015) 1630-1638.

[11]An Estimation Method of PV Power Output in Electric Power Systems by using Covariance between Solar Radiation Intensity and Power Flow (oral), K. Yasunami, T. Washio: International Conference on Electrical Engineering (ICEE) 2015.

[12]New toxicogenomic predictive model for decreased reticulocytes based on gene expressions in liver of rats built with class association rule mining (poster), K. Nagata, T. Washio, Y. Kawahara, A. Unami: ISMB/ECCB 2015: 23rd Annual International Conference on Intelligent Systems for Molecular Biology/ 14th European Conference on Computational Biology.

[13]An Accuracy Evaluation of PV Power Output Estimation Method Using Covariance between Solar Radiation Intensity and Power Flow (oral), K. Yasunami, T. Washio: IEEE Power and Energy Society ISGT (Innovative Smart Grid Technology) Asia 2015.

[14]Discriminative and Generative Models in Causal and Anticausal Settings (oral), P. Blobaum, S. Shimizu, T. Washio: Second Workshop on Advanced Methodologies for Bayesian Networks (AMBN 2015).

[15]Applicability of a PV Power Output Estimation Method using Low Sampling Rates (oral), K. Yasunami, T. Washio: International Workshop on Time Series Data Analysis and its Applications (TSDAA 2015).

[16]Non-Gaussian methods for causal discovery (invited), S. Shimizu: International Workshop on Causal Inference, Tokyo, Japan, January 1-6, 2016.

[17]Statistical estimation of causal directions based on observational data (invited), S. Shimizu: The 3rd CiNet Conference - Neural Mechanism of Decision Making: Achievements and New Directions, Osaka, Japan, Feburary 5-7, 2016.

[18]Non-Gaussian structural equation models for causal discovery (invited), S. Shimizu: 2016 Probabilistic Graphical Model Workshop: Sparsity, Structure and High-dimensionality, Tokyo, Japan, March 23-25, 2016.

[19]Fast and Memory-Efficient Significant Pattern Mining via Permutation Testing (oral), F. Llinares-López, M. Sugiyama, L. Papaxanthos, K. M. Borgwardt: 14th International Workshop on Data Mining in Bioinformatics.

[20]Statistical Analysis on Order Structures (invited), M. Sugiyama: 3rd mini-symposium on Computations, Brains and Machines.

Books

[1]Machine Learning with Submodular Functions(M. Sugiyama) Y. Kawahara, K. Nagano, “Machine Learning with Submodular Functions”, KODANSHA, 2015.

Patents

[1]K20150022 Evaluation information supplement system, and evaluation information supplement method, 2015-207449

[2]K20150073 Program, group prediction device, and group prediction method, 2015-152899

[3]K20150077 Analysis device, method, and program, 2015-166712

[4]K20150145 How particle species analysis,particle species analyzer and particle species analysis for the storage medium, 2015-254398

[5]K20150298 Analysis device, method, and program, 2016-036106

Contributions to International Conferences and Journals

T. WASHIO	21st ACM SIGKDD Conference on Knowledge Discovery and Data Mining (Program Committee)
T. WASHIO	The 19th Pacific-Asia Conference on Knowledge Discovery and Data Mining 2015 (PAKDD2015) (Publicity Chair)
T. WASHIO	The 2015 SIAM Data Mining Conference (SDM 2015) (Program Committee)
T. WASHIO	IEEE International Conference on Data Mining 2015 (ICDM2015) (Program Committee)
T. WASHIO	The European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML/PKDD 2015) (Journal Track Guest Editor)
T. WASHIO	Journal of Data Science and Engineering, Springer (Editorial Board)
T. WASHIO	Neural Information Processing Systems Foundation 2015 (NIPS 2015) (Program Committee)
T. WASHIO	The Workshop on Probabilistic Graphical Models and its Application 2015 (PGM 2015) (Advisory Member)
T. WASHIO	22st ACM SIGKDD Conference on Knowledge Discovery and Data Mining (Program Committee)
T. WASHIO	Knowledge and Information Systems (KAIS): An International Journal (Associated Editor)

T. WASHIO	Journal of Data Mining and Knowledge Discocvery (Editorial Board)
Y. Kawahara	18th Int'l Conf. on Artificial Intelligence and Statistics (AISTATS'15) (Program Committee)
Y. Kawahara	32nd Int'l Conf. on Machine Learning (ICML'15) (Program Committee)
Y. Kawahara	24th Int'l Joint Conf. on Artificial Intelligence (IJCAI'15) (Program Committee)
S. SHIMIZU	Behaviormetrika (Coordinating Editor)
M. SUGIYAMA	The 7th Asian Conference on Machine Learning (ACML 2015) (Program Committee)
M. SUGIYAMA	The 25th European Conference on Machine Learning and 18th Principles and Practice of Knowledge Discovery in Databases (ECMLPKDD 2015) (Program Committee)
M. SUGIYAMA	The 24th International Joint Conference on Artificial Intelligence (IJCAI 2015) (Program Committee)
M. SUGIYAMA	The 2nd Workshop on Features and Structures (Program Committee)

Publications in Domestic Meetings

Annual Conference of the Institute of Electrical Engineers of Japan	1 paper
Spring Conference of the Chemical Society of Japan	1 paper
The 8th Vascular Medicine Workshop	1 paper
The 13th Cutting Edge Forum of Vascular Medicine	1 paper
The 9th Annual Conference of the Japanese Society for Artificial Intelligence	2 papers
Symposium of Kanto Branch of Ecological Society of Japan 2015	1 paper
Computational Science and Visual Analytics	1 paper
The 3rd Methodology Seminar of the Japanese Society of Social Psychology	1 paper
The 23rd Infomation-Based Induction Sciences and Machine Learning (IBISML) Meeting	1 paper

Academic Degrees

Ph.D of Engineering K. Yasunami	Study on Analysis of Solar Photovoltaic Generation Output Changes using Statistical Methods
Bachelor Degree of Engineering K. Miyazawa	Automatic Discovery of Group Structures for Latent Group Regularization
Bachelor Degree of Engineering Y. Katayama	Study on Anomaly Detection Based on Causal Structures Using Non-Gaussianity
Bachelor Degree of Engineering S. Anand	Prediction of User Evaluations Using Multi-Task Learning

Grant-in-Aid for Scientific Research

T. Washio	Development and Application of Statistical Estimation and Simulation for Super-high Dimensional Data Space	¥13,390,000
T. Washio	Model Mining: Research on Enumeration Method of Local Model Using Super-high Dimensional and Large Data	¥1,430,000
Y. Kawahara	Combinatorial approach to sparse modeling and optimization	¥2,470,000
Y. Kawahara	Development of machine learning algorithms based on discrete convex analysis and its applications	¥4,290,000
Y. Kawahara	Hardware-friendly machine learning by integer parameter regularized learning with discrete convexity	¥1,430,000
S. Shimizu	Causal structure learning from multiple high-dimensional datasets and its application to life sciences	¥1,170,000
M. Sugiyama	Development of methods to find statistically significant substructures from graph data	¥1,170,000

Entrusted Research

T. Washio	NCVC	Analysis of Hart Failure Case Big Data Using a New Data Mining	¥1,000,000

		Method LAMP - Discovery of New Hart Failure Aggravating Factors and its Practical Application	
T. Washio	JST	Feasibility Evaluation and Validation of Discrete Structure Processing for Statistics and Data Mining	¥5,005,000
T. Washio	FUJITSU LABORATORIES LTD.	Study on Technical Basis for Data Analysis	¥2,000,000
T. Washio	JST	Extraction of Information Characterizing Cell Physiology from Super-High-Resolution Image Time Series	¥650,000
M. Sugiyama	JST	Scalable Technologies for Finding Significant Patterns	¥16,575,000
Contribution to Research			
T. Washio	AOARD		¥3,585,000
Cooperative Research			
T. Washio	Kobe Steel,Ltd.		¥1,080,000
T. Washio	NCVC		¥36,000
T. Washio	NIMS		¥0,000
T. Washio	NAGANO SCIENCE CO. LTD		¥0,000
Y. Kawahara	MIZUNO Corporation,University of Tsukuba		¥480,000
Y. Kawahara	BIJIN&Co. Inc. ,University of Tsukuba		¥374,000
Y. Kawahara	NTT Communication Scinece Laboratories		¥0,000

Department of Knowledge Systems

Original Papers

[1]Posteriori Restoration of Turn-Taking and ASR Results for Incorrectly Segmented Utterances, K. Komatani, N. Hotta, S. Sato, M. Nakano: IEICE Transactions on Information and Systems, E98-D (11) (2015) 1923-1931.

[2]A Keyword Exploration based on a Biomimetics Ontology and Linked Data, K. Kozaki, Y. Kitamura, R. Mizoguchi: Transactions of the Japanese Society for Artificial Intelligence, 31 (1) (2016) 12 pages.

[3]Families of roles: A new theory of occurrent-dependent roles, R. Mizoguchi, A. Galton, Y. Kitamura, K. Kozaki: Applied Ontology, 10 (3-4) (2015) 367-399.

[4]Towards the Integration of Disease Knowledge with Abnormality Ontology Derived Linked Data, Y. Yamagata, K. Kozaki, T. Imai, K. Ohe, R. Mizoguchi: Transactions of the Japanese Society for Artificial Intelligence, 31 (1) (2016) 15 pages.

International Conferences

[1]Acoustic Model Training based on Node-wise Weight Boundary Model Increasing Speed of Discrete Neural Networks, R. Takeda, K. Komatani: Proc. of 2015 IEEE Automatic Speech Recognition and Understanding Workshop (ASRU 2015), (2015) 52-58.

[2]Sound Source Localization based on Deep Neural Networks with Directional Activate Function Exploiting Phase Information, R. Takeda, K. Komatani: Proc. of the 41st International Conference on Acoustics, Speech and Signal Processing (ICASSP2016), (2016) 405-409.

[3]Question Selection based on Expected Utility to Acquire Information through Dialogue, K. Komatani, T. Otsuka, S. Sato, M. Nakano: Proc. International Workshop on Spoken Dialogue Systems (IWSDS2016), (2016) 12 pages.

[4]User Adaptive Restoration for Incorrectly Segmented Utterances in Spoken Dialogue Systems, K. Komatani, N. Hotta, S. Sato, M. Nakano: Proc. 16th Annual SIGDIAL Meeting on Discourse and Dialogue, (2015) 393-401.

[5]Disease Compass - a navigation system for disease knowledge based on ontology and linked data techniques, K. Kozaki, Y. Yamagata, R. Mizoguchi, T. Imai, K. Ohe: Proc. of the 6th International Conference on Biomedical Ontology (ICBO 2015), (2015) 5 pages.

[6]Efficiently Finding Paths Between Classes to Build a SPARQL Query for Life-Science Databases, A. Yamaguchi, K. Kozaki, K. Lenz, H. Wu, Y. Yamamoto, N. Kobayashi: Proc. of the 5th Joint International Semantic Technology Conference (JIST 2015), (2015) 321-330.

[7]Development of Ontology for Information Literary, H. Kanoh, K. Kozaki, M. Hasegawa, T. Hishida: Proc. of the 19th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems (KES 2015), (2015) 170-177.

[8]RDF-Based Integration with SPARQL Building System for Life Science Database Archive, A. Yamaguchi, K. Okubo, N. Kobayashi, K. Kozaki, S. Kumagai, K. Lenz, T. Nobusada, H. Wu, Y. Yamamoto, H. Hatanaka: Proc. of the 2015 Semantic Web Applications and Tools for Life Sciences Conference (SWAT4LS 2015), (2015) 195-196.

[9]Estimating Response Obligation in Multi-Party Human-Robot Dialogues, T. Sugiyama, K. Funakoshi, M. Nakano, K. Komatani: Proc. IEEE-RAS International Conference on Humanoid Robots (Humanoids 2015), (2015) 166-172.

[10]Performance Comparison of MUSIC-based Sound Localization Methods on Small Humanoid under Low SNR Conditions, R. Takeda, K. Komatani: Proc. of 2015 IEEE-RAS International Conference on Humanoids Robots (Humanoids), (2015) 859-865.

Review Papers

Ontology-Enhanced Thesaurus : Towards advanced information retrieval for idea creation, R. Mizoguchi, K. Kozaki, Y. Kitamura, Journal of Information Processing and Management, Showa Joho Process Co., Ltd., 58[5] (2015), 361-371.

Books

[1]Question and Answer Dialogue System K. Komatani, “Evolving Speech Communication between Human and Machine”, NTS Inc., (180-191) 2015.

[2]What is Ontology-Enhanced Thesaurus - To Assist Idea Creation of Engineers using Words(M. Shimomura) M. Mizoguchi, K. Kozaki, “Tokoton Friendly Biomimetics”, The Nikkan Kogyo Shinbun, ltd., (134-135) 2016.

[3]Glossary(G. Shinohara, S. Nomura) K. Kozaki, S. Nomura, G. Shinohara, T. Yamazaki, “Biomimetics - a study to use form and capacity of living things”, Tokai University Press, (145-147) 2016.

Contributions to International Conferences and Journals

K. KOMATANI	Special Interest Group on Discourse and Dialogue (SIGdial) (Scientific Advisory Committee (Board))
K. KOMATANI	The 2015 Conference of the North American Chapter of the Association for Computational Linguistics – Human Language Technologies (NAACL HLT 2015) (Programme Committee)
K. KOMATANI	The 53rd Annual Meeting of the Association for Computational Linguistics and The 7th International Joint Conference of the Asian Federation of Natural Language Processing (ACL IJCNLP2015) (Programme Committee)

K. KOMATANI	The 16th Annual SIGdial Meeting on Discourse and Dialogue (SIGDIAL 2015) (Programme Committee)
K. KOMATANI	Interspeech2015 (Programme Committee)
K. KOMATANI	The 24th International Symposium on Robot and Human Interactive Communication (Ro-man2015) (Programme Committee)
K. KOMATANI	The 2015 IEEE Automatic Speech Recognition and Understanding Workshop (ASRU2015) (Programme Committee)
K. KOMATANI	The 4th Workshop on Machine Learning for Interactive Systems (MLIS2015) (Programme Committee)
K. KOMATANI	The International Workshop on Spoken Dialogue Systems (IWSDS2016) (Programme Committee)
K. KOZAKI	The 4th Joint International Semantic Technology Conference (JIST2015) (Program Chair)
K. KOZAKI	The 8th International Conference on Knowledge Engineering and Ontology Development (KEOD2015) (Organaizing Committtee)
K. KOZAKI	The International Workshop on Intelligent Exploration of Semantic Data (IESD2015) (Organaizing Committtee)
K. KOZAKI	Journal of Information Processing (Editorial board)

Publications in Domestic Meetings

The Japan Society of Artificial Intelligence	9 papers
Information Processing Society of Japan	2 papers

Academic Degrees

Docter Degree for Engineering Y. Yamagata	A Development of Abnormality Ontology in Disease Description and its Applications
Master Degree for Engineering K. Tada	A Development of Expantion Methods for Biomimetics Ontology using Technical Document and Linked Open Data
Bachelor Degree for Engineering K. Ohno	Class Estimation for Generating Implicit Confirmation to Acquire Unknown Words in Non Task-Oriented Dialogues
Bachelor Degree for Engineering T. Kajino	Analysis of Effective Features to Estimate Internal States of Drivers in Car-Navigation System

Grant-in-Aid for Scientific Research

K.Kozaki	Intelligent Exploration of Semantic Data through Domains based on Multi-dimension Viewpoint Management of Ontologies	¥4,550,000
K.Kozaki	Formalizations of Probability, Causality and Risk in Applied Ontology	¥400,000
R.Takeda	Automatic Improvement of Acoustic and Language Model of Automatic Speech Recognition through Sponken Dialogue	¥2,600,000

Entrusted Research

K. Komatani	Ministry of Internal Affairs and Communications (MIC)	Development of Adaptation Process Model to Spoken Dialogue Robots based on Hierarchical Understanding of User Behaviors	¥3,510,000

Cooperative Research

K. Komatani	Honda Research Institute Japan Co., Ltd.	¥3,600,000
K. Komatani	Honda Research Institute Japan Co., Ltd.	¥600,000
K. Komatani	Mitsubishi Electric Corporation	¥1,000,000
K. Kozaki	Toyonaka City	¥0,000

Department of Architecture for Intelligence

Original Papers

[1]Kernel density compression for real-time Bayesian encoding/decoding of unsorted hippocampal spikes, D. Sodkomkham, D. Ciliberti, M. A. Wilson, K. Fukui, K. Moriyama, M. Numao, and F. Kloosterman: Knowledge-Based Systems, 94 (2016) 1-12.

[2]Developing an Expert Agent in an Educational Game with Evolutionary Computation, K. Moriyama, M. Numao and R. Ichise: Transactions of the Japanese Society for Artificial Intelligence, 30 (5) (2015) 639-646.

International Conferences

[1]Adaptive Two-stage Learning Algorithm for Repeated Games, W. Fujita, K. Moriyama, K. Fukui, and M. Numao: Proc. The 8th International Conference on Agents and Artificial Intelligence (ICAART2016), (2016) 47-55.

[2]Cluster Sequence Mining: Causal Inference with Time and Space Proximity under Uncertainty, Y. Okada, K. Fukui, K. Moriyama, and M. Numao: Lecture Notes on Artificial Intelligence, 9078 (2015) 293-304.

[3]Investigation of Familiarity Effects in Music-Emotion Recognition based on EEG, N. Thammasan, K. Moriyama, K. Fukui, and M. Numao: Lecture Notes on Artificial Intelligence, 9250 (2015) 242-251.

[4]Prediction as Faster Perception in a Real-time Fighting Video Game, K. Asayama, K. Moriyama, K. Fukui, and M. Numao: Proc. the 2015 IEEE Conference on Computational Intelligence and Games (CIG 2015), (2015) 517-522.

[5]Training Dataset to Induce the Personal Sensibility Model for a Music Composition System, N. Tsuchiya, T. Koori, M. Numao, and N. Otani: Proceedings of International Workshop on Informatics (IWIN'2015), (2015) 193-197.

[6]Concept Drift Detection with Clustering via Statistical Change Detection Methods, Y. Sakamoto, K. Fukui, J. Gama, D. Nicklas, K. Moriyama, and M. Numao: Proc. The Seventh International Conference on Knowledge and Systems Engineering (KSE2015), (2015) 37-42.

[7]Cluster Analysis of Face Images and Literature Data by Evolutionary Distance Metric Learning, W. Kalintha, T. Megano, S. Ono, K. Fukui, and M. Numao: Proc. Thirty-fifth SGAI International Conference on Artificial Intelligence (AI-2015), (2015) 301-315.

[8]Error Detection of Oceanic Observation Data Using Sequential Labeling, S. Ono, H. Matsuyama, K. Fukui, and S. Hosoda: Proc. the 2015 IEEE International Conference on Data Science and Advanced Analytics (DSAA2015), (2015) .

[9]Evolutionary Multi-objective Distance Metric Learning for Multi-label Clustering, T. Megano, K. Fukui, M. Numao and S. Ono: Proc. IEEE Congress on Evolutionary Computation (CEC2015), (2015) 2945-2952.

[10]Concept Drift Detection with Self-Organizing Map for Damage Monitoring (oral), Y. Sakamoto, M. Furukawa, K. Fukui, J. Gama, D. Nicklas, K. Moriyama, and M. Numao: Workshop on Computation: Theory and Practice (WCTP-2015), Cebu, Phillippine, September 22-23, 2015.

[11]Individual Sleep Pattern Characterization via Cluster Analysis of Audio Data (oral), H. Wu, K. Fukui, T. Kato, and M. Numao: Workshop on Computation: Theory and Practice (WCTP-2015), Cebu, Phillippine, September 22-23, 2015.

[12]Dry electrode EEG-based music emotion recognition (poster), N. Thammasan, K. Kawintiranon, Y. Buatong, K. Moriyama, K. Fukui, and M. Numao: The 19th SANKEN International The 14 SANKEN

Nanotechnology Symposium, Osaka, Japan, December 7-9, 2015.

[13]A Combination Method of Multi-layer Perceptron and Hierarchical Clustering to Estimate Affect of Similar Users on Music (poster), R. Otsuki, K. Fukui, K. Moriyama, N. Otani, and M. Numao: The 19th SANKEN International The 14 SANKEN Nanotechnology Symposium, Osaka, Japan, December 7-9, 2015.

Review Papers

(Conference report) CEC2015, K. Fukui, Journal of the Japanese Society for Artificial Intelligence, Ohmsha, 30[4] (2015), 556.

Patents

[1]K20150055 Estimation Method of Music Listening Experience, Estimation Device of Music Listening Experience, and Estimation Program of Music Listening Experience, 2015-169802

Contributions to International Conferences and Journals

M. NUMAO	New Generation Computing (Area Editor)
M. NUMAO	Frontiers of Science Symposium (Advisory Board)
M. NUMAO	Pacific Rim International Conference on Artificial Inteligence (Program Committee Member)
M. NUMAO	International Workshop on Empathic Computing (Organizer/Program co-Chair)
M. NUMAO	Workshop on Computing Theory and Practice (General Co-chairs)
M. NUMAO	ICT4 Aging Well (Program Committee member)
M. NUMAO	5th International Conference on E-Service and Knowledge Management (ESKM 2014) (Program Committee member)
K. MORIYAMA	IEICE Transactions on Information and Systems (Associate Editor)
K. MORIYAMA	The 14th International Conference on Autonomous Agents and Multiagent Systems (AAMAS2015) (Program Committee Member)
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. FUKUI	IPSJ Journal of Information Processing (Editorial Member)
K. FUKUI	Workshop on Computation: Theory and Practice (Program Committee Member)

Publications in Domestic Meetings

Annual Conference of the Japan Society of Artificial Intelligence	11 papers
SIG Knowledge-Base Ssytem, the Japan Society of Artificial Intelligence	1 paper
SIG Digital Contents Creation, Information Processing Society of Japan	1 paper

Academic Degrees

Doctor Degree for Information Science D. Sodkomkham	Human Mobility Modeling and Predictive Analysis
Doctor Degree for Information Science I. Puspitasari	Characterization of Individual Health Topic Familiarity in Consumer Health Information Search
Master Degree for Information Science R. Otsuki	Estimation Model for Time-Varying Emotion of Similar Users on Music
Master Degree for Information Science W. Kalintha	Integrating Class Information and Features in Cluster Analysis Based on Evolutionary Distance Metric Learning
Master Degree for Information Science J.L. Hagad	A Flexible Work Stress Modelling Framework Using Physiological Signals and Stress Coping Profiles

Grant-in-Aid for Scientific Research

M. Numao	Distributed Inference to Support Inter-Subjective Formalization and Its Application to Sensor Network	¥1,170,000
K. Fukui	Causality Mining from Event Sequence Data and Its Applications to Causality Discovery in Earthquakes and Damages	¥1,950,000

Department of Quantum Functional Materials

Original Papers

[1]Ferromagnetism in Cr-doped topological insulator TlSbTe2, Wang, Zhiwei; Segawa, Kouji; Sasaki, Satoshi; Taskin, A. A.; Ando, Yoichi: APL MATERIALS, 3 (2015) 83302.

[2]Long-range two-dimensional superstructure in the superconducting electron-doped cuprate Pr0.88LaCe0.12CuO4, Campbell, B. J.; Rosenkranz, S.; Kang, H. J.; Stokes, H. T.; Chupas, P. J.; Komiya, S.; Ando, Y.; Li, Shiliang; Dai, Pengcheng: PHYSICAL REVIEW B, 92 (2015) 14118.

[3]Superconducting Sn1-xInxTe Nanoplates, Sasaki, Satoshi; Ando, Yoichi: CRYSTAL GROWTH & DESIGN, 15 (2015) 2748-2752.

[4]Spin-polarized quantum well states on Bi2-xFexSe3, Yee, Michael M.; Zhu, Z. -H.; Soumyanarayanan, Anjan; He, Yang; Song, Can-Li; Pomjakushina, Ekaterina; Salman, Zaher; Kanigel, Amit; Segawa, Kouji; Ando, Yoichi; Hoffman, Jennifer E.: PHYSICAL REVIEW B, 91 (2015) 161306.

[5]Infrared probe of the bulk insulating response in Bi2-xSbxTe3-ySey topological insulator alloys, Post, K. W.; Lee, Y. S.; Chapler, B. C.; Schafgans, A. A.; Novak, Mario; Taskin, A. A.; Segawa, Kouji; Goldflam, M. D.; Stinson, H. T.; Ando, Yoichi; Basov, D. N.: PHYSICAL REVIEW B, 91 (2015) 165202.

[6]Dual-Gated Topological Insulator Thin-Film Device for Efficient Fermi-Level Tuning, Yang, Fan; Taskin, A. A.; Sasaki, Satoshi; Segawa, Kouji; Ohno, Yasuhide; Matsumoto, Kazuhiko; Ando, Yoichi: ACS NANO, 9 (2015) 4050-4055.

Academic Degrees

Master Degree for Engineering T. Sakai	Signale crystal growth and transport properties of Weyl semimetal candidates TaAs and NbAs
Master Degree for Engineering Y. Maekawa	Fabrication and characterization of dual-gated topological insulator devices

Grant-in-Aid for Scientific Research

Y. Ando	Explorations of Novel Quantum Phenomena in Topological Insulators and Superconductors	¥21,308,000

Department of Semiconductor Materials and Processes

Original Papers

[1]Ultralow reflectivity surfaces by formation of nanocrystalline Si layer for crystalline Si solar cells, D. Irishika, K. Imamura, H. Kobayashi: Sol. Energ. Mat. Sol. C., 141 (2015) 1-6.

[2]High-level doping of nitrogen, phosphorus, and sulfur into activated carbon monoliths and their electrochemical capacitances, G. Hasegawa, T. Deguchi, K. Kanamori, Y. Kobayashi, H. Kageyama, T. Abe, K. Nakanishi: Chem. Mater., 27 (2015) 4703-4712.

[3]High aspect ratio Si micro-holes formed by wet etching using Pt needles, K. Imamura, T. Akai, H. Kobayashi: Mater. Res. Exp., 2 (2015) 075901.

[4]Ultralow Reflectivity and Light Trapping for Crystalline Si Solar Cells by Use of Surface Structure

Chemical Transfer Method on Pyramidal Textured Surfaces, K. Imamura, T. Nonaka, D. Irishika, H. Kobayashi: ECS J. Solid State Sci. Technol., 4 (2015) Q63-Q65.

[5]Hard carbon anodes for Na-ion batteris: toward a practical use, G. Hasegawa, K. Kanamori, N. Kannari, J. Ozaki, K. Nakanishi, T. Abe: ChemElectroChem, 2 (2015) 1917-1920.

[6]Photoluminescence enhancement of adsorbed species on Si, T. Matsumoto, M. Maeda, H. Kobayashi: Nanoscale Res. Lett., 11 (2016) 7.

International Conferences

[1]Improvement of crystalline solar cell characteristics by formation of ultralow reflectivity surface using surface structure chemical transfer method (invited), H. Kobayashi: The 5th Asia-Africa Sustainable Energy Forum and Jointly with 7th International Workshop on Sahara Solar Breeder, Japan.

[2]Chemical methods for improvement of performance of crystalline Si solar cells (invited), H. Kobayashi: 2015 Symposium for Eco Multi-Functional Nano Materials & ISO/TC 107 Workshop, Korea.

[3]Fabrication of Si nanoparticles from Si swarf and enhancement of photoluminescence (oral), T. Matsumoto, M. Maeda, H. Kobayashi: 1st International Conference on Applied Surface Science, China.

[4]Ultra-low reflectivity crystalline Si surfaces fabricated by use of SSCT method and application to high efficiency Si solar cells (oral), K. Imamura, D. Irishika, T. Nonaka, H. Kobayashi: 1st International Conference on Applied Surface Science, China.

[5]Hydrogen generation by reaction of Si nanoparticles fabricated from Si swarf with water (poster), K. Kimura, T. Matsumoto, Y. Kanatani, T. Higo, H. Kobayashi: 1st International Conference on Applied Surface Science, China.

[6]Fast fabrication method of atomically flat SiC surfaces by electrochemical polishing (poster), T. Akai, K. Imamura, H. Kobayashi: 1st International Conference on Applied Surface Science, China.

[7]Fabrication of ultra-low reflectivity Si solar cells with light trapping effect to achieve a high conversion efficiency (poster), T. Nonaka, D. Irishika, K. Imamura, H. Kobayashi: 1st International Conference on Applied Surface Science, China.

[8]Ultralow reflectivity crystalline Si surfaces by formation of nanocrystalline Si layer and application to polycrystalline Si solar cells (poster), D. Irishika, K. Imamura, H. Kobayashi: 1st International Conference on Applied Surface Science, China.

[9]Studies on porous monolithic carbon electrodes for energy storage (oral), G. Hasegawa, K. Kanamori, K. Nakanishi, T. Abe: XVIII International Sol-Gel Conference, Japan.

[10]18.9% efficiency crystalline Si solar cells with simple structure fabricated by surface (invited), H. Kobayashi: ACTSEA-2015, Taiwan.

[11]Si surface control for achieving high conversion efficiencies of crystalline Si solar cells (invited), H. Kobayashi, D. Irishika, T. Nonaka, K. Imamura: Progress in applied surface, interface and thin film science 2015, Italy.

[12]Improvement of crystalline silicon solar cells by the nitric acid oxidation (NAOS) method", Progress in applied surface (invited), T. Matsumoto, R. Hirose, H. Nakajima, H. Kobayashi: Progress in applied surface, interface and thin film science 2015, Italy.

[13]Hydrogen rich water produced by the reaction of Si nanopowder with water (poster), Y. Kobayashi, S.

Matsuda, K. Imamura, H. Kobayashi: Progress in applied surface, interface and thin film science 2015, Italy.

[14]Vapor-phase Transport of Heteroatoms into Porous Carbon Monoliths for High-level Doping (poster), G. Hasegawa, K. Kanamori, Y. Kobayashi, H. Kageyama, T. Abe, K. Nakanishi: 2015 MRS Fall Meeting, United States.

[15]Fabrication mechanism of atomically flat SiC surfaces by electrochemical method (poster), T. Akai, K. Imamura, H. Kobayashi: 3rd KANSAI Nanoscience and Nanotechnology International Symposium, 11th Handai Nanoscience and Nanotechnology International Symposium, Japan.

[16]Ulta-low reflectivity polycrystalline Si surfaces by formation of nanocrystalline Si layer and achievement of high efficiency crystalline Si solar cells (poster), D. Irishika, K. Imamura, H. Kobayashi: 3rd KANSAI Nanoscience and Nanotechnology International Symposium, 11th Handai Nanoscience and Nanotechnology International Symposium, Japan.

[17]Ultra-low reflectivity surfaces with nano-structured Si layer (poster), Y. Onitsuka, K. Imamura, H. Kobayashi: 3rd KANSAI Nanoscience and Nanotechnology International Symposium, 11th Handai Nanoscience and Nanotechnology International Symposium, Japan.

[18]Fabrication of I nanoparticles from Si swarf ad application to Li-ion batteries anode (poster), K. Kimura, T. Matsumoto, Y. Kanatani, T. Higo, H. Kobayashi: 3rd KANSAI Nanoscience and Nanotechnology International Symposium, 11th Handai Nanoscience and Nanotechnology International Symposium, Japan.

Review Papers
Hydrogen rich water produced by the reaction of Si nanopowder with water, H. Kobayashi, K. Kimura, S. Fujie, Y. Kobayashi, K. Imamura, Fuel Cells, Fuel Cell Development Information Center, 15 (2016), 59-62.

Patents
[1]K20140003 Anode materials for lithium ion batteries, manufacturing method of same, manufacturing apparatus, and lithium ion batteries, TW104117976

[2]K20090325 Method and Device for Manufacturing Semiconductor Devices, Semiconductor Device and Transfer member, US9076916

[3]K20080344 Solar cells and their manufacturing method of same, and manufacturing apparatus of same, CN201080006379.8

[4]K20140184 Anode materials for lithium ion batteries, lithium ion batteries, manufacturing method and apparatus of aanode or anode materials for lithium ion batteries, TW104132084

[5]K20140184 Anode materials for lithium ion batteries, lithium ion batteries, manufacturing method and apparatus of aanode or anode materials for lithium ion batteries, PCT/JP2015/076428

[6]K20140260 Manufacturing method of silicon nanoparticles and washing method of same, JP2015-235768

[7]K20100081 Manufacturing apparatus and method of semiconductor appatus, TW1517224

[8]K20150198 Solid preparations, manufacturing method of solid preparations, and hydrogen production method, JP2016-015123

[9]K20140003 Anode materials for lithium ion batteries, manufacturing method of same, manufacturing apparatus, and lithium ion batteries, JP5866589

[10]K20140260 Manufacturing apparatus of solar cells, JPO2016-28429

[11]K20130324 Hydrogen Production Apparatus, Hydrogen Production Method, Silicon Fine Pariticles for Hydrogen Production and Production Method for Sillicon Fine Pariticles for Hydrogen Production, US14/216650

Contributions to International Conferences and Journals

H. Kobayashi	Applied Surface Science (Editor)
H. Kobayashi	1st International Conference on Applied Surface Science (Organizing Committee Chair)
H. Kobayashi	Progress in applied surface, interface and thin film science 2015 (Science Committee Chairperson)
T. Matsumoto	Progress in applied surface, interface and thin film science 2015 (Science Committee)

Publications in Domestic Meetings

Japan Applied Surface Science Meeting	5 papers
Japan Physics Meeting	3 papers
The Electrochemical Society of Japan	2 papers

Academic Degrees

Doctor of Science Fabrication and Application of Silicon Nanopowder from Silicon Swarf
M. Maeda

Grant-in-Aid for Scientific Research

H.Kobayashi	Fabrication of Si nanoparticles from Si swarf and application of Si nanoparticles to silicon solar cells	¥25,090,000
T.Matsumoto	Surface science of highly-doped Si surface for devices in the next generation	¥1,300,000
K.Imamura	Fabrication of ultrathin poly Si solar cells with high light trapping effect using the surface strcture chemical transfer method	¥1,560,000
G.Hasegawa	Hetero-atom doping into carbon materials and application to electrochemical devices	¥2,435,000

Entrusted Research

H. Kobayashi	Japan Science and Technology Agency	Fabrication of silicon surface with ultra-low reflectivity with the interface control method and development of crystalline silicon solar cells with ultra-high efficiency	¥48,000,000

Cooperative Research

H.Kobayashi	IDEC Corporation	¥4,241,000
H.Kobayashi	Nissin Kasei Co., Ltd.	¥0,000

Department of Metallic Materials Process

Original Papers

[1]Effects of stacking sequence and short-range ordering of solute atoms on elastic properties of Mg-Zn-Y alloys with long-period stacking ordered structures, M. Tane, H. Kimizuka, K. Hagihara , S. Suzuki, T. Mayama , T. Sekino and Y. Nagai: Acta Mater., 90 (2015) 170–188.

[2]Elastic-modulus enhancement during room-temperature aging and its suppression in metastable Ti-Nb-based alloys with low body-centered cubic phase stability, M. Tane, K. Hagihara, M. Ueda, T. Nakano and Y. Okuda: Acta Mater., 102 (2016) 373-384.

[3]Effect of Simultaneous Sonication with Horn and Plate Types on the Preparation of Few Layer

Graphite, S.H. Cho, G. Gyawali, S.H. Kim, T.H. Kim, J.H. Choi, S.W. Lee: J. Nanosci. Nanotechnol, 15 (9) (2015) 7376-7380.

[4]Microwave Assisted Hydrothermal Synthesis and Structural Characterization of TiO2 Nanotubes, S.H. Cho, R.Adhikari, S.H. Kim, T.H. Kim, S.W. Lee: J. Nanosci. Nanotechnol, 15 (9) (2015) 7391-7394.

[5]Synthesis of g-C3N4/NaTaO3 Hybrid Composite Photocatalysts and Their Photocatalytic Activity Under Simulated Solar Light Irradiation, T.H. Kim, Y.H. Jo, S.W. Lee, R. Adhikari, S.H. Cho: J. Nanosci. Nanotechnol, 15 (9) (2015) 7125-7129.

[6]Synthesis of Solar-Light-Responsive ZnO/TaON Nanocomposite and Their Photocatalytic Activity, T.H. Kim, Y.H. Jo, S.W. Lee, S.H. Cho, S.H. Kim: J. Nanosci. Nanotechnol, 15 (9) (2015) 7405-7048.

[7]Effect of microwave-assisted hydrothermal process parameters onformation of different TiO2nanostructures, S.H. Cho, H.H. Nguyen, G. Gyawali, J.E. Son, T. Sekino, B. Joshi, S.H. Kim, Y.H. Jo, T.H. Kim, S.W. Lee: Catalysis Today, 266 (2015) 46-52.

[8]Effects of solid lubricant and laser surface texturing on frictional performance of pulse electric current sintered Al2O3–ZrO2 composites, S.H. Jeong, S.H. Kim, T.H. Kim, S.H. Cho, G. Gyawali, S.W. Lee: Ceramics International, 42 (2016) 7830-7836.

[9]Comparative analysis and characterization of TiO2 nanotubes produced by microwave assisted hydrothermal method and normal hydrothermal, S.H. Cho, N.H. Hao,T. Yamaguchi: Journal of Ceramic Processing Research, 17 (1) (2016) 41-45.

[10]CO sensing performance of a micro thermoelectric gas sensor with AuPtPd/SnO_2 catalyst and effects of a double catalyst structure with Pt/ α -Al_2O_3, T. Goto, T. Itoh, T. Akamatsu, W. Shin: Sensors, 15 (2015) 31687-31698.

[11]CO sensing properties of Au/SnO_2-Co_3O_4 catalysts on a micro thermoelectric gas sensor, T. Goto, T. Itoh, T. Akamatsu, N. Izu, W. Shin: Sens. Actuators B: Chem. , 223 (2016) 774-783.

[12]Synthesis of morphologically controlled hydroxyapatite from fish bone by urea-assisted hydrothermal treatment and its Sr^{2+} sorption capacity, T. Goto and K. Sasaki: Powder Technol., 292 (2016) 314-322.

[13]Nanostructured Ti6Al4V alloy fabricated using modified alkali-heat treatment: Characterization and cell adhesion, Y. Su, S. Komasa, T. Sekino, H. Nishizaki, and J. Okazaki: Materials Science and Engineering C, 59 (2016) 617-623.

[14]Characterization and Bone Differentiation of Nanoporous Structure Fabricated on Ti6Al4V Alloy, Y. Su, S. Komasa, T. Sekino, H. Nishizaki, and J. Okazaki: Journal of Nanomaterials, 2015 (2015) 358951.

[15]Graphene/$MxWO_3$ (M = Na, K) nanohybrids with excellent electrical properties, B. Liu, S. Yin, X. Wu, Y. Wang, Y. Huang, T. Sekino, J. Matsushita, S. W. Lee, M. Kobayashi, M. Kakihana, and T. Sato: Carbon, 94 (2015) 309-316.

[16]Fitting accuracy and fracture resistance of crowns using a hybrid zirconia frame made of both porous and dense zirconia, T. Nakamura, T. Sugano, H. Usami, K. Wakabayashi, H. Ohnishi, T. Sekino, and H. Yatani: Dental Materials Journal, 34 (2015) 257-262.

International Conferences

[1]M. Tane, K. Hagihara, M. Ueda, T. Nakano, Y. Okuda: (The 19th SANKEN International Symposium, The Institute of Scientific and Industrial Research (ISIR), Osaka University) (poster) 2016.

[2]K. Yamori, M. Tane, T. Sekino: (14th International Union of Materials Research Societies-International Conference on Advanced Materials) (poster) 2016.

[3]S.H. Cho, J.E. Son, T. Sekino: (17^{th} International Symposium on Eco-materials Processing and Design: first announcement) (poster) 2016.

[4]T. Goto, I.Y. Kim, K. Kikuta, T. Sekino, C. Ohtsuki: (TAM2015 (The 1st International Conference, Tech-Connection of Advanced Materials)) (poster) 2015.

[5]T. Itoh, T. Goto, T. Nakashima, T. Akamatsu, N. Izu, W. Shin: (PACRIM11 (The 11th International Conference of Pacific Rim Ceramic Societies)) (oral) 2015.

[6]K. Sato, W. Shin, T. Goto, T. Itoh, T. Kondo, : , (IABR summit 2015 - IABR's 10th anniversary conference) (poster) 2015.

[7]K. Fujii, H. Nishida, T. Goto, T. Sekino: (IUMRS-ICAM2015 (The 14th International Union of Materials Research Societies-International Conference on Advanced Materials)) (poster) 2015.

[8]H. Nishida, K. Fujii, T. Goto, T. Sekino, (IUMRS-ICAM2015 (The 14th International Union of Materials Research Societies-International Conference on Advanced Materials)) (poster) 2015.

[9]T. Goto, T. Itoh, T. Akamatsu, W. Shin: (IUMRS-ICAM2015 (The 14th International Union of Materials Research Societies-International Conference on Advanced Materials)) (oral) 2015.

[10]W. Jiang, T. Goto, T. Sekino, (JK-Ceramics 32 (The 32nd International Japan-Korea seminar on ceramics)) (oral) 2015.

[11]K. Fujii, H. Nishida, T. Goto, T. Sekino: (The 19th SANKEN International Symposium) (poster) 2015.

[12]K. Fujii, H. Nishida, T. Goto, S. H. Cho, S. W. Lee, T. Sekino, (ISEPD-2016 (17th International Symposium on Eco-materials Processing and Design)) (plenary) 2016.

[13]T. Goto and T. Sekino, : , (ISEPD-2016 (17th International Symposium on Eco-materials Processing and Design)) (oral) 2016.

[14]T. Sekino, K. Fujii, H. Nishida, T. Goto, (ICACC2016(The 40th International Conference & Exposition on Advanced Ceramics & Composites)) (invited) 2016.

[15]H. Nishida and T. Sekino: (The 19th SANKEN International Symposium) (poster) 2015.

[16]T. Sekino: (International symposium of innovative ceramic manufacturing process technology) (invited) 2016.

[17]T. Sekino: (Advanced Materials Challenges for Alternative Energy Solutions (AMAES 2015)) (invited) 2015.

[18]T. Sekino, K. Fujii, H. Nishida, T. Goto, H. Sugiyama, O. Komatsu:, (The 5th International Symposium on Advanced Ceramics and Technology for Sustainable Energy Applications toward a Low Carbon Societ (ACTSEA 2015)) (invited) 2015.

[19]T. Sekino and S. W. Lee : (IUMRS-ICAM2015 (The 14th International Union of Materials Research Societies-International Conference on Advanced Materials)) (invited) 2015.

[20]Tohru Sekino* and Youn-Gyu Han, : , (IUMRS-ICAM2015 (The 14th International Union of Materials Research Societies-International Conference on Advanced Materials)) (poster) 2015.

[21]Tohru Sekino, and Y.-G. Han: (The 11th International Conference on Ceramic Materials and Components for Energy and Environmental Applications (CMCEE-11)) (invited) 2015.

[22]Tohru Sekino*, Hisataka Nishida, and Satoshi Komasa : (The international Workshop of China-Japan-Korea (CJK) in Ceramics Science (CJK2015)) (invited) 2015.

[23]T. Sekino, : , (The 1st International Conference Tech-connection of Advanced Materials (TAM2015)) (plenary) 2015.

[24]T. Sekino, H. Sugiyama, H. Nishida, D.-J. Park, S.-I. Tanaka: (The 11th International Conference on Ceramic Materials and Components for Energy and Environmental Applications (CMCEE-11)) (oral) 2015.

[25]T. Sekino, H. Sugiyama, H. Nishida, S.-I. Tanaka: (2015 Symposium for Eco Multi-Functional Nano Materials & ISO/TC 107 Workshop) (oral) 2015.

Review Papers

Structure and Properties Tuning of Low-dimensional Nanostructured Oxides, T. Sekino, Refractories, The Technical Association of Refractories, Japan, 67 (2015), 457-466.

Breath hydrogen excretion in healty adults-average by gender/age group, and relation to lifestyle, M. Ohso, A. Muramoto, K. Sakuta, N. Inomata, W. Shin, T. Goto, K. Sato, T. Kondo, M. Ohta, K. Tsushita, Stable isotope and Biogas: Medical applications, Japan Society fot Medical Application of Stable Isotope and Biogas, 7 (2015), 9-19.

Books

[1]Solution Processing of Low-dimensional Nanostructured Titanium Dioxide: Titania Nanotubes(M. Singh, T. Ohji, and R. Asthana) T. Sekino, “Green and Sustainable Manufacturing of Advanced Materials”, Elsevier Inc, (475-496) 2015.

Contributions to International Conferences and Journals

T. Sekino	International Journal of Applied Ceramic Technology (Associate Editor)
T. Sekino	The 7th International Symposium on Functional Materials (ISFM2016) (International Advisory Committee)
T. Sekino	The International Symposium on Advanced Functional Materials (ISAFM2016) (International Advisory Committee)
T. Sekino	The Science of Engineering Ceramics (EnCera2016) (Organizing Committee)
T. Sekino	The 4th International Conference on Competitive Materials and Technology Processes (IC-CMTP4) (The Organizers)
T. Sekino	The International Symposium on Hybrid Materials and Processing (HyMaP 2016) (International Advisory Committee)
T. Sekino	The Korea-Japan International Seminar on Ceramics (Organizing Committee)
T. Sekino	The International Symposium on Eco-Materials Processing and Design (ISEPD) (Academic Committee/Editorial Committee)
T. Sekino	Materials Challenges in Alternative and Renewable Energy 2015 (MCARE2015) (International Advisory Committee)
T. Sekino	The 40th International Conference & Exposition on Advanced Ceramics & Composites (ICACC) (Symposiuym Co-organizer)
T. Sekino	The 11th International Conference on Ceramic Materials and Components for Energy and Environmental Applications (11th CMCEE) (Symposium Organizer)
T. Sekino	International Conference on Characterization and Control of Interfaces for High

	Quality Advanced Materials (ICCCI) (Organizing Committee)
T. Sekino	The 14th International Union of Materials Research Societies-International Conference on Advanced Materials (IUMRS-ICAM) (Program/Publication Committee)
T. Sekino	Advanced Ceramics and Technologies for Sustainable Energy Applications toward a Low Carbon Society (ACTSEA) (International Advisory Committee)
T. Sekino	IUPAC Photochemistry 2016 (Local Organizing Committee)
T. Sekino	The 19th SANKEN International Symposium (Organizing Committee)
T. Sekino	PacRim12 (Organizing Committee)
T. Sekino	IUMRS-ICAM 2017 (Organizing Committee)

Publications in Domestic Meetings

2015 Fall Meeting, The Japan Institute of Metals and Materials	3 papers
2016 Spring Meeting, The Japan Institute of Metals and Materials	1 paper
2016Spring Meeting, The Japan Society for Technology of Plasticity	1 paper
The Ceramic Society of Japan, The 28th Fall Meeting	6 papers
The Ceramic Society of Japan, Annual Meeting 2016	7 papers
The Jaoanese Society for Dental Materials and Devices, The 65th General Session	1 paper
Symposium on Materials Science Research Promotion Organization of Osaka University 2015	1 paper
Ceramics Research Symposium 2015	1 paper
The 4th Young Scientist Seminar on Bulk Ceramics Research	1 paper
2015 Annual Meeting of Nano-Macro Materials, Devices, and System Research Alliance Project	1 paper
The Ceramic Society of Japan, Academic Forum on Ceramics Research in Kansai, 2015	1 paper

Academic Degrees

Master Degree for Engineering K. Yamori	Determination of single-crystalline elastic constants from polycrystals with crystallographic texture
Master Degree for Engineering K. Fujii	Innovative structure modification of titania nanotube and its physical-chemical and visible-light responsible photocatalytic functions

Grant-in-Aid for Scientific Research

T. Sekino	Physical Photochemical Functionalization of Oxide Nanotubes through Hierarchical Structure Tuning	¥35,750,000
M. Tane	Elastic properties and thermal expansion coefficient of LPSO phases	¥4,810,000
M. Tane	Elastic properties of Mg alloys and Mg-based intermetallic	¥2,210,000
M. Tane	Development of original method for the determination of single-crystalline elastic properties	¥8,840,000
T. Goto	Hydrothermal synthesis and investigation of hydroxyapatite/titanium or titanic acid compound composites for environmental remediation materials.	¥1,560,000

Contribution to Research

T. Sekino	Nikkato Corporation	¥1,000,000
T. Sekino	Inaba Rubber Co. Ltd.	¥1,500,000
M. Tane	The Light Metal Educational Foundation, Inc.	¥150,000
M. Tane	The amada foundation	¥1,700,000

Cooperative Research

T. Sekino	Sun Moon University	¥5,140,000
T. Sekino	Korea Institute of Ceramic Engineering and Technology (KICET)	¥5,230,000
T. Sekino	Lotus Alloy Co., Ltd.	¥420,000
M. Tane	Toray Industries, Inc.	¥800,000

Department of Advanced Interconnection Materials

Original Papers

[1]Simultaneous synthesis of nano and micro-Ag particles and their application as a die-attachment material, H: Journal of Materials Science, 26 (9) (2015) 7183-7191.

[2]Heel crack propagation mechanism of cold-rolled Cu/Al clad ribbon bonding in harsh environment, H: Journal of Materials Science, 26 (9) (2015) 7277-7289.

[3]Growth and Extension of One–Step Sol–Gel Derived Molybdenum Trioxide Nanorods via Controlling Citric Acid Decomposition Rate, H: Cryst. Growth Des, 15 (9) (2015) 4536-4542.

[4]High-Temperature Die Attachment Using Sn-Plated Zn Solder for Power Electronics, H: Components, Packaging and Manufacturing Technology, IEEE, 5 (7) (2015) 902-909.

[5]Using the Friedman method to study the thermal degradation kinetics of photonically cured electrically conductive adhesives, H: J. Therm. Anal. Calorim, 119 (1) (2015) 425-433.

[6]Targeted kinetic strategy for improving the thermal conductivity of epoxy composite containing percolating multi-layer graphene oxide chains, H: Exp. Polym. Lett, 9 (7) (2016) 608-623.

[7]High performance heat curing copper-silver powders filled electrically conductive adhesives, H: Electron. Mater. Lett, 11 (2) (2015) 315-322.

[8]Nanoscale Dynamic Mechanical Analysis on Heat-Resistant Silsesquioxane Nanocomposite for Power-Device Packaging, H: Materials Science Forum, 821 (2015) 923-926.

[9]Laser-induced forward transfer of high-viscosity silver precursor ink for non-contact printed electronics, H: RSC Adv, (95) (2015) 77942-77947.

[10]Fabrication of flexible copper pattern based on sub-micro copper paste by low temperature plasma technique, H: RSC Adv, (2015) .

[11]Fast fabrication of copper nanowire transparent electrodes by a high intensity pulsed light sintering technique in air, H: Phys. Chem. Chem. Phys, (46) (2015) 31110-31116.

[12]Electromigration behavior in Cu/Ni-P/Sn-Cu based joint system with low current density, H: Microelectronics Reliability, 55 (12) (2015) 2554-2559.

[13]Rapid self-assembly of ultrathin graphene oxide film and application to silver nanowire flexible transparent electrodes, H: RSC ADVANCES, (19) (2016) 15838-15845.

[14]One-Step Fabrication of Stretchable Copper Nanowire Conductors by a Fast Photonic Sintering Technique and Its Application in Wearable Devices, H: ACS APPLIED MATERIALS & INTERFACES, 8 (9) (2016) 6190-6199.

[15]Thermostable Ag die-attach structure for high-temperature power devices, H: Journal of Materials Science: Materials in Electronics, 27 (2) (2016) 1337-1344.

[16]Facile fabrication of stretchable Ag nanowire/polyurethane electrodes using high intensity pulsed light, H: Nano Research, 9 (2) (2016) 401-404.

International Conferences

[1] Electromigration phenomena of soldered joint in power modules for HV (oral), Takuya Kadoguchi, Keisuke Gotoh, Kimihiro Yamanaka, Shijo Nagao, Katsuaki Suganuma: Kansai workshop 2015, Shiga, Japan.

[2] Thermal stability of sintered Ag joint interfaces (oral), Norio Asatani Yukharu Kimoto, Tohru Sugahara, ShijoNagao, Katsuaki Suganuma: 28th Autumn Symposium, Japan Ceramic Association, Toyama, Japan.

[3] Miniaturization of flexible antenna designed by controlled permittivity of paper substrate. (oral), Tetsuji Inui, Hirotaka Koga, Masaya Nogi, Katsuaki Suganuma: MES2015, Osaka Japan.

[4] Improved thermal reliability of Ni plating/Sn-0.7Cu solder joint interface (oral), Takuya Kadoguchi, Naoya Take, Kimihiro Yamanaja, Shijo Nagao, Katsuaki Suganuma: MES2015, Osaka, Japan.

[5] Heterointerface control of power semiconductors operatable in extreme environments (oral), Katsuaki Suganuma, Shijo Nagao, Tohru Sugahara, Emi Yokoi, Hao Zhang, Jinting Jiu: MES2015, Osaka, Japan.

[6] High temperature reliability of Cu/Al clad ribbon wiring for WBG semiconductor power devices (oral), Semin Park, Shijo Nagao, Tohru Sugahara, Emi Yokoi, Katsuaki Suganuma: MES2015, Osaka, Japan.

[7] Advanced packaging technologies for wide band-gap power semiconductors (invited), Katsuaki Suganuma: Vacuum forum 2015.

[8] Synthesis of nanowires and their applications to flexible devices (invited), Katsuaki Suganuma: Chemical Engineering Association 47th Autumn.

[9]Printed electronics: present and future (invited), Katsuaki Suganuma: RadTech Seminar

[10]Nanomaterials for printed electronics and measurement technology (invited), Katsuaki Suganuma: Advanced measurement development center seminar.

[11]Future of electronics opend by print technlogy (invited), Katsuaki Suganuma: Color Materials Advanced Seminar.

[12]Thermostable joininig technology for wide bandgap semiconductors (invited), Katsuaki Suganuma, Shijo Nagao, Tohru Sugahara, Jinting Jiu, Emi Yokoi, Hao Zhang, Shih-kang Lin 2: Applied Physics Association Advanced Power Semiconductor Group 2nd Seminar.
[13]Fabrication of Flexible Thermoelectric Module and its Performance with Packaging Technique for the Applying of Curved Surface (invited), T. Sugahara, Y. Hirose, N. Kagami, K. Suganuma: EMN Meeting 2016.

[14]Super-capacitor paper electrode developed with papermaking and flashlight reduction method (oral), Hirotaka Koga, Hideki Ohata, Hiroshi Uchida, Masaya Nogi, Katsuaki Suganuma: 30th JIEP Spring Meeting, Tokyo, Japan.

[15]Toransportation analysis of electroconducting nanomaterials for printed antenna (oral), Yusuke Goya, Hirotaka Koga, Masaya Nogi, Katsuaki Suganuma: 30th JIEP Spring Meeting, Tokyo, Japan.

[16]Synthesis of Cu nanowires and transparent conductive films (oral), Jinting Jiu, Su Ding, Yue Gao, Tohru Sugahara, Teppei Araki ShijoNagao, Katsuaki Suganuma: 30th JIEP Spring Meeting, Tokyo, Japan.

[17]Thermal-stress degradation of Sintered Ag bonding interface by thermal cycling tests (oral), Norio Asatani, Yukiharu Kimoto, Tohru Sugahara, Shijo Nagao, Katsuaki Suganuma30th JIEP Spring Meeting, Tokyo, Japan.

[18]Molecular weight optimization of PEG solvent in low temperature sintering Cu particle pastefor

power device die-attach (oral), Hiroki Yshikawa, Shijo Nagao, Noriko Kagami, Takahiko Sakaue, Yoichi Kamikohriyama, Takafumi Sasaki, Katsuaki Suganuma30th JIEP Spring Meeting, Tokyo, Japan.

Review Papers
Die-attach technologies for wide-bandgap power semicolnductors, K. Suganuma: Kogyo Zairyo, Nikkan Kogyo Shinbun, 63 (2015), 40-49.

New outlook of printed electronics, K. Suganuma: Robots, Japan Robot Industries Association, 227 (2015), 14-19.

Development status of electric conducting paste ink, K. Suganuma, Kino Zairyo, CMC publishing 35[12] (2015), 4-11.

Materials and processing of stretchable wiring, K. Suganuma: Material Stage 15[9] (2015), 9-15.

Movements in printed electronics technology, K.Suganuma: Plastics Age (2016)、pp.56-61.

Patents
[1]K20130273 Production method of transparent films, 2015-229572

[2]K20140382 Stretchable conducting films, and their farication method, 2015-093063

[3]K20140384 Sysnthesys method of Ag particles, Ag particles, and Ag particle paste, 2015-146958

[4]K20150119 Productioon method of conductive nano cellurose aggregation, 2015-170120

[5]K20150159 Bonding material, the production method of the bonding material, and the production method of the bond structure, 2016-024512

[6]K20150250 Production method of Ag nanowires, 2016-052375

[7]K20150275 Semiconductor device, 2016-027220

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[10]G20150071WO Joint structure, and production method of the joint structure, PCT/JP2015/084519

[11]G20150103WO Productioon methoid of Cu particles, the Cu particles, and Cu particle paste, PCT/JP2016/056851

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[13]K20100197 Boiler waste heat reusing system, 2011-131453

[14]K20100345 Systhesis method of nanoparticles, 2011-123694

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[17]G20120037US Cu patterning composite and the method of creating Cu pattern, 14/358164

[18]G20120091KR Producton method of transparent conductive pattern, 10-2014-7025211

[19]G20120096KR Transparent conductive ink and patterning method of transparent electrode, 10-2014-7029936

Grant-in-Aid for Scientific Research

K.Suganuma	Heterophase interface science in power semiconductor devices for extreme environments	¥17,300,000
T.Daio	3D EM analysis to clarify chemical degradation of solid state polymer fuel cells	¥2,700,000

Entrusted Research

K.Suganuma	New Energy and Industrial Technology Development Organization(NEDO)	SIP（Strategic Inovation Program）/Next generation power electronics/Center of common plat form SiC development/Total research and development of SiC next generation power electronics	¥35,593,000
K.Suganuma	Next generation printedelectronics technololgy cooporation (NEDO)	Research and development of improved high-frequency characteristics of printed TFT integrated circuits	¥4,000,000
K.Suganuma	New Energy and Industrial Technology Development Organization(NEDO)	Clean device social implementation business promotion/Various social implementation of super small power conversion modules using next genration semiconductors	¥56,994,000
K.Suganuma	Rector promotion funding	Technology development in eliabilty inmprovement of metal nanowires using graphen	¥5,848,000

Contribution to Research

K.Suganuma	E Thermogentech CEO, Shutaro Nanbe
K.Suganuma	Kishu Giken CEO Toshiyuki Kamanaka
K.Suganuma	Mimaki Engineering CEO Hisayuki Kobayashi
K.Suganuma	Daicel CEO, CTO　Hisao Nishimura
K.Suganuma	WBG packaging Consortium Katsuaki Suganuma
K.Suganuma	ShowaDenko CTO Isao Murase
K.Suganuma	Uyemura Industires CEO Hiroya Uyemura
K.Suganuma	JX Metal CTO Susumu Kubo
K.Suganuma	Okura KazuchikaFoundation President Toshiaki Kato
K.Suganuma	Senju Metal CTO Satoshi Akita
K.Suganuma	Fujitsu Research President Shigenori Aoki
K.Suganuma	Energy/Recycle Science foundation President Hiroshi Ishikawa
K.Suganuma	E Thremogentech President Shutaro Nanbe
K.Suganuma	Tonen Genral Petroleum Research Promotion Fuondation President Masayshi Okai
S.Nagao	Senju Metal CTO Satoshi Akita

Cooperative Research

K.Suganuma	Cemedine Co
K.Suganuma	Uyematsu
K.Suganuma	Fujitsu Ten
K.Suganuma	Showa Denko
K.Suganuma	Nippon Shokubai

K.Suganuma	Pi Crysital	
K.Suganuma	Uyemura Industry	
K.Suganuma	Denso	
K.Suganuma	Sharp	
K.Suganuma	Stanley Electric	
K.Suganuma	Toppan Forms	
K.Suganuma	Siemens AG, Senju Metal, Showa Denko, Uyemura Industry	
K.Suganuma	Senju Metal, Research Dev.	
K.Suganuma	NIPPON SOKEN,INC.	
K.Suganuma	Mitsui Mining and Smelting, Hkoshima Smelting	
K.Suganuma	Denshi Giken	
K.Suganuma	Senju Metal	
K.Suganuma	imec	
K.Suganuma	Denshi Giken	
K.Suganuma	Daicel	
K.Suganuma	JX Metal	
K.Suganuma	E Thremogentech	
S.Nagao	Senju Metal	

Other Research Fund

K.Suganuma	COI	¥8,460,000
T.Sugahara	Okura Kazuchika Foundation	¥1,000,000
T.Sugahara	Energy Recycling Science Research Promotion Foundation	¥880,000
T.Sugahara	Tonen Genral Petroleum Research Promotion Fuondation	¥1,200,000

Department of Excited Solid-State Dynamics

Original Papers

[1]Photon energy dependence of angle-resolved photoemission spectroscopy in graphene, P. Ayria, A. R. T. Nugraha, E. H. Hasdeo, T. R. Czank, S. Tanaka, R. Saito: Physical Review B, 92 (19) (2015) 195148-1-7.

International Conferences

[1]State-resolved ultrafast dynamics of impact ionization in InSb studied by time- and angle-resolved photoemission spectroscopy (oral), H. Tanimura, J. Kanasaki, K. Tanimura: 9th International Symposium on Ultrafast Surface Dynamics (USD-9).

[2]Momentum-resolved direct-observation of the electron-phonon scattering for graphite and graphene by using ARPES and HREELS (oral), S. Tanaka, M. Matsunami, K. Tanaka, S. Kimura, M. Arita, K. Shimada, K. Mukai, J. Yoshinobu, and T. Maruyama: The 15th International Conference on Vibrations at Surfaces.

[3]Proposal of a new scattering mechanism in the electron energy loss spectroscopy: A case study in graphite (poster), S. Tanaka,K. Mukai and J. Yoshinobu: The 15th International Conference on Vibrations at Surfaces.

[4]Momentum-resolved detection of the electron-phonon scattering in graphene by using ARPES (poster), S. Tanaka, M. Matsunami, K. Tanaka, T. Maruyama: The sixteenth International Conference on the Science and Application of Nanotubes.

[5]The dispersions of the phonons coupling with the electron in the graphite and graphene: An angle-resolved photoelectron spectroscopy study (poster), S. Tanaka, M. Arita and K. Shimada: International Conference on Electron Spectroscopy and Structure: ICESS-2015.

Review Papers

Time- and angle-resolved photoemission spectroscopy study on ultrafast hot-electron dynamics in III-V

semiconductors, J. Kanasaki, H. Tanimura, K. Tanimura, 50[10] (2015), 519-530.

Publications in Domestic Meetings

Annual meeting of the physical society of Japan	2 papers
Joint Symposium of the Surface Sience Society of Japan and the Vacuum Society of Japan	3 papers
Annual meeting of the Japanese society for synchrotron radiation research	2 papers
Fullerenes-Nanotubes-Graphene General Symposium	2 papers

Grant-in-Aid for Scientific Research

S.Tanaka	Elemental processes of the electron-phonon interaction in carbon nanomaterials	¥1,300,000

Department of Accelerator Science

Original Papers

[1]Momentum microscopy of the layered semiconductor TiS2 and Ni intercalated Ni1/3TiS2, Shigemasa Suga, Christian Tusche, Yu-ichiro Matsushita, Martin Ellguth, Akinori Irizawa and Jürgen Kirschner: New Journal of Physics, 17 (2015) 083010.

International Conferences

[1]Nonlinear effects on solids induced by THz FEL , Akinori IRIZAWA, Keigo KAWASE, Ryuko KATO, Masaki FUJIMOTO, Goro ISOYAMA, Kazuyuki SAKAMOTO, and Ken NAGASHIMA: The Second International Symposium on Frontiers in THz Technology (FTT2015), Japan, 8.30-9.2.

[2]Current condition and potential for experimental use of THz FEL at ISIR. (invited), Akinori IRIZAWA: Advanced Accelerator & Radiation Physics, Russia, 11.16-11.18.

Patents

[1]G20130044US, 14/183548

Publications in Domestic Meetings

The 2015 autumn meeting of the physical society of Japan (invited)	1 paper
The 72th annual meeting of the Japan society of infrared science and technology (invited)	1 paper
The 22th meeting of FEL & High-Power Radiation	1 paper
The 3rd chiral meeting	1 paper
The 29th annual meeting of the Japanese society for synchrotron radiation research (invited)	1 paper
The 3rd meeting of novel phenomena created by interactions (invited)	1 paper
Meeting of Institute for Molecular Science (invited)	1 paper

Grant-in-Aid for Scientific Research

G.Isoyama	Development of new operating region of the free electron laser	¥0,000

Entrusted Research

G.Isoyama	Inter-University Research institute Corporation,High Energy Accelerator Research Organization	RF 電子銃用大強度レーザーの開発と若手育成	¥3,000,000

Department of Beam Materials Science

Original Papers

[1]Theoretical study of fabrication of line-and-space patterns with 7-nm quarter-pitch using electron beam lithography with chemically amplified resist processes: I. Relationship between sensitivity and chemical gradient, Takahiro Kozawa: Japanese Journal of Applied Physics, 54 (2015) 056501.

[2]Effects of diffusion constant of photodecomposable quencher on chemical gradient of chemically amplified extreme ultraviolet resists, Takahiro Kozawa: Japanese Journal of Applied Physics, 54 (2015) 056502.

[3]Effect of thermalization distance on chemical gradient of line-and-space patterns with 7 nm half-pitch in chemically amplified extreme ultraviolet resists, T. Kozawa, J. J. Santillan, and T. Itani: Japanese Journal of Applied Physics, 54 (2015) 066501.

[4]Relationship between information and energy carried by photons in extreme ultraviolet lithography: Consideration from the viewpoint of sensitivity enhancement, Shinya Fujii, Takahiro Kozawa, Kazumasa Okamoto, Julius Joseph Santillan, Toshiro Itani: Japanese Journal of Applied Physics, 54 (2015) 086502.

[5]Theoretical study of fabrication of line-and-space patterns with 7-nm quarter-pitch using electron beam lithography with chemically amplified resist processes: II. Stochastic effects, Takahiro Kozawa: Japanese Journal of Applied Physics, 54 (2015) 096501.

[6]Theoretical study of fabrication of line-and-space patterns with 7 nm quarter-pitch using electron beam lithography with chemically amplified resist process: III. Post exposure baking on quartz substrates, Takahiro Kozawa: Japanese Journal of Applied Physics, 54 (2015) 096703.

[7]Theoretical study of fabrication of line-and-space patterns with 7-nm quarter-pitch using electron beam lithography with chemically amplified resist processes: I. Relationship between sensitivity and chemical gradient, Takahiro Kozawa: Japanese Journal of Applied Physics, 54 (2015) 056501.

[8]Effects of diffusion constant of photodecomposable quencher on chemical gradient of chemically amplified extreme ultraviolet resists, Takahiro Kozawa: Japanese Journal of Applied Physics, 54 (2015) 056502.

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[10]Relationship between information and energy carried by photons in extreme ultraviolet lithography: Consideration from the viewpoint of sensitivity enhancement, Shinya Fujii, Takahiro Kozawa, Kazumasa Okamoto, Julius Joseph Santillan, Toshiro Itani: Japanese Journal of Applied Physics, 54 (2015) 086502.

[11]Theoretical study of fabrication of line-and-space patterns with 7-nm quarter-pitch using electron beam lithography with chemically amplified resist processes: II. Stochastic effects, Takahiro Kozawa: Japanese Journal of Applied Physics, 54 (2015) 096501.

[12]Theoretical study of fabrication of line-and-space patterns with 7 nm quarter-pitch using electron beam lithography with chemically amplified resist process: III. Post exposure baking on quartz substrates, Takahiro Kozawa: Japanese Journal of Applied Physics, 54 (2015) 096703.

[13]Quencher diffusion in chemically amplified poly(4-hydroxystyrene-co-t-butyl methacrylate) resist, Takahiro Kozawa, Julius Joseph Santillan, Toshiro Itani: Japanese Journal of Applied Physics, 54 (2015) 118002.

[14]Shot noise limit of sensitivity of chemically amplified resists used for extreme ultraviolet lithography, Shinya Fujii, Takahiro Kozawa, Kazumasa Okamoto, Julius Joseph Santillan, Toshiro Itani: Japanese Journal of Applied Physics, 54 (2015) 116501.

[15]Optimum concentration ratio between photodecomposable quencher and acid generator in chemically amplified extreme ultraviolet resists, Takahiro Kozawa: Journal of Photopolymer Science and Technology,

54 (2015) 126501.

[16]Effect of thermalization distance on stochastic phenomena in 7 nm half-pitch line-and-space pattern fabrication using chemically amplified extreme ultraviolet resists, Takahiro Kozawa, Julius Joseph Santillan, Toshiro Itani: Japanese Journal of Applied Physics, 55 (2016) 026504.

[17]Acid Quantum Efficiency of Anion-bound Chemically Amplified Resists upon Exposure to Extreme Ultraviolet Radiation, Y. Komuro, D. Kawana, T. Hirayama, K. Ohmori, and T. Kozawa: J. Photopolym. Sci. Technol., 28 (2015) 501-505.

[18]Resist material options for extreme ultraviolet lithography, T. Kozawa: Adv. Opt. Techn, 4 (2015) 311-317.

[19]Relationship between Thermalization Distance and Line Edge Roughness in Sub-10 nm Fabrication Using Extreme Ultraviolet Lithography, T. Kozawa, J. J. Santillan, and T. Itani: J. Photopolym. Sci. Technol., 28 (2015) 669-675.

[20]Quick Measurement of Continuous Absorption Spectrum in Ion Beam Pulse Radiolysis: Application of Optical Multi-channel Detector into Transient Species Observation, K. Iwamatsu, Y. Muroya, S. Yamashita, A. Kimura, M. Taguchi, Y. Katsumura: Radiat. Phys. Chem., 119 (2016) 213-217.

[21]Deciphering the reaction between a hydrated electron and a hydronium ion at elevated temperatures, J. Ma, S. Yamashita, Y. Muroya, Y. Katsumura and M. Mostafavi: Phys. Chem. Chem. Phys., 17 (2015) 22934-22939.

[22]Redox-dependent DNA distortion in a SoxR protein-promoter complex studied using fluorescent probes, M. Fujikawa, K. Kobayashi, and T. Kozawa: J. Biochem., 157 (2015) 389-397.

[23]Binding of Promoter DNA to SoxR Protein Decreases the Reduction Potential of the [2Fe-2S] Cluster, K. Kobayashi, M. Fujikawa, and T. Kozawa: Biochemistry, 54 (2015) 334.

[24]The Radical S-Adenosyl-L-methionine Enzyme QhpD Catalyzes Sequential Formation of Intra-protein Sulfur-to-Methylene Carbon Thioether Bonds, T. Nakai, H. Ito, K. Kobayashi, Y. Takahashi, H. Hori, M. Tsubaki, K. Tanizawa, and T. Okajima: J. Biol. Chem., 292 (2015) 11144.

[25]Synthesis of Hyperbranched Polyacetals via An + B2-Type Polyaddition (n=3, 8, 18, and 21): Candidate Resists for Extreme Ultraviolet Lithography, H. Kudo, S. Matsubara, H. Yamamoto, and T. Kozawa: J. Polym. Sci. Part A: Polym. Chem., 53 (2015) 2343-2350.

[26]High-aspect-ratio patterning by ClF3-Ar neutral cluster etching, H.Yamamoto, T. Seki , J. Matsuo , K. Koike, and T. Kozawa: Microelectron. Eng., 141 (2015) 145-149.

[27]Study on radiation chemistry of fluorinated polymers for EUV resist, N. Nomura, K. Okamoto, H. Yamamoto, T. Kozawa, R. Fujiyoshi, and K. Umegaki: Japanese Journal of Applied Physics, 54 (2015) 06FE03.

[28]Synthesis and Resist Properties of Hyperbranched Polyacetals, H. Kudo, S. Matsubara, H. Yamamoto, and T. Kozawa: J. Photopolym. Sci. Technol., 28 (2015) 125-129.

International Conferences

[1]Relationship between Thermalization Distance and Line Edge Roughness in Sub-10nm Fabrication of Extreme Ultraviolet Lithography (invited), Takahiro Kozawa1, Julius Joseph Santillan2, and Toshiro Itani2, Osaka Univ.1, EIDEC2, Japan: The 32nd International Conference of Photopolymer Science and Technology Material & Process for Advanced Microlithography, Nanotechnology and Phototechnology.

[2]Shot noise effects in extreme ultraviolet lithography (oral), T. Kozawa1, J. Joseph Santillan2, T. Itani2 (1Osaka University, 2EIDEC): 13th Fraunhofer IISB Lithography Simulation Workshop.

[3]Resist material options for extreme ultraviolet lithography (invited), T. Kozawa: 41th MICRO and NANO ENGINEERING.

[4]Pulse Radiolysis in Concentrated Poly(4-hydroxystyrene) Solution:Acid Generation Dynamics in EUV and Electron Beam Chemically Amplified Resist (poster), K. Okamoto 1, T. Ishida 1, H.Yamamoto 2, T. Kozawa 2, R. Fujiyoshi 1 and K. Umegaki 1, 1Hokkaido Univ. and 2 Osaka Univ., Japan : 28th International Microprocesses and Nanotechnology Conference.

[5]Radiation Chemistry of Fluorinated Compounds with 2-Hydroxyhexafluoro-Isopropyl Group :Reaction Mechanism of Extreme Ultraviolet Resist (poster), N. Nomura 1, K. Okamoto 1, H. Yamamoto 2, T. Kozawa 2, R. Fujiyoshi 1 and K. Umegaki 1, 1 Hokkaido Univ. and 2 Osaka Univ., Japan: 28 t h International Microprocesses and Nanotechnology Conference.

[6]Shot Noise Limit of Sensitivity of Chemically Amplified Resists Used for Extreme-Ultraviolet (EUV) Lithography (oral), S. Fujii 1, T. Kozawa 2, K. Okamoto 1, J.J. Santillan 3 and T. Itani 3, 1 Hokkaido Univ., 2 Osaka Univ. and 3 EIDEC, Japan: 28 t h International Microprocesses and Nanotechnology Conference.

[7]Study on stochastic phenomena induced in chemically amplified poly(4-hydroxystyreneco-t-butyl methacrylate) resist (high-performance model resist for extreme-ultraviolet lithography), (oral), Takahiro Kozawa, Osaka Univ. (Japan); Julius J. Santillan, Toshiro Itani, EUVL Infrastructure Development Ctr., Inc. (Japan): SPIE ADVANCED LITHOGRAPHY 2016.

[8]EB and EUV lithography using inedible cellulosebased biomass resist material (oral), Satoshi Takei, Makoto Hanabata, Toyama Prefectural Univ. (Japan); Akihiro Oshima, Miki Kashiwakura, Takahiro Kozawa, Seiichi Tagawa, Osaka Univ. (Japan): SPIE ADVANCED LITHOGRAPHY 2016.

[9]Observation of Solvated Electron at Elevated Temperatures Up to Supercritical Condition by The Newly Improved ps Pulse-probe System (oral), Yusa Muroya, Daisuke Hatomoto, Tesuro Yoshida, Yosuke Katsumura, Mingzhang Lin, Shinichi Yamashita, Jean Paul Jay Gerin, Takahiro Kozawa: 15th International Congress of Radiation Research.
[10]Pulse Radiolysis Study on n-propanol at High Temperature / Pressure Conditions (poster), Tetsuro Yoshida, Yusa Muroya, Shinichi Yamashita, Yosuke Katsumura, Takahiro Kozawa: 15th International Congress of Radiation Research.

[11]Pulse Radiolysis Study on n-propanol at High Temperature / Pressure Conditions (poster), Tesuro Yoshida, Yusa Muroya, Shinichi Yamashita, Yosuke Katsumura, Takahiro Kozawa: 15th International Congress of Radiation Research.

[12]Radiolysis of water at high temperature and pressure conditions:: A picosecond pulse radiolysis experiment and numerical simulations (poster), Yusa Muroya, Tetsuro Yoshida, Yosuke Katsumura, Shinichi Yamashita, Mingzhang Lin, Takahiro Kozawa: Symposium on Water Chemistry and Corrosion in Nuclear Power Plants in Asia-2015.

[13]Picosecond Pulse Radiolysis Study on n-propanol at High Temperature / High Pressure (poster), Tesuro Yoshida, Yusa Muroya, Shinichi Yamashita, Yusuke Katsumura and Takahiro Kozawa: 6 t h Asia Pacific Symposium on Radiation Chemistry(APSRC-2016).

[14]Deprotonation of Guanine Cation Radical in Quadruplex from Telomeric DNA (poster), Kazao Kobayashi, Takahiro Kozawa: 15th International Congress of Radiation Research.

[15]Structure and Function of SoxR (poster), Mayu Fujikawa, Kazuo Kobayashi, and Takahiro Kozawa: Metals in Biology.

[16]Fundamental Study on Dissolution Behavior of Poly(methyl methacrylate) for Development of High Resolution Resist Materials (poster), Akihiro Konda, Hiroki Yamamoto, Masaki Mitsuyasu, Takahiro Kozawa, Shusuke Yoshitake: Photomask Japan 2015.

[17]Study on Fusion between Electron Beam Lithography and Self-assembly for Advanced Patterning (poster), Hiroki Yamamoto, Takahiro Kozawa: 15th International Congress of Radiation Research.

[18]Fundamental Study on Dissolution Behavior of Poly(methyl methacrylate) for Extreme Ultraviolet Lithography (poster), Akihiro Konda, Hiroki Yamamoto, Masaki Mitsuyasu, Takahiro Kozawa, Shusuke Yoshitake: 15th International Congress of Radiation Research.

[19]Dissolution Dynamics of Chemically Amplified Resists for Extreme Ultraviolet Lithography Studied by Quartz Crystal Microbalance (invited), Masaki Mitsuyasu, Hiroki Yamamoto and Takahiro Kozawa: 2015 International Workshop on EUV Lithography.

[20]Study on Dissolution Behavior of Poly(4-hydroxystyrene) as model Polymer of Chemically Amplified Resists for Extreme Ultraviolet Lithography (oral), Masaki Mitsuyasu, Hiroki Yamamoto, Takahiro Kozawa: The 32nd International Conference of Photopolymer Science and Technology Material & Process for Advanced Microlithography, Nanotechnology and Phototechnology.

[21]Effect of Acid Generator Concentration on Dissolution Behavior of Chemically Amplified Resist Used for lonizing Radiations (poster), A.Konda1, H.Yamamoto1, S.Yoshitake2 and T.Kozawa1, 1Osaka Univ. and 2 NuFlare technol., Japan: 28ｔｈ International Microprocesses and Nanotechnology Conference.

[22]Fundamental study on dissolution behavior of poly(methyl methacrylate) using by quartz crystal microbalance, (poster), Akihiro Konda, Hiroki Yamamoto, Osaka Univ. (Japan); Shusuke Yoshitake, NuFlare Technology, Inc. (Japan); Takahiro Kozawa, Osaka Univ. (Japan): SPIE ADVANCED LITHOGRAPHY　2016.

[23]Radiation-induced synthesis of metal nanoparticles in ethers THF and PGMEA (oral), Hiroki Yamamoto, Takahiro Kozawa, Seiichi Tagawa, Jean-Louis Marignier, Mehran Mostafavi, Jacqueline Belloni: Pacifichem 2015.

[24]Study on Resist Performance of Chemically Amplified Molecular Resist based on Noria Derivative and Calixarene Derivative for EUV lithography (poster), Hiroki Yamamoto, Hiroto Kudo, Takahiro Kozawa: 2015 International EUVL Symposium.

[25]Suprresion of stochastic effects in chemically amplified resist processes for extreme ultraviolet lithography (invited), Takahiro Kozawa1, Julius Joseph Santillan2, and Toshiro Itani2, Osaka Univ.1, EIDEC2, Japan: 2015 International EUVL Symposium.

Review Papers

Physiological roles of uric acid as radical scavenger, K. Kobayashi, Hyperuricemia and Gout, Medical Review, 23 (2015), 114-119.

Progress in Radiation Chemistry of Sub- and Super-critical Solutionｓ, Yusa Muroya, Shinichi Yamashita, Mingzhang Lin, Yosuke Katsumura, RADIATION CHEMISTRY, Japanese Society of RADIATION CHEMISTRY, 100 (2015), 33-36.

Contributions to International Conferences and Journals

T.Kozawa	2015 International Symposium on Extreme Ultraviolet Lithography (Program Steering Committee)
T.Kozawa	28th International Microprocesses and Nanotechnology Conference (Organaizing Committtee)
T.Kozawa	29th International Microprocesses and Nanotechnology Conference (Organaizing Committtee)
T.Kozawa	29th International Microprocesses and Nanotechnology Conference (Steering Committee)
Y.Muroya	The 5th Asia Pacific Symposium on Radiation Chemistry (Steering Committee)
H. Yamamoto	28th International Microprocesses and Nanotechnology Conference (Program Committee)

Publications in Domestic Meetings

The 51th Japan Radioisotope Association Meeting	2 papers
The 88th Annual Meeting of the Japanese Biochemical Society	1 paper
59th annual meeting of Japan Society of Nuclear and Radiochemical Science	1 paper
SARAC2015	3 papers
The 24th Polymer Materials Forum	1 paper
2015 Autumn Meeting of Atomic Energy Society of Japan	2 papers
2016 Spring Meeting of Atomic Energy Society of Japan	1 paper
64th SPSJ Annual Meeting	1 paper

Academic Degrees

Master Degree for Engineering A.Konda	Study on Main Chain Scission and Dissolution Behavior of Poly(methyl methacrylate) Induced by Ionizing Radiation
Master Degree for Engineering T.Yoshida	Study on the early processes of radiation-induced reactions in n-propanol at high temperature and high pressure conditions

Grant-in-Aid for Scientific Research

T. Kozawa	Study on nano chemistry induce in nanofabrication materials using combination of quantum beams	¥8,060,000
Y. Muroya	Investigation of radiation-induced reaction process of supercritical water for fundamentals of	¥8,450,000
Y. Muroya	water chemistry of the next generation water-cooled reactor.	¥780,000
H. Ymamoto	Creation of Nanofabrication process for extreme quantum beam using organic-inorganice hybrid nanoparticles	¥4,550,000

Entrusted Research

Y. Muroya	Central Research Institute of Electric Power Industry
Y. Muroya	Central Research Institute of Electric Power Industry

Contribution to Research

T. Kozawa	Nissan Chemical Industries,Ltd	¥1,000,000
T. Kozawa	DAIHACHI CHEMICAL INDUSTRY CO.,LTD.	¥200,000
T. Kozawa	Clariant (Japan) K.K.	¥1,000,000

Cooperative Research

T. Kozawa	Nissan Chemical Industries,Ltd	
T. Kozawa	Taiwan Semiconductor Manufacturing Conductor (TSMC)	
T. Kozawa	MITSUBISHI GAS CHEMICAL COMPANY, INC.	
T. Kozawa	NuFlare Technology, Inc.	
T. Kozawa	Toyo Gosei Co., Ltd	¥600,000

Other Research Fund

Y. Muroya	Japan Science and Technology Agency	¥1,640,000

Department of Molecular Excitation Chemistry

Original Papers

[1]Proton Transfer of Guanine Radical Cation Formed upon One-Electron Oxidation Studied by

Time-resolved Resonance Raman Spectroscopy Combined with Pulse Radiolysis, J. Choi, C. Yang, M. Fujitsuka, S. Tojo, H. Ihee, and T. Majima: J. Phys. Chem. Lett., 6 (24) (2015) 5045–5050.

[2]Radical Ions of Cyclopyrenylene: Similarity and Difference from Cycloparaphenylenes, M. Fujitsuka, S. Tojo, T. Iwamoto, E. Kayahara, S. Yamago, and T. Majima: J. Phys. Chem. A, 119 (118) (2015) 4136-4141.

[3]Detection of structural changes upon one-electron oxidation and reduction of stilbene derivatives by time-resolved resonance Raman spectroscopy during pulse radiolysis and theoretical calculations, M. Fujitsuka, D. W. Cho, J. Choi, S. Tojo, T.Majima: J. Phys. Chem. A, 119 (26) (2015) 6816–6822.

[4]How Does Guanine:Cytosine Base Pair Affect Excess-Electron Transfer in DNA?, S-H. Lin, M. Fujitsuka, and T. Majima: J. Phys. Chem. B, 119 (25) (2015) 7994-8000.

[5]Emission from charge recombination during the pulse radiolysis of bis(diarylamino)dihydro-indenoindene derivatives, C. Lu, M. Fujitsuka, S. Tojo, W. J. Wang, Y. Wei, T. Majima: J. Phys. Chem. C, 119 (31) (2015) 17818–17824.

[6]Mesolysis mechanisms of aromatic thioether radical anions studied by pulse radiolysis and DFT calculation, M. Yamaji, S. Tojo, M. Fujitsuka, A. Sugimoto, and T. Majima: J. Org. Chem., 80 (16) (2015) 7890-7895.

[7]The unprecedented J-aggregate formation of rhodamine moieties induced by 9-phenylanthracenyl substitution, S. Kim, M. Fujitsuka, N. Tohnai, T. Tachikawa, I. Hisaki, M. Miyata, and T. Majima: Chem. Commun., 51 (58) (2015) 11580-11583.
[8]Plasmon-Induced Spatial Electron Transfer between Single Au Nanorod and ALD-coated TiO2: Dependence on TiO2 Thickness, Z. Zheng, T. Tachikawa, and T. Majima: Chem. Commun., 51 (2015) 14373-14376.

[9]Dual Electron Transfer Pathways from the Excited C60 Radical Anion: Enhanced Reactivities due to Photoexcitation of Reaction Intermediates, M. Fujitsuka, T. Ohsaka, and T. Majima: Phys. Chem. Chem. Phys., 17 (46) (2015) 31030-31038.

[10]Dynamics of Excess-Electron Transfer via Consecutive Thymines versus Alternating Adenine−Thymine Sequences in DNA, S.-H. Lin, M. Fujitsuka, and T. Majima: Chem. Eur. J., 21 (45) (2015) 16190-16194.

[11]DNA Microenvironment Monitored by Controlling Redox Blinking, K. Kawai, K. Higashiguchi, A. Maruyama, and T. Majima: ChemPhysChem, 16 (17) (2015) 3590-3594.

[12]Selective photoredox activity controlled on specific facet-dominated TiO2 mesocrystals, P. Zhang, T. Tachikawa, Z. Bian, and T. Majima: Appl. Catal. B Environ., 176 (2015) 678-686.

[13]TiO_2 mesocrystal with nitrogen and fluorine codoping during topochemical transformation: efficient visible light induced photocatalyst with the effect of codopants, P. Zhang, M. Fujitsuka, and T. Majima: Appl. Catal. B Environ., 185 (2015) 181‑188.

[14]Singlet-Singlet and Singlet-Triplet Annihilations in Structure-Regulated Porphyrin Polymers, M. Fujitsuka, K. Satyanarayana, T.-Y. Luh, and T. Majima: J. Photochem. Photobiol. A Chem., (2015) accepted.

[15]Covalently-attached-ferrocene dyads: synthesis, redox-switched emission, and observation of the charge-separated state, M. Abe, H. Yamada, T. Okawara, M. Fujitsuka, T. Majima, and Y. Hisaeda: Inorg. Chem., 55 (1) (2016) 7–9.

[16]Nanoplasmonic Photoluminescence Spectroscopy at Single-Particle Level: Sensing for Ethanol Oxidation, Z. Zheng and T. Majima: Angew. Chem. Int. Ed., 55 (8) (2016) 2879-2883.

[17]Atomic Layer Deposition-Confined Nonstoichiometric TiO_2 Nanocrystal with Tunneling Effect for Solar Driven Hydrogen Evolution, P. Zhang, T. Tachikawa, M. Fujitsuka, and T. Majima: J. Phys. Chem. Lett., 7 (7) (2016) 1173-1179.

[18]Multistep Electron Transfer Systems Including [2.2]- or [3.3]Paracyclophane, M. Fujitsuka, T. Miyazaki, C. Lu, T. Shinmyozu, and T. Majima: J. Phys. Chem. A, 120 (8) (2016) 1184-1189.

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[20]Reply to the Comment on “Proton Transfer of Guanine Radical Cations Studied by Time-resolved Resonance Raman Spectroscopy Combined with Pulse Radiolysis”, J. Choi, C. Yang, M. Fujitsuka, S. Tojo, H. Ihee, and T. Majima: J. Phys. Chem. B, 120 (11) (2016) 2987-2989.

[21]In Situ Topotactic n-Type F-Doping into TiO_2 Mesocrystal Superstructures for Efficient Visible-Light Driven Hydrogen Generation, P. Zhang, T. Tachikawa, M. Fujitsuka, and T. Majima: ChemSusChem, 9 (6) (2016) 617-623.

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[25]Pulse radiolysis studies of mesolytic processes with benzylic carbon-oxygen bond cleavage in radical anions of aryl benzyl ethers, M. Yamaji, S. Tojo, M. Fujitsuka, A. Sugimoto, and T. Majima: Bull. Chem. Soc. Jpn., (2016) accepted.

International Conferences

[1]Charge Transfer in DNA and its Application (plenary), T. Majima: Korean Biochip Society Spring Meeting, May 21, Gyeonggi-do, Korea (2015).

[2]Progress in Radiation Chemistry and Dosimetry in Biological Materials (invited), T. Majima: 15th International Congress of Radiation Research (ICRR2015), May 25-29, Kyoto, Japan (2015).

[3]Study on Radical Ions of Oligomers by Time-Resolved Resonance Raman Spectroscopy during Pulse Radiolysis (oral), M. Fujitsuka and T. Majima: 15th International Congress of Radiation Research (ICRR2015), May 25-29, Kyoto, Japan (2015).

[4]Single-Particle Study of Pt-Modified Au Nanorods for Plasmon-Enhanced Hydrogen Generation in Visible to Near Infrared Region (invited), T Majima: 11th Korea-Japan Symposium on Frontier Photoscience –2015, Jun. 26-28, Jeju, Korea (2015).

[5]Properties of Triplet-Excited [n]Cycloparaphenylenes (n = 8 – 12) (invited), C. Lu, T. Iwamoto, E. Kayahara, S. Yamago, and T. Majima: 11th Korea-Japan Symposium on Frontier Photoscience –2015, Jun. 26-28, Jeju, Korea (2015).

[6]Electron Transfer in S2-Excited Sb- and Ge Tetraphenylporphyrins with an Electron Donor Substituent at the Meso-Position (poster), M. Fujitsuka, T. Shiragami, D. W. Cho, M. Yasuda, and T. Majima: 11th Korea-Japan Symposium on Frontier Photoscience –2015, Jun. 26-28, Jeju, Korea (2015).

[7]Single-Molecule Chemistry of Nanocatalysis for Light Energy Conversion (plenary), T. Majima: 27th International Conference on Photochemistry, Jun. 28-Jul. 3, Jeju, Korea (2015).

[8]Photoinduced Electron Transfer Processes from Excited Naphthalene Diimide Radical Anions as an Efficient Electron Donor (oral), M. Fujitsuka, S-S. Kim, and T. Majima: 27th International Conference on Photochemistry, Jun. 28-Jul. 3, Jeju, Korea (2015).

[9]Radical Ions of Cycloparaphenylenes: Size-Dependence Contrary to the Neutral Molecules (poster), M. Fujitsuka, S. Tojo, T. Iwamoto, E. Kayahara, S. Yamago, and T. Majima: 27th International Conference on Photochemistry, Jun. 28-Jul. 3, Jeju, Korea (2015).

[10]Single molecule chemistry of photoenegry conversion systems (plenary), T. Majima: Fundamental Theory and Experimental Techniques for the Researchers on solar Energy Utilization, Jul. 30-Aug. 2, Dalian, China (2015).

[11]Metal Oxide Mesocrystals with Effective Charge Transport Pathways (plenary), T. Majima: Annual Meeting of Korean Society of Photoscience, Aug. 25, Seoul, Korea (2015).

[12]Far-Red Fluorescence Probe for Monitoring Singlet Oxygen during Photodynamic Therapy (invited), T. Majima: Asia Oceania Conference on Photobiology, Nov. 15-18, Taipei, Taiwan (2015).

[13]Excess Electron Transfer in DNA (invited), M. Fujitsuka: Asia Oceania Conference on Photobiology, Nov. 15-18, Taipei, Taiwan (2015).

[14]Single-particle, -molecule analysis of TiO_2 photocatalytic reaction (invited), T. Majima: The 2015 International Chemical Congress of Pacific Basin Societies (Pacifichem), Dec. 15-20, Hawaii, USA (2015).

[15]Single-molecule fluorescence imaging (invited), T. Majima: The 2015 International Chemical Congress of Pacific Basin Societies (Pacifichem), Dec. 15-20, Hawaii, USA (2015).

[16]Time Resolved Resonance Raman Spectroscopy during Pulse Radiolysis of Functional Molecules (invited), M. Fujitsuka and T. Majima: 13th DAE-BRNS Biennial Trombay Symposium on Radiation & Photochemistry and 6th Asia Pacific Symposium on Radiation Chemistry (APSRC-2016), Jan. 5-9, Mumbai, INDIA (2016).

[17]Metal Oxide Mesocrystals with Efficient Charge Transport Properties (plenary), T. Majima: 2016 International Symposium on Resource Chemistry, Jan. 15-16, Shanghai, China (2016).

[18]Charge Transfer in DNA (oral), T. Majima: International Conference on Polymers for energy and Environmental Application (Annual Meeting of the Polymer Society 2016), Jan. 29-30, Taipei, Taiwan (2016).

[19]Chemical reaction studied by pulse radiolysis (invited), T. Majima: 2016 3rd KAERI-Osaka University Workshop on Radiation Research, Feb. 24-25, Osaka, Japan.

[20]Pulse radiolysis-transient resonant Raman spectroscopy (invited), M. Fujitsuka: 2016 3rd KAERI-Osaka University Workshop on Radiation Research, Feb. 24-25, Osaka, Japan.

Review Papers

New development of pulse radiolysis of functionall molecules, T. Majima, Radiation Chemistry, Japanese Society of Radiation Chemistry, 99 (2015), 9-21.

Excess electron transfer in DNA, M. Fujitsuka, T. Majima, Chemical Indeustry, Chemical Indeustry Co., Ltd., 55[7] (2015), 497-502.

Photoinduced Electron Transfer of Porphyrin Isomers: Impact of Molecular Structures on Electron Transfer Dynamics, M. Fujitsuka, T. Majima, Chem. Asian J., John Wiley & Sons, Inc., 10 (2015), 2320-2326.

Fluorescence detection of singlet oxygen in cells during photodynamic therapy, S. Kim, T. Majima, Chemical Engineering, Chemical Indeustry Co., Ltd., 60[9] (2015), .

Radiation chemistry of organic compounds, T. Majima, Radiation Chemistry, Japanese Society of Radiation Chemistry, 100 (2015), 18.

Books

[1]Photochemistry of DNA(T. Majima, M. Iino, Y. Shichida, T. Todo) T. Majima, “Encyclopedia of Photobiology”, Asakura Publishing Co., Ltd., 4[145] (296-297) 2015.

[2]Photochemical reactions of DNA(T. Majima, M. Iino, Y. Shichida, T. Todo) T. Majima, “Encyclopedia of Photobiology”, Asakura Publishing Co., Ltd., 4[146] (298-299) 2015.

[3]photoinduced electron transfer(T. Majima, M. Iino, Y. Shichida, T. Todo) M. Fujitsuka, “Encyclopedia of Photobiology”, Asakura Publishing Co., Ltd., 1[19] (38-39) 2015.
[4]Fluorescence labeling of DNA(T. Majima, M. Iino, Y. Shichida, T. Todo) K. Kawai, “Encyclopedia of Photobiology”, Asakura Publishing Co., Ltd., 5[178] (364-365) 2015.

[5]Confocal microscopy and two-photon excitation microscopy(T. Majima, M. Iino, Y. Shichida, T. Todo) Y. Osakada, “Encyclopedia of Photobiology”, Asakura Publishing Co., Ltd., 5[187] (382-383) 2015.

Patents

[1]K20140401 Chemical reagent for colorimetric analysis of halogen ions and singlet oxygen and singlet oxygen deteting reagent, 2015-115290

[2]G20150006WO Fluorescence probe, singlet oxygen detecting reagent, and singlet oxygen detecting method, PCT/JP2015/067522

Contributions to International Conferences and Journals

T. MAJIMA	26th IUPAC International Symposium on Photochemistry (Chair, Organizing Committee)
M. FUJITSUKA	26th IUPAC International Symposium on Photochemistry (Secretary-general, Organizing Committee)
T. MAJIMA	Rapid Communication in Photoscience, (Editorial Board)
T. MAJIMA	ChemPlusChem (Co-chair)
T. MAJIMA	Photochemistry and Photobiology (Associate Editor)
T. MAJIMA	Asian and Oceanian Society of Photobiology (Secretary-general, Committee)

Publications in Domestic Meetings

The 37th Japan Photomedicine and Photobiology Meeting	1 paper
Japan Photochemistry Meeting 2013	2 papers
2nd Young Researchers Symposium on Molecule Tecchnology, 'New Development of Organic Photochemistry'	1 paper
Symposium on Catalysts	1 paper
The 96th Japan Chemical Society Meeting	2 papers

Academic Degrees

Doctor Degree for Engineering P. Zhang	Studies on Photocatalyst of TiO2 Mesocrystals with Versatile Functions for Solar Energy Conversion Technique
Doctor Degree for Engineering S. Lin	Studies on Structure-Property Relationship in Excess-Electron Transfer in DNA Using Laser Flash Photolysis and Photoelectrochemical Technique
Master Degree for Engineering A. Kuroda	Development of fluorescent sensor for biomolecule using DNA-aptamer-modified microspheres
Master Degree for Engineering K. Nomura	Properties of Covalent Organic Frameworks (COFs) comprising porphyrins

Grant-in-Aid for Scientific Research

T. Majima	Single-molecule chemistry of nanocatalysts for light energy conversion	¥0,000
T. Majima	Single-molecule chemistry of nanocatalysts for light energy conversion	¥28,600,000
T. Majima	Development of high efficient solar energy exchange materials via rare-earth metal doped semiconductor photocatalysts	¥1,200,000
T. Majima	Development of high efficient plasmonic enhanced electrocatalytic oxidation in fuel cells with the visible light irradiation	¥600,000
M. Fujitsuka	Dynamics of excited state reactive intermediatesof supramolecules and polymers	¥3,510,000
K. Kawai	Development of single-molecule level analysis techniques for RNA editing and chemical modifications	¥0,000
K. Kawai	Single molecule analysis of the dynamics of superhelical DNA	¥1,430,000
Y. Osakada	Development of hard X-ray excited optical luminescence materials beyond 1000 nm emission wavelength toward depth tomographic imaging	¥1,430,000

Entrusted Research

T. Majima	Japan Science and technology Agency	Study on unstable reactive species of CPP	¥15,600,000

Contribution to Research

Y. Osakada	Research Grant, The Murata Science Foundation	¥1,600,000

Department of Synthetic Organic Chemistry

Original Papers

[1]Pd-Catalyzed Enantioselective Intramolecular α-Arylation of α-Substituted Cyclic Ketones: Facile Synthesis of Functionalized Chiral Spirobicycles, L. Fan, S. Takizawa, Y. Takeuchi, K. Takenaka, H. Sasai: Org. Biomol. Chem., 13 (2015) 4837-4840.

[2]Palladium(II)-Catalyzed Intramolecular Carboxypalladation–Olefin Insertion Cascade: Direct Access to Indeno[1,2,-b]furan-2-ones, P. Vinoth, T. Vivekanand, P. A. Suryavanshi, J. C. Menendez, H. Sasai, V. Sridharan: Org. Biomol. Chem., 13 (2015) 5175-5181.

[3]Enantioselective and Aerobic Oxidative Coupling of 2-Naphthols Derivatives Using Chiral Dinuclear Vanadium(V) Complex in Water, M. Sako, S. Takizawa, Y. Yoshida, H. Sasai: Tetrahedron: Asymmetry, 26 (2015) 613-616.

[4]Pd(II)-Catalyzed Diastereoselective and Enantioselective Domino Cyclization/Cycloaddition Reactions of Alkenyl Oximes for Polycyclic Heterocycles with Four Chiral Stereogenic Centers, M. A. Abozeid, S. Takizawa, H. Sasai: Tetrahedron Lett., 56 (2015) 4316-4319.

[5]Structural Features and Asymmetric Environment of i-Pr-SPRIX Ligand, K. Takenaka, X. Lin, S. Takizawa, H. Sasai: Chirality, 27 (2015) 532-537.

[6]Palladium-Catalyzed Direct C–H Arylation of Isoxazoles at the 5-Position, M. Shigenobu, K. Takenaka, H. Sasai: Angew. Chem. Int. Ed., 54 (2015) 9572-9576.

[7]An Enantioselective Organocatalyzed aza-Morita-Baylis-Hillman Reaction of Isatin-derived Ketimines with Acrolein, Y. Yoshida, M. Sako, K. Kishi, H. Sasai, S. Hatakeyama, S. Takizawa: Org. Biomol. Chem., 13 (2015) 9022-9028.

[8]Phosphine-Catalyzed β,γ-Umpolung Domino Reaction of Allenic Esters: Facile Synthesis of Tetrahydrobenzofuranones Bearing a Chiral Tetrasubstituted Carbon Stereogenic Center, S. Takizawa, K. Kishi, Y. Yoshida, S. Mader, F. A. Arteaga, S. Lee, M. Hoshino, M. Rueping, M. Fujita, H. Sasai: Angew. Chem. Int. Ed., 54 (2015) 15511-15515.

[9]Enantioselective Organocatalytic Oxidation of Ketimines, S. Takizawa, K. Kishi, M. A. Abozeid, K. Murai, H. Fujioka, H. Sasai: Org. Biomol. Chem., 14 (2016) 761-767.

International Conferences

[1]Palladium-Catalyzed Direct C–H Arylation of Isoxazoles at The 5-Position (poster), Shigenobu, M.; Takenaka, K.; Sasai, H.: 18th IUPAC International Symposium on Organometallic Chemistry Directed Towards Organic Synthesis (OMCOS18), Barcelona, Spain, June 28-July 2, 2015.

[2]Vanadium Complex Catalyzed Enantioselective Synthesis of Oxa[9]helicene (poster), Takizawa, S.; Sako, M.; Takeuchi, Y.; Tsujihara, T.; Yoshida, Y.; Kodera, J.; Kawano, T.; Sasai, H.: 18th IUPAC International Symposium on Organometallic Chemistry Directed Towards Organic Synthesis (OMCOS18), Barcelona, Spain, June 28-July 2, 2015.

[3]Enantioselective Organocatalyzed Formal Cycloaddition Reactions Based on the aza-Morita-Baylis-Hillman Process (poster), S. Takizawa, H. Sasai: The 39th Naito Conference, Hokkaido, Japan, July 6-9, 2015.

[4]Enantioselective and Aerobic Oxidative Coupling of 2-Naphthol Derivatives Using Chiral Dinuclear Vanadium Complex in Water (poster), M. Sako, S. Takizawa, Y. Yoshida, H. Sasai: The 3rd International Symposium on Process Chemistry, Kyoto, Japan, July 13-15, 2015.

[5]Enantioselective Synthesis of Oxa[9]helicenes Using Chiral Vanadium Catalysts (poster), S. Takizawa, M. Sako, Y. Takeuchi, T. Tsujihara, J. Kodera, T. Kawano, H. Sasai: 15th International Conference on Chiroptical Spectroscopy, Hokkaido, Japan, August 30-September 3, 2015.

[6]Catalytic Cyclative Haloacetoxylation Based on Palladium Enolate Umpolung (oral), K. Takenaka, S. C. Mohanta, H. Sasai: Aachen-Osaka Joint Symposium “Biological and Chemical Methods for Selective Catalysis”, Aachen, Germany, September 1-2, 2015.

[7]Vanadium(V)-Catalyzed Enantioselective C–C Bond Forming Reactions (oral), M. Sako, S. Takizawa, Y. Yoshida, H. Sasai: Aachen-Osaka Joint Symposium “Biological and Chemical Methods for Selective Catalysis”, Aachen, Germany, September 1-2, 2015.

[8]Spiro Chiral Ligand-Pd(II) Complex Catalyzed Enantioselective Construction of Heterocycles (poster), M. A. Abozeid, S. Takizawa, H. Sasai: The 13th International Kyoto Conference on New Aspects of Organic Chemistry (IKCOC-13), Kyoto, Japan, November 9-13, 2015.

[9]Organocatalyzed Synthesis Of Heterocycles Bearing a Chiral Tetrasubstituted Carbon Center (poster),

S. Takizawa, K. Kishi, H. Sasai: The 13th International Kyoto Conference on New Aspects of Organic Chemistry (IKCOC-13), Kyoto, Japan, November 9-13, 2015.

[10]Recent Progress of Enantioselective Pd-Catalysis Promoted by Spiro-type Chiral Ligands (poster), S. C. Mohanta, M. Shigenobu, K. Wakita, K. Takenaka, B. M Chaki, H. Sasai: The 13th International Kyoto Conference on New Aspects of Organic Chemistry (IKCOC-13), Kyoto, Japan, November 9-13, 2015.

[11]Enantioselective organocatalyzed formal [n+2] cycloaddition using allenoates (invited), S. Takizawa, H. Sasai: PACIFICHEM 2015.

[12]Spiro Chiral Ligand-Pd(II) Complex Catalyzed Enantioselective Construction of Heterocycles (poster), M. A. Abozeid, S. Takizawa, H. Sasai: The 8th Takeda Science Foundation Symposium on PharmaSciences, Osaka, Japan, January 21-22, 2016.

[13]Enantioselective Organocatalyzed Synthesis of Tetrahydrobenzofuranones Bearing a Tetrasubstituted Stereogenic Center (poster), K. Kishi, S. Takizawa, Y. Yoshida, S. Mader, M. Rueping, H. Sasai: The 8th Takeda Science Foundation Symposium on PharmaSciences, Osaka, Japan, January 21-22, 2016.

[14]Synthetic Studies on Heterohelicene Derivatives Using Vanadium-catalyzed Oxidative Reaction (oral), M. Sako, K. Ichinose, S. Takizawa, H. Sasai: Aachen-Osaka Joint Symposium “Biotechnology and Chemistry for Green Growth”, Osaka, Japan, March 9-10, 2016.

[15]Enantioselective Organocatalyzed [3+2] Annulation via Umpolung Domino Reaction of Allenoates (oral), K. Kishi, S. Takizawa, Y. Yoshida, S. Mader, M. Rueping, H. Sasai: Aachen-Osaka Joint Symposium “Biotechnology and Chemistry for Green Growth”, Osaka, Japan, March 9-10, 2016.

[16]Vanadium complex catalyzed enantioselective synthesis of oxa[9]helicenes (oral), S. Takizawa, M. Sako, H. Sasai: The 251st ACS National Meeting and Exposition, San Diego, USA March 13-17, 2016.

[17]Palladium Enolate Umpolung: Catalytic Cyclative Difunctionalization of Alkynyl Cyclohexadienones Using SPRIX Ligand (poster), S. C. Mohanta, K. Takenaka, H. Sasai: 16th Asian Chemical Congress (16ACC), Dhaka, Bangladesh, March 16-19, 2016.

[18]Development of Dual Activation Catalysts (plenary), H. Sasai: 7th National Conference on Science and Technology (Science, Technology and Innovation for Nepal’s Graduation to Developing Country Status), Kathmandu, Nepal, March 29-31, 2016.

[19]Development of Organocatalytic Enantioselective [n+2] Type Annulations (invited), H. Sasai, S. Takizawa: EMN Hawaii meeting "Energy Materials Nanotechnology".

Review Papers

1,2-Difunctionalization of Alkenes and Alkynes via Palladium(II)/Palladium(IV) Catalytic Cycle, K. Takenaka, J. Synth. Org. Chem. Jpn., The Society of Synthetic Organic Chemistry, Japan, 73[10] (2015), 964-976.

Reactivity Control of Palladium(II) Complexes: Development of New Enantioselective Palladium Catalysis, K. Takenaka, Chemistry & Chemical Industry, The Chemical Society of Japan, 68[12] (2015), 1123-1124.

Patents

[1]K20150238 Phosphorus-containing polyanilines and the synthetic methods, 2016-021092
[2]K20150239 Cathod catalysts for fuel cell, 2016-021090

[3]G20120072US Method for producing epoxy compound, US 926689

[4]G20120073US Method for producing alicyclic diepoxy compound, US 9212188

[5]G20120075US Method for producing epoxy compound, US 9187443

[6]K20080100 New Heteroaromatic Compounds, K20080100

[7]K20080101 New Heteroaromatic Polymers, K20080101

Publications in Domestic Meetings

Annual Meeting of The Chemical Society of Japan	12 papers
Symposium on Molecular Chirality	1 paper
Seminar on Organic Reaction for Young Chemists	2 papers
Symposium on Organometallic Chemistry	3 papers
Hokuriku Seminar on Organic Synthetic Chemistry	2 papers
CSJ Chemistry Festa	1 paper
Symposium on Reaction and Synthesis	3 papers
Symposium on Organic Synthesis	1 paper

Academic Degrees

Doctor Degree for Science K. Wakita	Development of New Chiral Ligands Bearing Isoxazoline/Isoxazole Donors
Doctor Degree for Science Ismiyarto	Ir-Catalyzed Asymmetric Redox Reaction and Utilization for Synthesis of Natural Products
Master Degree for Science M. A. Abozeid Hussein	Spiro Chiral Ligand-Pd(II) Complex Catalyzed Enantioselective Construction of Heterocycles
Master Degree for Science T. Sakai	Vanadium-Catalyzed Regioselective Asymmetric Oxidative Coupling of 2-Naphthol Derivatives
Master Degree for Science K. Sawada	Development of New Catalytic Reaction Based on Palladium Enolate Umpolung

Grant-in-Aid for Scientific Research

S. Takizawa	Development of Multifunctional Organocatalysts and their Applications to Enantioselective Domino Reactions	¥3,510,000
J. Ichihara	Reaction mechanism of the halogen-free epoxidation reaction by the environmentally friendly powder reaction	¥0,000
K. Takenaka	New Synthetic Strategy for Carbonyl Compounds Based on Palladium Enolate Umpolung	¥2,080,000

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	¥13,390,000
T. Hirao	Japan Science and Technology Agency	Development of advanced molecular transformation technology based on design of environmental benign redox systems consisting of early	¥5,590,000

transition metals

Contribution to Research

H. Sasai	Nagase & Co., LTD.	¥700,000
H. Sasai	Nagase ChemteX Corporation	¥500,000
H. Sasai	Nissan Chemical Industries, Ltd.	¥400,000
S. Takizawa	Itoh Chubei Foundation	¥500,000

Cooperative Research

J. Ichihara	OKAWARA MFG. Co., Ltd.	¥0,000

Other Research Fund

H. Sasai	National Institute of Natural Sciences, Institute for Molecular Science	¥2,700,000
S. Takizawa	Japan Society for the Promotion of Science	¥1,000,000

Department of Regulatory Bioorganic Chemistry

Original Papers

[1]A hybridisation-dependent membrane-insertable amphiphilic DNA, Dohno, C.; Matsuzaki, K.; Yamaguchi, H.; Shibata, T.; Nakatani, K.: Org. Biomol. Chem., 13 (2015) 10117-10121.

[2]Exploratory Study on the RNA-Binding Structural Motifs by Library Screening Targeting pre-miRNA-29a, Fukuzumi, T.; Murata, A.; Aikawa, H.; Harada, Y.: Nakatani, K.: Chem. Eur. J., 21 (2015) 16859-16867.

International Conferences

[1]A novel ligand that selectively targets CUG trinucleotide repeats (poster), J. Li, J. Mastumoto, L. Bai, C. Dohno, Z. Jiang, K. Nakatani: RNA2015, The 20th Annual Meeting of the RNA Society.
[2]Regulation of gene expression by ligand-inducible -1 ribosomal frameshifting (poster), S. Matsumoto, A. Murata, C. Hong, K. Nakatani: RNA2015, The 20th Annual Meeting of the RNA Society.

[3]In vitro selection of pre-miRNA loop mutant molecules that bind to the restrained naphthyridine dimer (poster), A. Murata, Y. Mori, Y. Di, A. Sugai, K. Nakatani: RNA2015, The 20th Annual Meeting of the RNA Society.

[4]Rational design of synthetic ligand dependent ribozyme (oral), C. Dohno, M. Kimura, I. Kohyama, J. Song, K. Nakatani: ISNAC2015.

[5]A novel ligand that selectively targets CCG trinucleotide repeats (poster), J. Li, C. Dohno, K. Nakatani: ISNAC2015.

[6]Synthesis and Binding Property of Naphthyridine-Azaquinolone Derivatives Targeting (CAG)n Repeat RNA (poster), A. Sakata, Jinxing Li, H. He, L. Bai, A. Murata, C. Dohno, S. Obika, K. Nakatani: ISNAC2015.

[7]Evaluation of Small Molecule Ligands that Bind to GGGGCC Repeats (poster), J. Matsumoto, S. Matsumoto, C. Dohno, and K. Nakatani: ISNAC2015.

[8]Small molecule-Loop Interaction that interferes the maturation on process of pre-miRNA by Dicer (poster), Y. Mori, Y. Di, A. Sugai, A. Murata, K. Nakatani: ISNAC2015.

[9]Regulation of gene expression by ligand-inducible -1 ribosomal frameshifting (poster), S. Matsumoto, A. Murata, C. Hong, K. Nakatani: ECBS & ICBS joint meeting 2015.

[10]Modulation of binding properties of DNA assemblies to lipid bilayer membrane (poster), C. Dohno, S. Makishi, H. Yamaguchi, K. Nakatani: Pacifichem2015.

[11]A small-molecule inhibitor of pre-miR-29 maturation (poster), A. Murata, T. Otabe, J. Zhang, K. Nakatani: Pacifichem2015.

[12]Synthesis and evaluation of naphthyridine derivatives having amino sugar (poster), H. Aikawa, Y. Okada, H. Ito, K. Nakatani: Pacifichem2015.

[13]Synthesis and properties of functional trinucleotide repeat-binding molecules to induce chemical transformation of trinucleotide repeats (poster), T. Yamada, K. Nakatani, A. Michikawa: Pacifichem2015.

[14]Design and evaluation of the specific ligand for CTG repeat sequence (poster), J. MATSUMOTO, J. Li, K. Nakatani: Pacifichem2015.

[15]Toward DNA-detecting FET devices with ligand-immobilized gate surface (poster), A. Michikawa, R. Verma, N. Sabani, K. Nakatani: Pacifichem2015.

[16]SPR-based in vitro selection of pre-miRNA loop mutant molecules that bind to the restrained naphthyridine dimer (poster), Y. Mori, Y. Di, A. Sugai, A. Murata, K. Nakatani: Pacifichem2015.

[17]Binding of amphiphilic DNAs with different secondary structures to lipid bi- layer membrane. (poster), H. Yamaguchi, K. Matsuzaki, T. Shibata, C. Dohno, K. Nakatani: Pacifichem2015.

[18]Analysis of binding of naphthyridine-azaquinolone derivatives to CAG repeats RNA (poster), A. Sakata, J. Li, H. He, A. Murata, C. Dohno, S. Obika, K. Nakatani: Pacifichem2015.

[19]Investigations of 2,7-diaminonaphthyridine conjugates for monitoring the hairpin probe PCR (poster), R. Verma, F. Takei, K. Nakatani: Pacifichem2015.

Books

[1]Non-covalent Modification of Double-Stranded DNA at the Mismatch and Bulged Site(K. Nakatani, Y. Tor) C. Dohno, K. Nakatani, “Modified Nucleic Acids”, Springer International Publishing, 31 (189-207) 2016.

[2]Folding RNA-Protein Complex into Designed Nanostructures(L. Ponchon) T. Shibata, Y. Suzuki, H. Sugiyama, M. Endo, H. Saito, “RNA Scaffolds”, Springer International Publishing, 1316 (169-179) 2015.

Patents

[1]G20150035WO PCR method and PCR kit, PCT/JP2015/073755

[2]G20120087US Method for detecting single nucleotide polymorphism in nucleic acid, 14/352208

Publications in Domestic Meetings

The 96th CSJ Annual Meeting 2016	6 papers
The 136th Annual Meeting of the Pharmaceutical Society of Japan	1 paper
10th Annual Meeting of Japanese Society for Chemical Biology	1 paper
Biochemistry and Molecular Biology (BMB) 2015	2 papers
1st Annual Meeting of Nucleic Acids Therapeutics Society of Japan	1 paper
Japanese Society for Cell Synthesis Research 8.0	1 paper

Academic Degrees

Doctoral Degree for Science T. Otabe	Regulation of the microRNA maturation process using a small molecule.
Doctoral Degree for Science J. Li	Studies on Trinucleotide Repeat Disease using Repeat-Binding Molecules

Master Degree for Science J. Matsumoto	Development of CTG trinucleotide repeat binding molecules
Master Degree for Science A. Michikawa	Studies on DNA/RNA mismatch binding molecules having nucleophilic functional group & fabrication of DNA sensor made of Au-SiO2 immobilized with mismatch binding molecules
Master Degree for Science Y. Mori	A novel naphtyridine derivative RND modulates maturation of miRNA
Master Degree for Science H. Yamaguchi	Studies on lipid membrane binding amphiphilic DNAs forming G-quadruplex
Master Degree for Pharmaceutical Sciences A. Sakata	Synthesis and evaluation of novel naphthyridine-azaquinolone derivatives targeting d(CAG) and r(CAG) repeats

Grant-in-Aid for Scientific Research

K, Nakatani	Chemical Biology Studies on Trinucleotide Reat Disease using Repat-Binding Molecules	¥0,000
K. Nakatani	Chemical Biology Studies on Trinucleotide Reat Disease using Repat-Binding Molecules	¥75,110,000
K. Nakatani	Studies on organic reader molecules toward single base resolution in nanopore sequencing	¥1,100,000
C. Dohno	Transformation and recognition of shape of lipid membrane by DNA nanostructures	¥1,820,000
A. Murata	Induction of -1 ribosomal frameshifting by a small molecule and its application to protein transport and localization	¥1,690,000
A. Murata	Gene regulation by small molecule-modulated miRNA pathway	¥0,000
H. Aikawa	Developments of new modification reactions of peptide and development of new amide isosteres	¥0,000
T. Yamada	Development of small molecules which inhibit expansion of a CAG trinucleotide repeat tract	¥2,080,000
T. Shibata	Construction of functional molecular robots using RNA/RNP nanostructures	¥3,068,000

Entrusted Research

K. Nakatani	JST	Development of Digital Hairpin Primer OCR for Diagnosis of Hepatitis	¥990,000

Cooperative Research

K. Nakatani	NITTO KASEI co.,ltd.	¥864,000
K. Nakatani	Yamato Scientific co.,ltd.	¥396,000

Department of Organic Fine Chemicals

Original Papers

[1]Potential applications of epigallocatechin gallate-fatty acid derivatives as antiviral agents., K. Kaihatsu: Journal of Antivirals & Antiretrovirals, 7 (2015) lv-lvi.

[2]A derivative of epigallocatechin-3-gallate induces apoptosis via SHP-1-mediated suppression of BCR-ABL and STAT3 signalling in chronic myelogenous leukaemia, J. H. Jung, M. Yun, E. J. Choo, S. H. Kim, M. S. Jeong, D. B. Jung, H. Lee, E. O. Kim, N. Kato, B. Kim, S. K. Srivastava, K. Kaihatsu, S. H. Kim: Br. J. Pharmacol., 172 (14) (2015) 3565-3578.

[3]Loss of G2 subunit of vacuolar-type proton transporting ATPase leads to G1 subunit upregulation in the brain, N. Kawamura, G. H. Sun-Wada, Y. Wada: Sci Rep, 5 (2015) 14027.

[4]DABCO- and DBU-intercalated α-zirconium phosphate as latent thermal catalysts in the copolymerization of glycidyl phenyl ether (GPE) and hexahydro-4-methylphthalic anhydride (MHHPA), O. Shimomura, T. Nishisako, S. Yamaguchi, J. Ichihara, M. Kirino, A. Ohtaka, R. Nomura: J. Mol. Cata. A: Chem., 411 (2016) 230-238.

[5]Pretreatment Prediction of Individual Rheumatoid Arthritis Patients' Response to Anti-Cytokine Therapy Using Serum Cytokine/Chemokine/Soluble Receptor Biomarkers, K. Uno, K. Yoshizaki, M. Iwahashi, J. Yamana, S. Yamana, M. Tanigawa, K. Yagi: PLoS One, 10 (7) (2015) e0132055.

[6]Intracellular Generation of a Diterpene-Peptide Conjugate that Inhibits 14-3-3-Mediated Interactions, P. Parvatkar, N. Kato, M. Uesugi, S. Sato, J. Ohkanda: J. Am. Chem. Soc., 137 (50) (2015) 15624-15627.

[7]Combined treatment with tamoxifen and a fusicoccin derivative (ISIR-042) to overcome resistance to therapy and to enhance the antitumor activity of 5-fluorouracil and gemcitabine in pancreatic cancer cells, T. Miyake, Y. Honma, T. Urano, N. Kato, J. Suzumiya: Int. J. Oncol., 47 (1) (2015) 315-324.

International Conferences
[1]Improved DNA binding specificity of tolane-modified peptide nucleic acid and its application for virus detection. (oral), K. Kaihatsu, N. Kato: The 42nd International Symposium on Nucleic Acids Chemistry.

[2]Rapid identification of RNA viruses by peptide nucleic acid chromatography, (poster), K. Kaihatsu, N. Kato: Pacifichem-2015.

[3]Sialic acid-modified nucleic acids that bind to all kinds of influenza viruses. (poster), K. Kaihatsu, N. Kato: Pacifichem-2015.

[4]Sialyllactose-modified 3-way junction DNA as an inhibitor of influenza hemagglu- tinin. (oral), K. Kaihatsu, N. Kato: Pacifichem-2015.

[5]Diagnosis of influenza virus drug-resistant by tolane modified peptide nucleic acid chromatography, (poster), K. Kaihatsu, N. Kato: The 8th Takeda Science Foundation Symposium on Pharma Sciences, “Biomolecule-Based Medicinal Science: Featuring Mid-Size Drugs”.

[6]Sequence specific detection of RNA viral gene by chemically-modified peptide nucleic acid (oral), K. Kaihatsu, N. Kato: 6th Euro Virology Congress and Expo.

[7]SBDD approach of the novel inhibitor of bacterial multidrug efflux transporter (oral), S. Yamasaki, Y. Higuchi, A. Yamaguchi, N. Kato: Pacifichem-2015.

[8]Synthesis and structure function relationship study of fusicoccin/cotylenin analogs (oral), Y. Higuchi, F. Yesil, T. Yoneyama, C. Ottmann, J. Ohkanda, N. Kato: Pacifichem-2015.

Review Papers
Role of vacuolar-type proton ATPase in signal transduction, G. H. Sun-Wada, Y. Wada, Biochim. Biophys. Acta, Elsevier, 1847 (10) (2015), 1166-1172.

Membrane dynamics in mammalian embryogenesis: Implication in signal regulation., Y. Wada, G. H. Sun-Wada, N. Kawamura, J. Yasukawa, Birth Defects Res. C Embryo Today, Wiley, 108 (1) (2016), 33-44.

Patents
[1]K20150129 Nucleic acid sequence discrimination methodology using peptide nucleic acid modified with alkoxy type-tolane derivatives at the N-terminal, JP2015-184545

[2]K20100101 Influenza virus detection method using azobenzene-tethered peptide nucleic acid., 2010-222951

[3]G20120072US Method for producing epoxy compound., 14/402398

[4]G20120073US Manufacture of alicyclic diepoxides by epoxidizing alicyclic olefins in the presence of solid carriers and solid catalysts., 14/402376

[5]G20120075US Method for producing epoxy compound., 14/402481

[6]G20100018EPGB Epigallocatechin gallate derivatives for antiviral agents., G20100018EPGB

Contributions to International Conferences and Journals

K. Kaihatsu	Journal of Antivirals and Antiretrovirals (Editorial Board)

Publications in Domestic Meetings

The Chemical Society of Japan	2 papers
12th Biooptics	1 paper
Japan Catechinology	1 paper
136th Annual Meeting of the Pharmaceutical Society of Japan	1 paper
10th Annual Meeting of Japanese Society for Chemical Biology	2 papers

Academic Degrees

Master Degree for Science T. Fukuoka	Studies on an evaluation method to ditect activity of sphingosine-1-phosphate transporter by use of click chemistry
Bachelor Degree for Science R. Ashimura	Production of point-mutated 14-3-3 proteins

Grant-in-Aid for Scientific Research

Y. Wada	Microautophagy as a regulatory mechanism in early embryogenesis	¥5,070,000
Y. Wada	A novel endocytic pathway, microautophagy	¥1,170,000
K. Kaihatsu	Highly sensitive and rapid detection method for acute dengue virus infection	¥5,590,000
K. Kaihatsu	Highly sensitive detection method for a single-base mismatch of virus gene by chemically modfied peptide nucleic acid	¥4,550,000
K. Kaihatsu	Development of artificial nucleoprotein for sensitive detection of RNA virus	¥1,950,000
K. Kaihatsu	Evaluation of virus evolution and human pathogenicity risk in H5N1 avian infuenza virus endemic area	¥800,000
K. Kaihatsu	Development of Sugar-modified 3-way junctin nucleic acid for detecting of any influenza viruses	¥200,000
K. Kaihatsu	Evaluation of influenza prevention effect of mask containing novel tea catechin derivative	¥100,000

Entrusted Research

N. Kato	Japan Science and Technology agency	Design and synthesis of universal inhibitors for bacterial efflux pumps	¥18,070,000
K. Kaihatsu	Japan Agency for Medical Research and Development	Novel Strategic Development of Osaka University and Thailand Research Collaboration on Emerging and Re-emerging Infections	¥2,500,000

Contribution to Research

N. Kato	K. Yoshizaki	¥1,200,000
N. Kato	N. Kato	¥1,500,000

Cooperative Research

K. Kaihatsu	Rico Co. Ltd.,	¥1,000,000
K. Kaihatsu	Protectea Ltd.	¥684,000

Other Research Fund

K. Kaihatsu	Japan Society for the Promotion of Science	¥2,250,000

Department of Biomolecular Science and Reaction

Original Papers

[1]Virosomes of hepatitis B virus envelope L proteins containing doxorubicin: synergistic enhancement of human liver-specific anti-tumor growth activity by radiotherapy., Q. Liu, J. Jung, M. Somiya, M. Iijima, N. Yoshimoto, T. Niimi, A.D. Maturana, S.H. Shin, S.Y. Jeong, E.K. Choi, S. Kuroda: Int. J. Nanomed., 10 (2015) 4159-4172.

[2]One-step scalable preparation method for non-cationic liposomes with high siRNA content., M. Somiya, K. Yamaguchi, Q. Liu, T. Niimi, A.D. Maturana, M. Iijima, N. Yoshimoto, S. Kuroda: Int. J. Pharm., 490 (2015) 316-323.

[3]Intracellular trafficking of bio-nanocapsule-liposome complex: identification of fusogenic activity in the pre-S1 region of hepatitis B virus surface antigen L protein., M. Somiya, Y. Sasaki, T. Matsuzaki, Q. Liu, M. Iijima, N. Yoshimoto, T. Niimi, A.D. Maturana, S. Kuroda.: J. Control. Release, 212 (2015) 10-18.

[4]Probing the catalytic mechanism of copper amine oxidase from Arthrobacter globiformis with halide ions., T. Murakawa, A. Hamaguchi, S. Nakanishi, M. Kataoka, T. Nakai, Y. Kawano, H. Yamaguchi, H. Hayashi, K. Tanizawa, T. Okajima: J. Biol. Chem., 290 (2015) 23094-23109.

[5]Scaffold protein enigma homolog activates CREB whereas a short splice variant prevents CREB activation in cardiomyocytes, J. Ito, M. Iijima, N. Yoshimoto, T. Niimi, S. Kuroda, A.D. Maturana: Cell Signal., 27 (2015) 2425-2433.

[6]Mapping the heparin-binding site of the osteoinductive protein NELL1 by site-directed mutagenesis., K. Takahashi, A. Imai, M. Iijima, N. Yoshimoto, A.D. Maturana, S. Kuroda, T. Niimi: FEBS Lett., 589 (2015) 4026-4032.

[7]Deciphering the receptor repertoire encoding specific odorants by time-lapse single-cell array cytometry., M. Suzuki, N. Yoshimoto, K. Shimono, S. Kuroda: Sci. Rep., 6 (2016) 19934.

[8]Bio-nanocapsules displaying various immunoglobulins as an active targeting-based drug delivery system., K. Tatematsu, M. Iijima, N. Yoshimoto, T. Nakai, T. Okajima, S. Kuroda: Acta Biomaterialia, 35 (2016) 238-247.

International Conferences

[1]Efficient one-step preparation of siRNA-encapsulated non-cationic liposomes (oral), M. Somiya, K. Yamaguchi, S. Kuroda: 2015 Annual Meeting of Controlled Release Society, Jul., 2015, Edinburgh, UK.

[2]Bio-nanocapsule scaffold for oriented immobilization and clustering of sensing molecules on biosensor surfaces (poster), M. Iijima, S. Kuroda: 4th International Conference on Bio-Sensing Technology, May 10-13, 2015, Lisbon, Portugal.

[3]Role of the pre-S1 fusogenic domain in the early infection machinery of HBV (oral), M. Somiya, S. Kuroda: 2015 International Meeting on Molecular Biology of Hepatitis B Viruses, Oct., 2015, Bad Nauheim, Germany.

[4]Bio-nanocapsule-based scaffold for biosensing techniques: A clustering and oriented immobilization of

sensing molecules (poster), M. Iijima, S. Kuroda: The 19th SANKEN International Symposium, The Institute of Scientific and Industrial Research (ISIR), Osaka University, December 8-10, 2015, Osaka, Japan.
[5]Detection of vimentin using antibody-modified nanoneedle and AFM to eliminate undifferentiated iPS cells (invited), K. Shimizu, R. Kawamura, T. Kobayashi, M. Iijima, S. Kuroda, F. Iwata, K. Fukazawa, K. Ishihara, C. Nakamura: Pacifichem 2015, December 15-20, 2015, Honolulu, USA.

[6]Decipherment of olfactory receptor repertoire by using an automated single-cell analysis and isolation system equipped with real-time calcium imaging device (invited), N. Yoshimoto, M. Suzuki, K. Shimono, S. Kuroda: Pacifichem 2015, December 15-20, 2015, Honolulu, USA.

Review Papers
Bio-nanocapsule-based scaffold for biosensing molecules: enhancement of sensitivity by the clustering and oriented immobilization of sensing molecules, M. Iijima, S. Kuroda, Journal of Bioscience and Bioengineering, The Society for Biotechnology, Japan, 93 (2015), 248-258.

Development of a Virus-mimicking Nanocarrier for Drug Delivery Systems: the Bio-nanocapsule, M. Somiya, S. Kuroda, Adv. Drug Deliv. Rev., Elsevier, 95 (2015), 77-89.

Automated isolation and analysis system of single-cell for developing novel cell-breeding technology, N. Yoshimoto, S. Kuroda, Bioscience & Industry, Japan Bioindustry Association, 74 (2016), 30-33.

Potential of a non-cationic liposomes-based delivery system for nucleic acid medicines, M. Somiya, S. Kuroda, Drug Delivery Systems, The Japan Society of Drug Delivery System, 31 (2016), 35-43.

Books
[1]Bionanocapsule (K. Maruyama) M. Iijima, S. Kuroda, “The Protocols for the Preparation of DDS Carriers.”, CMC Publishiing, (118-129) 2015.

[2]Elucidation of mechanism for bionanocapsule-liposome complex (virosomes) to escape from endosome and its application to si-RNA delivery to cytoplasm. (N. Oku, S. Yamada, Y. Kagawa, S. Sakai, N. Namiki) M. Somiya, K. Yamaguchi, S. Kuroda, “Progress on DDS studies XXIV”, Shizuoka DDS Association, (75-80) 2015.

[3] Automated isolation and analysis system of single-cell for developing novel cell-breeding technology. (T. Omasa) N. Yoshimoto, S. Kuroda, “Fine chemical series: Cell construction, culture, and downstream on therapeutic antibodies”, CMC Publishiing, (56-66) 2015.

Patents
[1]G20080027CN Drug derivery system, G20080027CN

Grant-in-Aid for Scientific Research

S. Kuroda	Development of next-gen DDS carrier based on the functional domain analysis of viral envelope protein	¥12,740,000
T. Okajima	Reaction mechanism of novel tryptophan-hydroxylating enzyme involving in quinone cofactor biogenesis	¥1,950,000
N. Yoshimoto	Comprehensive analysis of odorant receptor repertoire by automated single cell analysis and isolation system	¥1,820,000

Entrusted Research

S. Kuroda	Japan Agency for Medical Research and Development	Identification of hepatitis B virus receptors, establishment of HBV infection systems, analysis of HBV pathophysiological mechanism, and development of novel anti-HBV drugs	¥13,000,000

Contribution to Research

N. Yoshimoto N. Yoshimoto ¥300,000

Department of Biomolecular Science and Regulation

Original Papers

[1]AcrB-AcrA Fusion Proteins That Act as Multidrug Efflux Transporters, Katsuhiko Hayashia, Ryosuke Nakashima, Keisuke Sakurai, Kimie Kitagawa, Seiji Yamasaki, Kunihiko Nishino, Akihito Yamaguchi: Journal of Bacteriology, 198 (2) (2015) 332-342.

[2]Multidrug efflux pumps contribute to Escherichia coli biofilm maintenance, Yamasaki S, Wang LY, Hirata T, Hayashi-Nishino M, Nishino K: Int J Antimicrob Agents, 45 (4) (2015) 439-441.

[3]Single-Cell Detection and Collection of Persister Bacteria in a Directly Accessible Femtoliter Droplet Array, Ryota Iino, Shouichi Sakakihara, Yoshimi Matsumoto, Kunihiko Nishino: Methods Mol Biol, 1333 (2016) 101-109.

[4]A Microfluidic Channel Method for Rapid Drug-Susceptibility Testing of Pseudomonas aeruginosa, Yoshimi Matsumoto, Shouichi Sakakihara, Andrey Grushnikov, Kazuma Kikuchi, Hiroyuki Noji, Akihito Yamaguchi, Ryota Iino, Yasushi Yagi, Kunihiko Nishino: PLoS One, 11 (2) (2016) e0148797.

International Conferences

[1]Stoichiometry of a Functional AcrA and AcrB Complex (oral), Hayashi K., Nakashima R., Sakurai K., Kitagawa K., Yamasaki S., Nishino K., and Yamaguchi A.: Gordon Research Seminar (Multi-Drug Efflux Systems) 2015.

[2]Crystal structure of multidrug resistance regulator RamR complexed with bile acids (oral), Suguru Yamasaki, Ryosuke Nakashima, Keisuke Sakurai, Sylvie Baucheron, Etienne Giraud, Benoît Doublet, Axel Cloeckaert, and Kunihiko Nishino: 6th Symposium on Antimicrobial Resistance in Animals and the Environment: ARAE2015.

[3]Inhibitor-bound structures and inhibition mechanism of multidrug efflux pumps (oral), Seiji Yamasaki, Ryosuke Nakashima, Keisuke Sakurai, Katsuhiko Hayashi, Chikahiro Nagata, Kazuki Hoshino, Yoshikuni Onodera, Akihito Yamaguchi, and Kunihiko Nishino: 6th Symposium on Antimicrobial Resistance in Animals and the Environment: ARAE2015.

[4]Xenobiotic recognition and efflux control by bacterial cells (oral), Hayashi-Nishino, Mitsuko; Hayashi, Katsuhiko; Fujioka, Takuma; Takeuchi, Yuna; Yamasaki, Seiji; Yan, Aixin; Nishino, Kunihiko: The International Chemical Congress of Pacific Basin Societies 2015: Pacifichem 2015.

[5]Regulation of bacterial multidrug exporters (oral), Kunihiko Nishino: JSPS-DAAD Joint Seminar at University of Veterinary Medicine Hannover.

[6]Stoichiometry of a Functional AcrA and AcrB Complex (poster), Hayashi K., Nakashima R., Sakurai K., Kitagawa K., Yamasaki S., Nishino K., and Yamaguchi A.: Gordon Research Seminar (Multi-Drug Efflux Systems) 2015.

[7]Stoichiometry of a Functional AcrA and AcrB Complex (poster), Hayashi K., Nakashima R., Sakurai K., Kitagawa K., Yamasaki S., Nishino K., and Yamaguchi A.: Gordon Research Conference (Multi-Drug Efflux Systems) 2015.

[8]Inhibitor-bound structures and inhibition mechanism of multidrug efflux transporters (poster), Seiji Yamasaki, Ryosuke Nakashima, Keisuke Sakurai, Katsuhiko Hayashi, Chikahiro Nagata, Kazuki Hoshino, Yoshikuni Onodera, Akihito Yamaguchi, and Kunihiko Nishino: The 14th Awaji International Forum on Infection and Immunity.

[9]Application of an Image Analysis Software for the New Rapid Susceptibility Testing Method via Microscopy in DSTM (Drug Susceptibility Testing Microfluidic device) (poster), Y. Matsumoto, A. Grushnikov, K. Kikuchi, A. Yan, K. Nishino, and Y. Yagi: 55th Interscience Conference on Antimicrobial Agents and Chemotherapy: ICAAC　2015.

[10]Structural Basis for the Inhibition of Multidrug Efflux Pumps (poster), Seiji Yamasaki, Ryosuke Nakashima, Keisuke Sakurai, Katsuhiko Hayashi, Chikahiro Nagata, Kazuki Hoshino, Yoshikuni Onodera, Akihito Yamaguchi, and Kunihiko Nishino: The 19th SANKEN International Symposium 2015, The 14th SANKEN Nanotechnology Symposium.

[11]Electron/immuno-electron tomography of autophagosomal membranes and bacterial multidrug efflux systems (poster), Hayashi-Nishino, Mitsuko; Nishino, Kunihiko: The International Chemical Congress of Pacific Basin Societies 2015: Pacifichem 2015.

[12]Peristaltic drug export mechanism of the multidrug exporter AcrB (poster), Seiji Yamasaki, Kunihiko Nishino, Ryosuke Nakashima, Keisuke Sakurai, and Akihito Yamaguchi: 6th Symposium on Antimicrobial Resistance in Animals and the Environment: ARAE2015.

Books

[1]Sphingosine 1-phosphate signaling via transporters in zebrafish and mice(Takehiko Yokomizo、Makoto Murakami) Yu Hisano, Tsuyoshi Nishi, Atsuo Kawahara, “Bioactive Lipid Mediators: Current Reviews and Protocols”, Springer, (207-220) 2015.

Patents

[1]K20150242 The screening method of inhibitors of bacterial toxicity, 2016-028653

[2]KB2015003 Inspection method of bacterial or fungal antimicrobial susceptibility and the system to be used to it, 2015-130750

[3]KP2013043 Inspection method of bacterial or fungal antimicrobial susceptibility and the system to be used to it, 2013-533608

[4]G20100018EPGB Epigallocatechin gallate derivatives as antibacterial agents, G20100018EPGB

[5]Inhibitors of multidrug efflux pumps, 2015-238703

Contributions to International Conferences and Journals

K. NISHINO	Frontiers in Micirobiology (Antimicrobials, Resistance and Chemotherapy) (Associate Editor)
K. NISHINO	PLoS One (Ad-Hoc Reviewer)
K. NISHINO	Frontiers in Micirobiology (Ad-Hoc Reviewer)
K. NISHINO	Journal of Antimicrobial Chemotherapy (Ad-Hoc Reviewer)
K. NISHINO	Molecular BioSystems (Ad-Hoc Reviewer)
K. NISHINO	Applied and Environmental Microbiology (Ad-Hoc Reviewer)
K. NISHINO	Veterinary Microbiology (Ad-Hoc Reviewer)
K. NISHINO	Scientific Reports (Ad-Hoc Reviewer)
K. NISHINO	Journal of Structural Biology (Ad-Hoc Reviewer)
K. NISHINO	Antimicrobial Agents and Chemotherapy (Ad-Hoc Reviewer)
K. NISHINO	JSPS-DAAD Joint Symposium at University of Veterinary Medicine Hannover (Organaizing Committtee)

Publications in Domestic Meetings

Joint Meeting of Eastern Japan Branches of the Japanese Association for Infectious Deseases and the Japanese Society of Chemotherapy	1 paper

Symposium at Osaka Pharmaceutical University	1 paper
Annual Meeting of Society of Genome Microbiology, Japan	1 paper
Annual Meeting of the Pharmaceutical Society of Japan	6 papers
Lecture by Graduate of Ibaraki Highschool in Osaka Pref.	1 paper
Annual Meeting of Kinki Branch of the Japanese Biochemical Society	2 papers
Annual Meeting of the Japanese Society of Chemotherapy	2 papers
Annual Meeting of Association of the Rapid Method and Automation in Microbiology	2 papers
Report Meeting of JSPS Ikushi Prize	2 papers
Symposium on Microorganisms	1 paper
Annual Meeting of Western Japan Branch of the Japanese Society of Chemotherapy	1 paper
Annual Meeting of Kinki Branch of Japanese Association of Medical Technologists	1 paper
Research Meeting of Society for Bacterial Drug Resistance	3 papers
Scientific Lectures at ISIR, Osaka Univ.	3 papers
Annual Meeting of Kansai Branch of the Japanese Society for Bacteriology	3 papers
JBEG 2015	1 paper
Annual Meeting of Japanese Society for Clinical Microbiology	3 papers
BioTech 2015	1 paper
G3 Report Meeting of Nano-Macro Materials, Devices and System Research Alliance	8 papers
Symposium on interaction between biological membrane and drugs	1 paper
Annual Meeting of the Japanese Society for Bacteriology	5 papers
Report Meeting of Nano-Macro Materials, Devices and System Research Alliance	1 paper

Academic Degrees

Bachelor Degree for Pharmaceutical Science	Phenotype microarray analysis of the bacterial xenobiotic transporters	
T. Fujioka		

Grant-in-Aid for Scientific Research

K. Nishino	Mechanism of bacterial homeostasis modulated by transportes and development of novel therapeutics	¥11,700,000
M. Nishino	Regulation of bacterial virulence by ABC-type transporters	¥1,980,000
S. Yamasaki	Roles of drug efflux pumps in the environmental adaptation and screening of novel inhibitors	¥1,560,000
K. Hayashi	X-ray crystal structure analysis of drug efflux transporters to develop their inhibitors	¥1,000,000

Entrusted Research

K. Nishino	Ministry of Education, Culture, Sports, Science and Technology	Mechanism of bacterial homeostasis modulated by transportes and development of novel therapeutics	¥9,200,000
K. Nishino	Ministry of Education, Culture, Sports, Science and Technology	Mechanism of bacterial homeostasis modulated by transportes and development of novel therapeutics	¥1,126,000

Contribution to Research

M. Nishino	Mitsuko Nishino (The Naito Foundation)	¥2,000,000
S. Yamasaki	The Ogasawara Foundation for the Promotion of Science & Engineering	¥250,000

Cooperative Research

K. Nishino	Shionogi & Co., Ltd.	¥791,000
K. Nishino	Chikara Furusawa (RIKEN)	¥100,000
K. Nishino	Ayano Satoh (Okayama University)	¥150,000
K. Nishino	Junichi Yamagishi (Nihon Pharmaceutical University)	¥150,000
K. Nishino	Yuji Morita (Aichi Gakuin University)	¥100,000
T. Nishi	Naoki Kobayashi (Setsunan Univ.)	¥200,000
T. Nishi	Hiroshi Nakagawa (Chubu Univ.)	¥150,000

K. Nishino	FINE JAPAN CO.,LTD.	¥1,000,000
Y. Matsumoto	Fukoku Co. Ltd.	¥2,730,000
K. Nishino	Corinna Kehrenberg (Tierärztliche Hochschule Hannover)	¥0,000
K. Nishino	Axel Cloeckaert (INRA, France)	¥0,000
K. Nishino	Filip Van Immerseel (Ghent University)	¥0,000
K. Nishino	Cecília Maria Arraiano (Universidade Nova de Lisboa)	¥0,000
K. Nishino	Aixin Yan (University of Hong Kong)	¥0,000
K. Nishino	Mikio Tanabe (Martin Luther University Halle-Wittenberg)	¥0,000

Other Research Fund

K. Nishino	Japan Society for the Promotion of Science	¥2,250,000
K. Nishino	Japan Science and Technology Agency	¥19,077,000
K. Nishino	Japan Science and Technology Agency	¥8,954,000

Department of Biomolecular Science and Engineering

Original Papers

[1]Transcriptional characteristics and differences in Arabidopsis stigmatic papilla cells pre- and post-pollination., T. Matsuda, M. Matsushima, M. Nabemoto, M. Osaka, S. Sakazono, H. Masuko-Suzuki, H. Takahashi, M. Nakazono, M. Iwano, S. Takayama, KK. Shimizu, K. Okumura, G. Suzuki, M. Watanabe, K. Suwabe: Plant Cell Physiol., 56 (2015) 663-673.

[2]GM130 is a parallel tetramer with a flexible rod-like structure and N-terminally open (Y-shaped) and closed (I-shaped) conformations., R. Ishida, A. Yamamoto, K. Nakayama, M. Sohda, Y. Misumi, T. Yasunaga, N. Nakamura: FEBS J., 282 (2015) 2232-2244.

[3]A fast- and positively photoswitchable fluorescent protein for ultralow-laser-power RESOLFT nanoscopy., DK. Tiwari, Y. Arai, M. Yamanaka, T. Matsuda, M. Agetsuma, M. Nakano, K. Fujita, T. Nagai: Nat. Methods, 12 (2015) 515-518.

[4]Spectral fingerprinting of individual cells visualized by cavity-reflection-enhanced light-absorption microscopy., Y. Arai, T. Yamamoto, T. Minamikawa, T. Takamatsu, T. Nagai: PLoS ONE, 10 (2015) e0125733.

[5]Partial agonistic effects of pilocarpine on Ca^{2+} responses and salivary secretion in the submandibular glands of live animals., A. Nezu, T. Morita, Y. Tojyo, T. Nagai, A. Tanimura: Exp. Physiol, 100 (2015) 640-651.

[6]Single-Molecule Imaging Reveals Dynamics of CREB Transcription Factor Bound to Its Target Sequence., N. Sugo, M. Morimatsu, Y. Arai, Y. Kousoku, A. Ohkuni, T. Nomura, T. Yanagida, N. Yamamoto: Sci Rep., 5 (2015) 10662.

[7]Nuclear membrane localization during pollen development and apex-focused polarity establishment of SYP124/125 during pollen germination in Arabidopsis thaliana., M. Ichikawa, M. Iwano, MH. Sato: Plant Reprod., 28 (2015) 143-151.

[8]Visible-wavelength two-photon excitation microscopy for fluorescent protein imaging., M. Yamanaka, K. Saito, IN. Smith, Y. Arai, K. Uegaki, Y. Yonemaru, K. Mochizuki, S. Kawata, T. Nagai, K. Fujita: J. Biomed. Opt., 20 (2015) 101202.

[9]MagIC, a genetically encoded fluorescent indicator for monitoring cellular Mg^{2+} using a non-FRET ratiometric imaging approach., VP. Koldenkova, T. Matsuda, T. Nagai: J. Biomed. Opt., 20 (2015) 101203.

[10]A Temporary Gating of Actin Remodeling during Synaptic Plasticity Consists of the Interplay between the Kinase and Structural Functions of CaMKII., K. Kim, G. Lakhanpal, HE. Lu, M. Khan, A.

Suzuki, M. Kato-Hayashi, R. Narayanan, TT. Luyben, T. Matsuda, T. Nagai, TA. Blanpied, Y. Hayashi, K. Okamoto: Neuron, 87 (2015) 813-826.

[11]Calcium signalling mediates self-incompatibility response in the Brassicaceae., M. Iwano, K. Ito, S. Fujii, M. Kakita, H. Asano-Shimosato, M. Igarashi, P. Kaothien-Nakayama, T. Entani, A. Kanatani, M. Takahisa, M. Tanaka, K. Komatsu, H. Shiba, T. Nagai, A. Miyawaki, A. Isogai, A. Takayama: Nature Plants., 1 (2015) 15128.

[12]Threshold-free evaluation of near-surface diffusion and adsorption-dominated motion from single-molecule tracking data of single-stranded DNA through total internal reflection fluorescence microscopy., I. Hanasaki, S. Uehara, Y. Arai, T. Nagai, S. Kawano: Jpn. J. Appl. Phys., 54 (2015) 125601.

[13]Rotational motion of rhodamine 6G tethered to actin through oligo(ethylene glycol) linkers studied by frequency-domain fluorescence anisotropy., T. Wazawa, N. Morimoto,T. Nagai, M. Suzuki: Biophysics and Physicobiology, 12 (2015) 87-102.

[14]Apoplastic ROS production upon pollination by RbohH and RbohJ in Arabidopsis. Plant Signal Behav., H. Kaya, M. Iwano, S. Takeda, MM. Kanaoka, S. Kimura, M. Abe, K. Kuchitsu: Plant Signal Behav., 10 (2016) e989050.

[15]Dependence of fluorescent protein brightness on protein concentration in solution and enhancement of it., T. J. Morikawa, H. Fujita, A. Kitamura, T. Horio, J. Yamamoto, M. Kinjo, A. Sasaki, H. Machiyama, K. Yoshizawa, T. Ichimura, K. Imada, T. Nagai, TM. Watanabe: Sci Rep., 6 (2016) 22342.

[16]Ca^{2+} monitoring in Plasmodium falciparum using the yellow cameleon-Nano biosensor., K. Pandey, PE. Ferreira, T. Ishikawa, T. Nagai, O. Kaneko, K. Yahata: Sci Rep., 6 (2016) 23454.

International Conferences

[1]A fast- and positively photoswitchable fluorescent protein for ultralow-laserpower RESOLFT nanoscopy (invited), T. Nagai: ABA2015, Shangyu, Chaina, May 9 - May 12, 2015.

[2]Genetically-encoded tools to optically control and image calcium dynamics (invited), T. Nagai: CabP19 (19th International Symposium on Ca^{2+} and Ca^{2+} Binding Proteins in Health and Disease), Nashville, Tennessee, USA, May 30 - June 3, 2015.

[3]GENETICALLY-ENCODED CHEMILUMINESCENT INDICATOR APPLICABLE IN MILLI-SECOND VOLTAGE PHENOMENA (oral), S. Inagaki, T. Matsuda, Y. Arai, Y. Jinno, H. Tsutsui, Y. Okamura, T. Nagai: 19th International Symposium on Calcium Binding Proteins and Calcium Function In Health and Disease , Nashville, Tennessee, USA, May 30 - June 3, 2015.

[4]Revolutionary Bioimaging with Bright Luminescent Proteins (invited), T. Nagai: 3rd China-Japan Symposium on Nanomedicne, Beijing, China, June 19 - June 20, 2015.

[5]Revolutionary Bioimaging with Bright Luminescent Proteins - Comparing Pros and Cons of Fluorescence and Luminescence (invited), T. Nagai: Biophysical Society Thematic Meeting, New Biological Frontiers Illuminated by Molecular Sensors and Actuators, Taipei, Taiwan, June 28 - July 1, 2015.

[6]Photo-Manipulation of Intracellular Ca^{2+} by Genetically Encoded Caged Ca^{2+} (oral), T. Matsuda, N. Fukuda, T. Nagai: Biophysical Society Thematic Meeting, New Biological Frontiers Illuminated by Molecular Sensors and Actuators, Taipei, Taiwan, June 28 - July 1, 2015.

[7]Genetically-encoded tools to optically control and image cellular functions (invited), T. Nagai: The 4th Hsinchu Summer Course and Workshop Single Molecule/Nanoparticle Spectroscopy and Imaging,

Hsinchu, Taiwan, July 8 - July 10, 2015.

[8]Genetically-encoded tools to optocally control and image physiological events (invited), T. Nagai: PRESTO-Harvard Joint Symposium, Cambridge, USA, September 20 - September 21, 2015.

[9]Genetically-encoded tools to optically control and image neuronal activity (invited), T. Nagai: 4th International Frontiers in Neurophotonics Symposium, Québec city, Canada, October 3 - October 6, 2015.

[10]Fluorescent and bioluminescent sensors for imaging biological events (invited), T. Matsuda, T. Nagai: Roundtable Discussion Photoreceptors, DFG-Rundgespräch, Chiemsee, Germany, October 8 - October 12, 2015.

[11]Multiple color pallet of super-duper luminescent proteins for long-term and ultrafast acquisition of biological phenomena (poster), K. Suzuki , K. Enami, S. Mizobuchi, Y. Arai, M. Nakano, T. Nagai: Pacifichem 2015 (The 2015 International Chemical Congress of Pacific Basin Societies), Honolulu, Hawaii, December 15 - December 20, 2015.

[12]Revolutionary bioimaging with super-duper luminescent proteins (invited), T. Nagai: a Physical Biology Lecture at SINAP, Shanghai, P. R. China, November 2 - November 2, 2015.

[13]Biocompatible super-resolution imaging of fast photoswitching fluorescent proteins by polarization demodulation/excitation angle narrowing (poster), T. Wazawa, Y. Arai, H. Takauchi, DK. Tiwari, T. Nagai: the 2nd EastAsia Microscopy Conference (EAMC2), Himeji, Hyogo, JAPAN, November 24 - November 27, 2015.

[14]Spectral fingerprinting of individual cells visualized by cavity-reflection-enhanced light-absorption microscopy (poster), Y. Arai, T. Yamamoto, T. Minamikawa, T. Takamatsu, T. Nagai: the 2nd EastAsia Microscopy Conference (EAMC2), Himeji, Hyogo, JAPAN, November 24 - November 27, 2015.

[15]Genetically-Ecoded Tools to Optically Control and Image Ca^{2+} Dynamics (invited), T. Nagai: the 2nd EastAsia Microscopy Conference (EAMC2), Himeji, Hyogo, JAPAN, November 24 - November 27, 2015.

[16]Multi-modal super-duper chemiluminescent proteins for long-term and ultra-fast acquisition of biological phenomena (poster), K. Suzuki, M. Iwano, T. Kimura, Y. Arai, M. Nakano, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[17]Ca^{2+} monitoring upon wounding stress in plants by luminescence probes (poster), M. Iwano, N. Suetsugu, R. Nishihama, T. Kaku, T. Kohchi, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[18]Functional Analysis of the Bacterial Luminescence Components in Plants (poster), T. Entani, T. Kaku, M. Iwano, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[19]Genetically Encoded Ratiometric Fluorescent thermometer with Broad and Rapid Response (poster), M. Nakano, Y. Arai, l. Kotera, T. Iwasaki, Y. Kamei, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.
[20]A spontaneous switching-on fluorescent protein for high-speed single molecule localization-based super-resolution imaging (poster), H. Takauchi, Y. Arai, M. Nakano, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[21]Spectral fingerprinting of individual cells observed by cavity-reflection-enhanced light-absorption microscopy (poster), Y. Arai, T. Yamamoto, T. Minamikawa, T. Takamatsu, T. Nagai: The 19th SANKEN

International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[22]The Imaging of Calcium Ion in Living Cells Using BRET-Based Calcium Indicator Affinity Variants (poster), R. Ishida, M. Nakano, K. Suzuki, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[23]Novel Green Fluorescent Protein from Olindias formosa with excellent pH stability (poster), H. Shinoda, Y. Ma, T. Matsuda, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[24]Improvement of the Brightness of NanoLuc Luciferase (poster), Y. Aoyagi, M. Nakano, Y. Arai, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[25]Biocompatible Super-Resolution Imaging of Fast Photoswitching Fluorescent Proteins by Polarization Demodulation/Excitation Angle Narrowing (poster), T. Wazawa, Y. Arai, H. Takauchi, DK. Tiwari, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[26]Improving G protein FRET indicator for constructing versatile chemical evaluating system (poster), Y. Kushida, Y. Arai, Y. Okumura, K. Shimono, T. Nagai: The 19th SANKEN International Symposium, Osaka, Japan, December 7 - December 8, 2015.

[27]Bioimaging with bright luminescent proteins: Comparing pros and cons of fluorescence and luminescence (invited), T. Nagai: Pacifichem 2015 (The 2015 International Chemical Congress of Pacific Basin Societies), Honolulu, Hawaii, December 15 - December 20, 2015.

[28]Genetically-encoded chemiluminescent indicator applicable in millisecond voltage phenomena (poster), S. Inagaki, T. Matsuda, Y. Arai, G. Bai, Y. Jinno, H. Tsutsui, Y. Okamura, T. Nagai: Pacifichem 2015 (The 2015 International Chemical Congress of Pacific Basin Societies), Honolulu, Hawaii, December 15 - December 20, 2015.

[29]Genetically-encoded luminescent indicator applicable in millisecond voltage phenomena (invited), T. Nagai: Pacifichem 2015 (The 2015 International Chemical Congress of Pacific Basin Societies), Honolulu, Hawaii, December 15 - December 20, 2015.

[30]Prospect of minority biology (oral), T. Nagai: Pacifichem 2015 (The 2015 International Chemical Congress of Pacific Basin Societies), Honolulu, Hawaii, December 15 - December 20, 2015.

[31]Super-duper chemilumiescent proteins (invited), T. Nagai: University of Bordeaux–Osaka,University, Osaka City University, Mini-Symposium,on Synthetic, Osaka, Japan, January 26 - January 26, 2016.

[32]Super-duper luminescent proteins applicable to wide range of research (invited), T. Nagai: 2016 IMCE International Symposium, Fukuoka, , January 27 - January 27, 2016.

[33]Novel Green Fluorescent Protein from Olindias Formosa with Excellent pH Resistance (poster), H. Shinoda, Y. Ma, T. Matsuda, T. Nagai: FOM2016(Focus on Microscopy 2016), Taipei, Taiwan, March 20 - March 23, 2016.

[34]Chemiluminescence Ca^{2+} imaging in iPS derived cardiomyocytes (poster), G. Bai, T. Matsuda, C. Nakada, R. Tsuchiya, T. Nagai: CiRA/ISSCR 2016 INTERNATIONAL SYMPOSIA, Kyoto, Japan, March 22 - March 24, 2016.

Review Papers
Recent progress in luminescent proteins development., K. Saito, T. Nagai, Curr. Opini. Chemi. Biol.,

Elsevier, 27 (2015), 46-51.

Self-incompatibility in plants: RNA degradation and ubiquitination-mediated self-/non-self-discrimination., T. Entani, K. Kubo, S. Takayama, SEIKAGAKU, The Japanese Biochemical Society, 87 (2015), 308-314.

Three color (cyan, yellow, and orange) variants of bright luminescent protein which can be observed with the naked eye., M. Nakano, T. Nagai, OplusE, Advanced Communication Media, 428 (2015), 505-506.

A guide to use photocontrollable fluorescent proteins and synthetic smart fluorophores for nanoscopy., S. Uno, DK. Tiwari, M. Kamiya, Y. Arai, T. Nagai, Y. Urano, Microscopy (Oxf)., Oxford Journals, 64 (2015), 263-277.

Fluorescence switching imaging; Bioimaging technology using photoswitchable fluorescence protein., T. Matsuda, T. Nagai, Optical Alliance, JAPAN INDUSTRIAL PUBLISHING, 26 (2015), 2015.11.1-5.

Various application of the fluorescent and chemiluminescent proteins., T. Nagai, T. Matsuda, SEIBUTSU BUTSURI, The Biophysical Society of Japan, 55 (2015), 305-310.

Self-incomptibility in the Solanaceae: ubiquitination-mediated self-/non-self-discrimination., T. Entani, K. Kubo, S. Takayama, KAGAKU TO SEIBUTSU, INTERNATIONAL ACADEMIC PUBLISHING, 53 (2015), 826-833.

Low damage superresolution imaging for biological samples., Y. Arai, T. Nagai, Nikkei Biotechnology and Business, Nikkei Business Publications, 2016 年 2 (2016), -(Web).
The current scope and future direction in genetically encoded voltage indicators for neural activity recording., S. Inagaki, T. Nagai, Drug Delivery System, The Japan Society of Drug Delivery System, 31 (2016), 119-126.

Books
[1]Fluorescence imaging/Fluorescent protein (7.1.3)(S. Kitoshita, N. Ota, T. Nagai, F. Minami) T. Nagai, “Encyclopedia of luminescence”, Asakura Publishing, (536-547) 2015.

[2]Fluorescence imaging/Tagging technology (7.1.8)(S. Kitoshita, N. Ota, T. Nagai, F. Minami) T. Nagai, “Encyclopedia of luminescence”, Asakura Publishing, (577-583) 2015.

[3]Fluorescence Imaging/Fluorescence Imaging/Image Processing (7.2.1.3)(S. Kitoshita, N. Ota, T. Nagai, F. Minami) Y. Arai, “Encyclopedia of luminescence”, Asakura Publishing, (594-599) 2015.

[4]Fluorescence Imaging/Fluorescence Imaging/Applied Image Processing (7.2.1.4)(S. Kitoshita, N. Ota, T. Nagai, F. Minami) Y. Arai, “Encyclopedia of luminescence”, Asakura Publishing, (599-605) 2015.

[5]Fluorescence imaging/Imaging target/Functional imaging with fluorescent protein (7.2.2.2.1)(S. Kitoshita, N. Ota, T. Nagai, F. Minami) T. Nagai, “Encyclopedia of luminescence”, Asakura Publishing, (611-616) 2015.

[6]Fluorescence imaging / Imaging based on photobleaching or photo activation (7.3.6)(S. Kitoshita, N. Ota, T. Nagai, F. Minami) T. Nagai, T. Matsuda, “Encyclopedia of luminescence”, Asakura Publishing, (661-668) 2015.

[7]Application of fluorescent protein (Theoretical section 13)(T. Haraguchi, H. Kimura, Y. Hiraoka) T. Nagai, T. Matsuda, “Renewal of fluorescence bioimaging”, KYORITSU SHUPPAN, (114-126) 2015.

[8]Basics of resonance energy transfer (FRET) (Theoretical section 19)(T. Haraguchi, H. Kimura, Y.

Hiraoka) T. Nagai, T. Kotera, “Renewal of fluorescence bioimaging”, KYORITSU SHUPPAN, (174-181) 2015.
[9]Measurement and evaluation of FRET (Theoretical section 20)(T. Haraguchi, H. Kimura, Y. Hiraoka) T. Nagai, K. Saito, “Renewal of fluorescence bioimaging”, KYORITSU SHUPPAN, (182-192) 2015.

[10]Construction of optical microscope (Practical section 2)(T. Haraguchi, H. Kimura, Y. Hiraoka) M. Yamanaka, T. Tani, K. Fujita, T. Nagai, “Renewal of fluorescence bioimaging”, KYORITSU SHUPPAN, (262-267) 2015.

[11]Detection of FRET by spectrum imaging (Practical section 7-1)(T. Haraguchi, H. Kimura, Y. Hiraoka) T. Haragushi, T. Nagai, T. Matsuda, “Renewal of fluorescence bioimaging”, KYORITSU SHUPPAN, (299-302) 2015.

[12]Evaluation of FRET by acceptor photobleaching (Practical section 7-2)(T. Haraguchi, H. Kimura, Y. Hiraoka) T. Nagai, “Renewal of fluorescence bioimaging”, KYORITSU SHUPPAN, (302-308) 2015.

[13]Spectrum measurement with a photometer and single molecule FRET (Practical section 10-2)(T. Haraguchi, H. Kimura, Y. Hiraoka) I. Kotera, T. Tani, T. Nagai, “Renewal of fluorescence bioimaging”, KYORITSU SHUPPAN, (329-331) 2015.

[14]Writing original plugin for ImageJ; an automated particle tracking tool as an example(Chapter 5-2)(K. Miura, Y. Tsukada) Y. Arai, “Starting biological image analysis with ImageJ”, Gakken Medical Shujunsha, (204-216) 2016.

Patents
[1]K20140233 Fluorescent protein, JP2015-097655

[2]K20150194 Fluorescent protein, JP2016-046953

Contributions to International Conferences and Journals

T. Nagai	Biophysics and Physicobiology (Editorial Board)
T. Nagai	MICROSCOPY (Editorial Board)

Publications in Domestic Meetings

The 71st Annual Meeting of the Japanese Society of Microscopy	3 papers
10th Annual Meeting of Japanese Society for Chemical Biology	1 paper
The 15th Annual Meeting of the Protein Science Society of Japan	1 paper
The 53th Annual Meeting of the Biophysical Society of Japan	9 papers
The 24th Annual Meeting of Bioimaging Society	2 papers
BMB2015 Biochemistry and Molecular Biology	6 papers
the 57th Annual Meeting of Japanese Society of Plant Physiologists	1 paper

Academic Degrees

Master Degree for Engineering Y. Aoyagi	Establishment of bacterial colony-based screening system for improvement of luminescent protein property
Master Degree for Engineering H. Takauchi	Invention of a spontaneously switchable fluorescent protein applicable to super-easy super-resolution microscopy
Master Degree for Engineering H. Shinoda	Cloning, engineering and application of a green fluorescent protein from Olindias formosa with excellent pH stability

Grant-in-Aid for Scientific Research

T. Nagai	Spying minority in biological phenomena -Toward bridging dynamics between individual and ensemble processes-	¥14,170,000
T. Nagai	Development of molecular probes and photonic tools for bio-manipulation	¥54,340,000

T. Nagai	Innovation of chemiluminogenetics capable of noninvasive manipulation of biological functions deep inside body	¥9,360,000
T. Nagai	Real time three dimensional imaging of chemiluminescence with Fresnel incoherent correlation holography	¥3,120,000
Y. Arai	Developlment of optical sectioning microscopy for chemiluminescent imaging	¥780,000
T. Wazawa	Kinetic analysis of local visicosity of hydration layers around actomyosin by frequency-domain fluorescence polarization	¥0,000
M. Iwano	Analysis of compatible-pollen reception system in Brassicaceae	¥1,690,000
M. Agetsuma	All-optical electrophysiology and investigation of visual cognition system	¥4,290,000

Entrusted Research

T. Nagai	Japan Science and Technology Agency (JST)	Development of multi-modal chemiluminescent imaging system	¥18,980,000
T. Nagai	Japan Science and Technology Agency (JST)	Superresolution of "physiological functions" and diagnostics of activity architecture in live cells	¥4,550,000
T. Matsuda	Japan Science and Technology Agency (JST)	Analysis of Dynamics of Drug Efflux Transporter and Drug	¥16,380,000

Contribution to Research

T. Nagai	General incorporated foundation, Okinawa Convention & Visitors Bureau	¥500,000
T. Nagai	Research Foundation for Opto-Science and Technology	¥1,500,000

Cooperative Research

T. Nagai	ONO PHARMACEUTICAL CO., LTD.	¥9,600,000
T. Nagai	OPTO-LINE, Inc.	¥7,632,000
T. Nagai	Nikon Instech Co.,Ltd.	¥0,000
T. Nagai	Nikon Co.,Ltd.	¥4,800,000
T. Nagai	Panasonic Corporation	¥960,000
T. Nagai	Japan Science and Technology Agency (JST)	¥2,268,000
T. Nagai	TAIYO NIPPON SANSO CORPORATION	¥3,000,000
T. Nagai	Olympus Corporation	¥0,000
T. Nagai	Hamamatsu Photonics K.K.	¥0,000
T. Nagai	DRVsion Technologies, Nikon Co.,Ltd.	¥0,000

Other Research Fund

T. Nagai	JSPS	¥1,350,000

Laboratory of Cellulose Nanofiber Materials

Original Papers

[1]One-Step Fabrication of Stretchable Copper Nanowire Conductors by a Fast Photonic Sintering Technique and Its Application in Wearable Devices, IS. Ding, J. Jiu, Y. Gao, Y. Tian, T. Araki, T. Sugahara, S. Nagao, M. Nogi, H. Koga, K. Suganuma and H. Uchida: KACS Appl. Mater. Interfaces, 8 (9) (2016) 6190-6199.

[2]Transparent Conductive Nanofiber Paper for Foldable Solar Cells, M. Nogi, M. Karakawa, N. Komoda, H. Yagyu and T. T. Nge: Sci. Rep., 5 (2015) 17254.

[3]Highly Reliable Silver Nanowire Transparent Electrode Employing Selectively Patterned Barrier Shaped by Self-Masked Photolithography, J. Wang, J. Jiu, T. Sugahara, S. Nagao, M. Nogi, H. Koga, P. He, K. Suganuma and H. Uchida: ACS Appl. Mater. Interfaces, 7 (41) (2015) 23297-23304.

[4]Chemical Modification of Cellulose Nanofibers for the Production of Highly Thermal Resistant and Optically Transparent Nanopaper for Paper Devices, H. Yagyu, T. Saito, A. Isogai, H. Koga and M. Nogi: ACS Appl. Mater. Interfaces, 7 (39) (2015) 22012-22017.

[5]Fast, Scalable, and Eco-Friendly Fabrication of Energy Storage Paper Electrode, H. Koga, H. Tonomura, M. Nogi, K. Suganuma and Y. Nishina: Green Chem., 18 (4) (2016) 1117-1124.

[6]Laser-induced forward transfer of high-viscosity silver precursor inks for non-contact printed electronics, T. Inui, R. Mandamparambil, T. Araki, R. Abbel, H. Koga, M. Nogi and K. Suganuma: RSC Adv., 5 (2015) 77942-77947.

[7]Targeted kinetic strategy for improving the thermal conductivity of epoxy composite containing percolating multi-layer graphene oxide chains, T. Zhou, H. Koga, M. Nogi, T. Sugahara, S. Nagao, T. T. Nge, K. Suganuma, H.-W. Cui, F. Liu and Y. Nishina: eXPRESS Polym. Lett., 9 (7) (2015) 608-623.

International Conferences
[1]Developments of nano-cellulose paper for printed electronics (invited), M. Nogi: 251st National ACS Meeting.

[2]Catalytic Paper Reactor with a Nano/Micro Hybrid Porous Structure (oral), H. Koga, N. Namba, M. Nogi: 251st National ACS Meeting.

[3]Cellulose nanopaper with controllable optical properties (oral), M.-C. Hsieh, H. Koga, M. Nogi and K. Suganuma: PACIFICHEM2015,.

[4]Morphology effect of silver nanowires on radio-wave transmission properties for printed antenna (poster), Y. Goya, H. Koga, M. Nogi and K. Suganuma: The 19th SANKEN International The 14th SANKEN Nanotechnology Symposium 2015.

[5]Improvement of Optically Transparent Cellulose Nanopaper for Electronic Devices (invited), M. Nogi: 2015 MRS Fall Meeting & Exhibit.

[6]A Printed Small Antenna on High Dielectric Nanopaper Composite for Flexible and Wearable Electronics (oral), T. Inui, H. Koga, M. Nogi and K. Suganuma: ICFPE 2015.

[7]Durability evaluation of inkjet printed conductive lines (poster), A. Tanaka, M. Nogi and K. Suganuma: ICFPE 2015.

[8]Optically transparent cellulose nanopaper for electronic devices (invited), M. Nogi: Symposium on Thin Film Technologies for Flexible Devices, The 76th JSAP Autum Meeting.

[9]Structural and Material Design of Cellulose Paper Composites (invited), H. Koga and M. Nogi: The 5th International Conference on Bio-based Polymers.

[10]Cellulose Nanofiber Materials for Electronic Devices (invited), M. Nogi: TAPPI International Conference on Nanotechnology for Renwwable Materials, Atlanta.

[11]Paper Electronics for All Paper-Based Displays (invited), H. Koga: IDW'15.

[12]The Effect of Ultraviolet Radiation on Silver NanowireTransparent Electrode Based on Flexible Polymeric Film Substrate (oral), J. Wang, J. Jiu, T. Sugahara, S. Nagao, M. Nogi, H. Koga, K. Suganuma and P. He: International Conference on Nanotechnology.

[13]Reliability of Silver Nanowire Transparent Electrode under Atmospheric Environment (oral), J. Jiu, J. Wang, T. Sugahara, S. Nagao, M. Nogi, H. Koga and K. Suganuma: International Conference on Nanotechnology.

Review Papers
Potential of cellulose nanofibers as electronic materials, M. Nogi, Chemical Economy, The Chemical Daily Co., Ltd, 4 (2015), 27-32.

Cellulose nanofibers for future electronic devices, M. Nogi, Fiber, THE TEXTILE MACHINERY SOCIETY OF JAPAN, 68 (2015), 31-35.

Cellulose nanopaper, M. Nogi, Petrotech, The Japan Petroleum Institute, 38 (2015), 397-401.

Research and development of paper electronics, M. Nogi, Journal of the Japan Society of Polymer Processing, The Japan Society of Polymer Processing, 27 (2015), 217-220.

Electronic devices on transparent paper, M. Nogi, OYO BUTURI, The Japan Society of Applied Physics, 84 (2015), 536-541.

Electronic applications of nanocellulose, M. Nogi, Nanofiber, The Nanofiber Society, 6 (2015), 11-14.

Cellulose nanomaterials, M. Nogi, Polymers, The Society of Polymer Science, Japan, 64 (2015), 433-434.

Small and flexible antenna on high-k paper composite, H. Koga and M. Nogi, Function & Materials, CMC Publishing Co., Ltd., 35 (2015), 33-38.

Nanocarbon/nanopaper electronics, H. Koga, Optical alliance, JAPAN INDUSTRIAL PUBLISHING CO., LTD., 26 (2015), 10-14.

Development of Paper Electronics by Using Paper-Specific Properties, H. Koga, Annals of the High Performance Paper Society, Japan, High Performance Paper Society, Japan, 54 (2015), 37-41.

Advanced Functional Paper Materials, H. Koga, Textile Processing Technology, Seni Co., Ltd., 51 (2016), 344-350.

Paper Electronics Based on Nanocellulose, H. Koga, Journal of the Imaging Society of Japan, The Imaging Society of Japan, 55 (2016), 361-368.

Books
[1]Development of cellulose nanopaper-based electronic devices(Association of Japanese Agricultural Scientific Societies) M .Nogi, “Recent progress in agricultural science”, Yokendo Co., Ltd., 2015.

[2]Electronic device based on cellulose nanofibers(A. Isogai, M. Kawasaki, T. Kondo, H. Nomura, S. Hirata, E. Mikami) M .Nogi, “Introduction of nanocellulose”, NIKKAN KOGYO SHIMBUN,LTD., 2015.

[3]Transparent conductive paper(A. Isogai, M. Kawasaki, T. Kondo, H. Nomura, S. Hirata, E. Mikami) M .Nogi, “Introduction of nanocellulose”, NIKKAN KOGYO SHIMBUN,LTD., 2015.

[4]Measurement of volume resistivity of printed silver nanoink lines(Technical Information Institute Co., Ltd.) M .Nogi, “Mesurement, evaluation, and understanding of electronic properties”, Technical Information Institute Co., Ltd., 2015.

[5]Highly Conductive Ink-Jet-Printed Lines(S. Ogawa) M. Nogi, H. Koga and K. Suganuma, “Organic Electronics Materials and Devices”, Springer, (Chapter 5) 2015.

[6]Flexible paper electronics(S. Ogawa) H. Koga and M. Nogi, “Organic Electronics Materials and Devices”, Springer, (Chapter 4) 2015.

[7]Paper memory(A. Isogai, M. Kawasaki, T. Kondo, H. Nomura, S. Hirata, E. Mikami) H. Koga, “Introduction of nanocellulose”, NIKKAN KOGYO SHIMBUN,LTD., 2015.

[8]A Miniturized Flexible Antenna based on High-dielectric Nanopaper(A. Isogai, M. Kawasaki, T. Kondo, H. Nomura, S. Hirata, E. Mikami) H. Koga, “Introduction of nanocellulose”, NIKKAN KOGYO SHIMBUN,LTD., 2015.

[9]Green and printable nanoink consisting of nanocarbon and nanocellulose(A. Isogai, M. Kawasaki, T. Kondo, H. Nomura, S. Hirata, E. Mikami) H. Koga, “Introduction of nanocellulose”, NIKKAN KOGYO SHIMBUN,LTD., 2015.

[10]Nanocellulose-based transparent conductive films(T. Kanai) H. Koga and M. Nogi, “Development and application of functionalized films”, CMC Publishing, 2016.

[11]Recyclable Organic Solar Cell Based on Cellulose Nanocrystal Substrates(Nanocellulose Forum) H. Koga, “Preparation and applications of nanocellulose”, S&T Publishing, 2016.

[12]Applications of nanocellulose for electronic devices(Nanocellulose Forum) M. Nogi, “Preparation and applications of nanocellulose”, S&T Publishing, 2016.

Patents

[1]K20130273 Preparation techniques for transpatent conductive films, 2015-229572

[2]K20150119 Preparation techniques for conductive nanocellulose composites, 2015-170120

[3]K20100345 Synthesis of nanoparticles, 2011-123694

[4]G20120037US Materials and preparation techniques for copper patterns, 14/358164

[5]G20120091KR Preparation techniques for transpatent conductive patterns, 10-2014-7025211

[6]K20090402 Polyurethan-based substrate and stretchable line, K20090402

Publications in Domestic Meetings

82nd Pulp and Paper Research Conference	1 paper
6th meeting of the Nanofiber Society	1 paper
22nd annual meeting of the Cellulose Society of Japan	3 papers
Micro Electronics Symposium 2015	1 paper
47th fall meeting of The Society of Chemical Engineers	1 paper
54th meeting of the High Performance Paper Society	1 paper
63rd spring meeting of the Japan Society of Applied Physics	1 paper
30th meeting of Japan Institute of Electronics Packaging	2 papers
66th meeting of the Japan Wood Research Society	2 papers

Grant-in-Aid for Scientific Research

M. Nogi	Flexible non-volatile memory prepared by using cellulose nanopaper	¥54,080,000
H. Koga	Printed paper reactor for efficient catalytic conversion	¥1,560,000
H. Koga	Flexible energy-storage paper based on cellulose nanofiber	¥12,610,000

Entrusted Research

M. Nogi	Sony Corp.	Preparation and characterization of nanocellulose film	¥2,000,000

Cooperative Research

M. Nogi	ALBION Co. Ltd.	¥1,576,000
M. Nogi	NIPPON SHOKUBAI CO., LTD.	¥1,050,000

Beam Application Frontier Research Laboratory

Original Papers

[1]AcrB-AcrA Fusion Proteins That Act as Multidrug Efflux Transporters, K. Hayashi, R. Nakashima, K. Sakurai, K. Kitagawa, S. Yamasaki, K. Nishino, A. Yamaguchi: Journal of Bacteriology, 198 (2) (2015) 332-342.

[2]A Microfluidic Channel Method for Rapid Drug-Susceptibility Testing of Pseudomonas aeruginosa, Y. Matsumoto, S. Sakakihara, Andrey Grushnikov, K. Kikuchi, H.i Noji, A. Yamaguchi, R. Iino, Y. Yagi, and Kunihiko Nishino: PLoS One, 11 (2) (2016) e0148797.

International Conferences

[1]Stoichiometry of a Functional AcrA and AcrB Complex (oral), K. Hayashi, R. Nakashima, K. Sakurai, K. Kitagawa, S. Yamasaki, K. Nishino, A. Yamaguchi: Gordon Research Seminar (Multi-Drug Efflux Systems) 2015.

[2]Crystal structure of multidrug resistance regulator RamR complexed with bile acids (oral), S. Yamasaki, R. Nakashima, K. Sakurai, S. Baucheron, E. Giraud, B. Doublet, A. Cloeckaert, K. Nishino: 6th Symposium on Antimicrobial Resistance in Animals and the Environment: ARAE2015.

[3]Inhibitor-bound structures and inhibition mechanism of multidrug efflux pumps (oral), S. Yamasaki, R. Nakashima, K. Sakurai, K. Hayashi, C. Nagata, K. Hoshino, Y. Onodera, A. Yamaguchi, K. Nishino: 6th Symposium on Antimicrobial Resistance in Animals and the Environment: ARAE2015.

[4]Structural Basis of Bacterial Multidrug Efflux Pumps and Development of Pump Inhibitors (oral), A. Yamaguchi: JST CREST-PREST Joint International Symposium “Structural Biological Dynamics from Molecules to Life with 60 Trillion Cells.

Review Papers

Structural basis of RND-type multidrug exporters, Akihito Yamaguchi, Ryosuke Nakashima, Keisuke Sakurai, Frontiers in Microbiology, Frontiers, 6[327] (2015), article327.

Patents

[1]K20150242 Method for screening bacterial toxicity reducing agent, JP2016-028653

[2]KB2015003 Method for testing antibacterial-drug sensitivity of bacterium or fungus and system used for same, JP2015-130750

[3]KP2013043 Method for testing antibacterial-drug sensitivity of bacterium or fungus and system used for same, JP2013-533608

[4]AF38P001 Multi-drug efflux pump inhibitor, JP2015-238703

Entrusted Research

A. Yamaguchi	JST Strategic Basic Research Programs, CREST	Studies on the structural basis of multidrug efflux transport and the development of multidrug transporter inhibitors	¥53,860,000

Cooperative Research

A. Yamaguchi	Fine Co., Ltd	¥1,200,000

Department of Functional Nanomaterials and Nanodevices

Original Papers

[1]Temperature Dependence of Magnetically Active Charge Excitations in Mangnite across the Verwey Transition, M. Taguchi, A. Chainani, S. Ueda, M. Matsunami, Y. Ishida, R. Eguchi, S. Tsuda, Y. Takata, M.

Yabashi, K. Tamasaku, Y. Nishino, T. Ishikawa, H. Daimon, S. Todo, H. Tanaka, M. Oura, Y. Senba, H. Ohashi, and S. Shin: Phys. Rev. Lett., 115 (2015) 256405(1-5).

[2]Electrical oscillation in Pt/VO2 bilayer strips, Ying Wang, Jianwei Chai, Shijie Wang, Long Qi, Yumeng Yang, Yanjun Xu, Hidekazu Tanaka and Yihong Wu: J. Appl. Phys., 117 (2015) 064502.

[3]Electric field-induced transport modulation in VO2 FETs with high-k oxide/organic parylene-C hybrid gate dielectric, T. Wei, T. Kanki, K. Fujiwara, M. Chikanari and H. Tanaka: Appl. Phys. Lett., 108 (2016) 053503.

[4]Impact of parylene-C thickness on performance of KTaO3 field-effect transistors with high-k oxide/parylene-C hybrid gate dielectric, T. Wei, K. Fujiwara, T. Kanki and H. Tanaka: J. Appl. Phys., 119 (2016) 034502.

[5]Electrochemical gating-induced reversible and drastic resistance switching in VO2 nanowires, T.Sasaki, H. Ueda, T. Kanki and H. Tanaka: Sci. Rep., 5 (2015) 17080.

[6]Fractal Nature of Metallic and Insulating Domain Configurations in a VO2 Thin Film Revealed by Kelvin Probe Force Microscopy, A. Sohn, T. Kanki, K. Sakai, H. Tanaka and D.-W. Kim: Sci. Rep., 5 (2015) 10417.

[7]Visualization of local phase transition behaviors near dislocations in epitaxial VO2/TiO2 thin films, A. Sohn, T. Kanki, H. Tanaka and D.-W. Kim: Appl. Phys. Lett., 107 (2015) 171603.

[8]Influence of thermal boundary conditions on the current-driven resistive transition in VO2 microbridges, N. Manca, T. Kanki, H. Tanaka, D. Marré and L. Pellegrino: Appl. Phys. Lett., 107 (2015) 143509.

[9]Mid-infrared Plasmonic Resonances in 2D VO2 Nanosquare Arrays, H. Matsui, Y.-L. Ho, T. Kanki, H. Tanaka, J.-J. Delaunay and H. Tabata: , 3 (2015) 1759-1767.

[10]Nanoscale study of perovskite BiFeO3/spinel (Fe,Zn)3O4 co-depositedthin film by electrical scanning probe methods, A. S. Borowiak, K. Okada, T. Kanki, B. Gautier, B. Vilquin, H. Tanaka: , 351 (2015) 531-536.

[11]Electrical transport properties of (La,Pr,Ca)MnO3 nanowires investigated using terahertz time domain spectroscopy, T. V. A. Nguyen, A. N. Hattori, M. Nagai, T. Nakamura, M. Ashida, H. T. V. A. Nguyen, A. N. Hattori, M. Nagai, T. Nakamura, M. Ashida, H. T. V. A. Nguyen, A. N. Hattori, M. Nagai, T. Nakamura, M. Ashida, H. Tanaka: J. Appl. Phys., 119 (2016) 125102-1-4.

[12]Creation of atomically flat Si{111}7×7 side-surfaces on a three-dimensionally-architected Si(110) substrate, A. N. Hattori, K. Hattori, S. Takemoto, H. Daimon, H. Tanaka: Surf. Sci., 644 (2015) 86-90.

[13]Identification of Giant Mott Phase Transition of Single Electric Nanodomain in Manganite nanowall wire, A. N. Hattori, Y. Fujiwara, K. Fujiwara, T. V. A. Nguyen, T. Nakamura, M. Ichimiya, M. Ashida, H. Tanaka: Nano Lett., 15 (2015) 4322-4328.
[14]Discrimination between gate-induced electrostatic and electrochemical characteristics in insulator-to-metal transition of manganite thin films, T. Nakamura, A. N. Hattori, T. V. A. Nguyen, K. Fujiwara, H. Tanaka: Appl. Phys. Express, 8 (2015) 073201-1-3.

[15]3D-architected and integrated metal oxides nanostructures and beyond by three-dimensional nanotemplate pulsed-laser deposition, A. N. Hattori, Y. Fujiwara, K. Fujiwara, H. Tanaka: e-J. Surf. Sci. Nanotech., 13 (2015) 279－283.

International Conferences

[1]Nanoscale correlated oxides for electronic phase change electronics (poster), H. Tanaka, A. N. Hattori and T. Kanki: The 34th Electronic Materials Symposium.

[2]Electric field effect on transition metal oxide heterostructures (oral), H.Tanaka: Workshop on nano-material design for sustainable element strategy.

[3]Nanostructured correlated oxides with sensitized phase transition phenomena (invited), H. Tanaka: CEMS topical meeting on Oxide Interfaces 2015.

[4]Strongly Correlated Oxides for Electronic Phase Change Electronics (invited), H. Tanaka: The 27 th Symposium on Phase Change Oriented Science.

[5]Enhancement of conductivity modulation on electrically frustrated YbFe2O4 epitaxial thin film field effect devices with designed ionic liquid gate (poster), Hidekazu Tanaka, Tatsuya Hori, Kohei Fujiwara: 2015 MRS Fall Meeting & Exhibit.

[6]Dual field effects in spinel ferrite field effect devices: volatile electrostatic carrier doping and nonvolatile redox reactions (oral), Hidekazu Tanaka1, Takashi Ichimura1, Kohei Fujiwara: 2015 MRS Fall Meeting & Exhibit.

[7]Nanoscale study of perovskite BiFeO3/spinel (Fe,Zn)3O4 co-deposited thin film by electrical scanning probe methods (poster), A.S. Borowiak, K. Okada, T. Kanki, B. Gautier, B. Vilquin, and H. Tanaka: The 2015 Joint ISAF-ISIF-PFM Conference.

[8]Electromechanical response of amorphous LaAlO3 thin film probed by scanning probe microscopies (poster), A.S. Borowiak, H. Tanaka N. Baboux, D. Albertini, B. Vilquin, G. Saint-Girons, S. Pelloquin and B. Gautier: The 2015 Joint ISAF-ISIF-PFM Conference.

[9]Nano-scaled conductive properties in VO2 nanowires (poster), K. Sakai, A. N. Hattori, T. Kanki, H. Tanaka : The 34th Electronic Materials Symposium.

[10]Reversible and non-volatile resistance modulation in VO2 nanowires by electric-induced hydrogenation (oral), T. Kanki, T. Sasaki and H. Tanaka: 2015 MRS Fall Meeting & Exhibit.

[11]Low power-driven metal-insulator transition in free-standing VO2 microstructures (poster), T. Kanki, S. Yamasaki, N. Manca, L. Pellegrino, D. Marré and H. Tanaka: 2015 MRS Fall Meeting & Exhibit.

[12]Resistance switching in VO2 field-effect transistors with high-k Ta2O5/organic parylene-C hybrid gate dielectric (poster), T. Wei, T. Kanki, K. Fujiwara and H. Takana: CEMS topical meeting on Oxide Interfaces 2015.

[13]Electric field-induced transport switching in VO2 nano-wire channels using a planer-type gate (poster), M. Chikanari, T. Kanki, and H. Tanaka: CEMS topical meeting on Oxide Interfaces 2015.

[14]Electric field-induced resistance switching in VO2 channels using Hybrid Gate Dielectric of High-k Ta2O5/Organic Parylene-C (poster), T. Wei, T. Kanki, K. Fujiwara and H. Takana: SANKEN International Symposium＆Nanotechnology Center International Symposium.

[15]Resistance switching induced by an electric field in VO2 nano-wire channels with air-gap gates (poster), M. Chikanari, T. Kanki and H. Takana: SANKEN International Symposium＆Nanotechnology Center International Symposium.

[16]Resistance Modulation in VO2 nanowires induced by an electric field via air-gap gates (oral), T.

Kanki. M. Chikanari, T. Wei and H. Tanaka: APS March Meeting 2016.

[17]Electric Field-induced Resistance Switching in VO2 Channels using Hybrid Gate Dielectric of High-k Ta2O5/Organic material Parylene-C (oral), T. Wei, T. Kanki, K. Fujiwara, M. Chikanari and H. Takana: APS March Meeting 2016.

[18]Electrochemical gating-induced hydrogenation in oxide nanowires at room temperature (invited), T. Kanki: EMN Meeting on Titanium Oxides.

[19]Drastic conductivity change on the strongly correlated (La,Pr,Ca)MnO3 nanowire corresponding to phase-separated nanodomain dynamics (poster), Azusa. N. Hattori, T. V. Anh Nguyen, Takuro Nakamura, Masaya Nagai, Masaaki Ashida, H. Tanaka: The 34th Electronic Materials Symposium.

[20]Construction of well-defined 3D transition metal oxides nanostructures and their novel properties (invited), Azusa N. HATTORI, Hidekazu TANAKA: Collaborative Conference on Crystal Growth (3CG) 2015.

[21]Electrical transport properties in phase-separated manganite nanowires investigated using terahertz time domain spectroscopy (oral), T. V. A. Nguyen, A. N. Hattori, M. Nagai, T. Nakamura, K. Fujiwara, M. Ashida, H. Tanaka: JSAP-OSA Joint Symposia 2015.

[22]Fabrication of VO2 nanowall wire structures with a few tens nm width using 3D nano template PLD (poster), : SANKEN International Symposium＆Nanotechnology Center International Symposium.

Patents

[1]K20140224（M14-1774） Thin films, fabrication process and their semiconductor device application, JP2015-060978

[2]K20150013 Yuragi oscillator, the signal detector system and the display, 2015-167624

[3]K20140224（M14-1774） Thin film, Their synthesis and semiconductor devices, JP2015-060978

Contributions to International Conferences and Journals

H.TANAKA	International Conference on Electronic Materials (IUMRS-ICEM 2016) (Organaizing Committtee)
H.TANAKA	9th International Conference on Physics and Applications of Spin-Related Phenomena in Solids （PASPS 9) (Organaizing Committtee)
H.TANAKA	Scientific Reports (Editorial Board Member)

Publications in Domestic Meetings

JSAP Kansai Chapter	1 paper
The 76th Autumn Meeting, 2015	4 papers
JPS 2015 fall meeting	1 paper
JSAP Kansai Chapter	2 papers
1st Materials WEEK	1 paper
The Sanken academic lecture presentations	1 paper
The joint Annual Symposium of the Vacuum Society of Japan and the Surface Science Society of Japan	1 paper
The Vacuum Society of Japan	1 paper
The 63th JSAP Spring Meeting, 2016	5 papers
2016 Annual (71th) Meeting	1 paper
MEXT Nanotechnology platform seminar on thin film processing	1 paper
JSAP Kansai Chapter	1 paper

Academic Degrees

Master Degree for Electric field control of nano-domains in manganites

Engineering T.Nakamura		
Master Degree for Engineering Y.Ooe	Research on nano-aterials	nano-optical fiber controlling the emissions and sensing for
Doctor of Philosophy in Science NGUYEN THI VAN ANH	Electrical transport properties in phase-separated manganite studied by terahertz time domain spectroscopy	

Grant-in-Aid for Scientific Research

H.Tanaka	3D correlated oxide nano-structures for nano-scaling phenomena and electronic phase change memory application	¥14,950,000
H.Tanaka	Construction of functional Oxide NEMS for environment adaptive sensor application	¥1,560,000
T. Kanki	Total control of phase transition, dinamics and spatial position of nano-scaled domains with strongly correlated electronic phase	¥2,730,000

Entrusted Research

T. Kanki	AXELL CORPORATION / University of Hyogo	Development of vertural harmonized and fuructral LED on computor display	¥325,000
T. Kanki	Japan Science and Technology Agency（JST)	Design of harmonized illumination mimicing firefly using Yuragi oscillator	¥2,920,000
A. Hattori	Japan Science and Technology Agency（JST)	Realization of the power saving functional phase switching device utilizing nano-confinment effect for the strongly correlated metal oxide	¥3,770,000

Contribution to Research

A. Hattori	The Murata Science Foundation	¥1,300,000
A. Hattori	The Hattori Hokokai Foundation	¥1,000,000

Cooperative Research

H.Tanaka	Murata Manufacturing Co., Ltd.	¥2,004,000
H.Tanaka	National Institute for Materials Science (NIMS)	¥0,000

Other Research Fund

H.Tanaka	National Institutes of Natural Sciences / Institutes for Molecular Sciences	¥32,197,000

Department of Advanced Nanofabrication

Original Papers

[1]Examination of the formation process of pre-solvated and solvated electron in n-alcohol using femtosecond pulse radiolysis, Tomohiro Toigawa, Masao Gohdo, Kimihiro Norizawa, Takafumi Kondoh, Koichi Kan, Jinfeng Yang, Yoichi Yoshida: Radiat. Phys. Chem., 123 (2016) 73-78.

[2]Radiolytic yields of solvated electrons in ionic liquid and its solvation dynamics at low temperature, Raluca M. Musat, Takafumi Kondoh, Masao Gohdo, Yoichi Yoshida, Kenji Takahashi: Radiat. Phys. Chem., 124 (2015) 14-18.

[3]Femtosecond Time-Resolved Electron Microscopy, J. Yang, Y. Yoshida, and H. Shibata: Electron. Comm. Jpn., 98 (2015) 50-57.

[4]Generation of Terahertz Waves Using Ultrashort Electron Beams from a Photocathode Radio-Frequency Gun Linac, K. Kan, J. Yang, A. Ogata, T. Kondoh, M. Gohdo, H. Shibata, and Y. Yoshida: Electron. Comm. Jpn., 99 (1) (2016) 22-31.

[5]Ultrafast Electron Microscopy Using Relativistic-Energy Femtosecond Electron Pulses, J. Yang: Kenbikyo, 50 (3) (2015) 156-159.

International Conferences

[1]RF gun based MeV electron diffraction and imaging (invited), J. Yang: International Conference on High Energy Density Science 2015 (HEDS2015).

[2]Bunch Length Measurement of Femtosecond Electron Beam by Monitoring Coherent Transition Radiation (poster), I. Nozawa, M. Gohdo, K. Kan, T. Kondoh, A. Ogata, J. Yang, Y. Yoshida: The 6th International Particle Accelerator Conference (IPAC'15).

[3]Measurement of Temporal Electric Field of Electron Bunch using Photoconductive Antenna (poster), K. Kan, M. Gohdo, T. Kondoh, I. Nozawa, A. Ogata, T. Toigawa, J. Yang, Y. Yoshida: The 6th International Particle Accelerator Conference (IPAC'15).

[4]RF Gun Based Ultrafast Electron Microscopy (poster), J. Yang, K. Tanimura, Y. Yoshida, J. Urakawa: The 6th International Particle Accelerator Conference (IPAC'15).

[5]Attosecond and Femtosecond Pulse Radiolysis (invited), Y. Yoshida: The 15th International Congress of Radiation Research (ICRR 2015).

[6]Ultrafast Electron Microscopy/difffraction for Radiation Chemistry (invited), J. Yang: The 15th International Congress of Radiation Research (ICRR 2015).

[7]Ultrafast Electron Transfer in Dodecane Studied by Femtosecond Pulse Radiolysis (invited), T. Kondoh, S. Nishii, M. Gohdo, K. Kan, J. Yang, S. Tagawa, Y. Yoshida: The 15th International Congress of Radiation Research (ICRR 2015).

[8]Generation of Ultrashort Electron Bunches for Attosecond Pulse Radiolysis (oral), I. Nozawa, K. Kan, J. Yang, A. Ogata, T. Kondoh, M. Gohdo, Y. Yoshida: The 15th International Congress of Radiation Research (ICRR 2015).

[9]Observation of Quasi-free Electrons Using Terahertz Pulse Radiolysis (poster), K. Kan, J. Yang, A. Ogata, T. Kondoh, M. Gohdo, I. Nozawa, T. Toigawa, K. Norizawa, Y. Yoshida: The 15th International Congress of Radiation Research (ICRR 2015).

[10]Formation Process of Alkyl Radicals in Alkanes Studied by Femtosecond Pulse Radiolysis (poster), S. Nishii, T. Kondoh, M. Gohdo, K. Kan, J. Yang, S. Tagawa, Y. Yoshida: The 15th International Congress of Radiation Research (ICRR 2015).

[11]Pulse Radiolysis Study of Polystyrene Dimer Phenyl Cation Radical in THF (poster), M. Gohdo, T. Kondoh, K. Kan, J. Yang, H. Shibata, S. Tagawa, Y. Yoshida: The 15th International Congress of Radiation Research (ICRR 2015).

[12]Spectral Shift of Hydrated Electron Studied By Femtosecond Pulse Radiolysis (poster), S. Yamaso: The 15th International Congress of Radiation Research (ICRR 2015).

[13]Measurement of Coherent Transition Radiation from Electron Beam Using Large-apeture Photoconductive Antenna (poster), K. Kan, J. Yang, A. Ogata, M. Gohdo, T. Kondoh, S. Sakakihara, I. Nozawa, K. Norizawa, T. Toigawa, H. Shibata, S. Gonda, and Y. Yoshida: The 40th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz 2015).

[14]Development of Attosecond and Femtosecond Pulse Radiolysis for Sutudy of Primary Process of Radiation Chemistry (oral), Y. Yoshida: the 13th Tihany Symposium on Radiation Chemistry.

[15]Pulse Radiolysis Study of Polystyrene Dimer Phenyl Cation Radical in THF (oral), M. Gohdo, T.

Kondoh, K. Kan, J. Yang, H. Shibata, S. Tagawa, Y. Yoshida: the 13th Tihany Symposium on Radiation Chemistry.

[16]Temperature Dependence of the Geminate Ion Recombination and Charge Transfer in n-Dodecane Studied by a Femtosecond Pulse Radiolysis (poster), T. Kondoh, S. Nishii, M. Gohdo, K. Norizawa, K. Kan, J. Yang, S. Tagawa, Y. Yoshida: the 13th Tihany Symposium on Radiation Chemistry.

[17]Femtosecond Pulse Radiolysis Study of the Radiation Decomposition Process and the Primary Process in n-Dodecane (poster), S. Nishii, T. Kondoh, M. Gohdo, K. Kan, J. Yang, S. Tagawa, Y. Yoshida: the 13th Tihany Symposium on Radiation Chemistry.

[18]Study of Primary Process of Radiation Chemistry by Femtosecond Pulse Radiolysis (invited), Y. Yoshida: Asia Pacific Symposium on Radiation Chemistry (APSRC-2016) & Trombay Symposium on Radiation & Photochemistry (TSRP-2016).

[19]Ultrafast Electron Attachment with Biphenyl in n-Dodecane Studied by Femtosecond Pulse Radiolysis (invited), T. Kondoh, S. Nishii, M. Gohdo, K. Kan, J. Yang, S. Tagawa, Y. Yoshida: Asia Pacific Symposium on Radiation Chemistry (APSRC-2016) & Trombay Symposium on Radiation & Photochemistry (TSRP-2016).
[20]Generation and detection of terahertz pulse from photocathode RF gun linac (invited), K. Kan, J. Yang, T. Kondoh, M. Gohdo, I. Nozawa, Y. Yoshida: The 7th Asian Forum for Accelerators and Detectors (AFAD2016).

[21]Femtosecond -pulse electron source and its applications (invited), J. Yang: Indo Japan Accelerator School.

Review Papers
Radiation Induced Primary Process and Decomposition Process in Saturated Hydrocarbon, T. Kondoh, K. Norizawa, J. Yang, M. Gohdo, K. Kan, and Y. Yoshida, Radiation Chemistry, Japanese Society of Radiation Chemistry, 100 (2015), 20-42.

Status and Prospect of Ultrafast Pulse Radiolysis, J. Yang, T. Kondoh, K. Kan, M. Gohdo, and Y. Yoshida, Radiation Chemistry, Japanese Society of Radiation Chemistry, 100 (2015), 52-55.

Publications in Domestic Meetings

Workshop on Radioisotope and Radiation	5 papers
Meeting of Particle Accelerator Society of Japan	6 papers
Meeting of Atomic Energy Society of Japan	13 papers
Symposium on Advanced Radiation Chemistry (SARAC)	3 papers
Workshop on 3D Gel Dosimetry	1 paper
Workshop on high blightness/rf electron gun	2 papers
Annual Meeting of the Physical Society of Japan	1 paper

Academic Degrees

Bachelor of Engineering R. Asakawa	Study of femtosecond time-resolved electron microscopy
Bachelor of Engineering K. Motonakano	Investigation of tetrahydrofuran radical cation by femtosecond pulse radiolysis
Master of Engineering S. Nishii	Study of Radiation Decomposition Process of n-Dodecane by Femtosecond Pulse Radiolysis
Master of Engineering	Femtosecond Pulse Radiolysis Study on formation process of the hydrated electron

S. Yamaso Doctor of Engineering T. Toigawa	Solvation Process of Electron in n-Alcohol Studied by Femtosecond Pulse Radiolysis	

Grant-in-Aid for Scientific Research

Y. Yoshida	Development of attosecond pulse radiolysis	¥12,740,000
J. Yang	Study on femtosecond-time-resolved transmission electron microscope	¥17,160,000
T. Kondoh	Radiation induced chemical reactions and decomposition of the saturated hydrocarbone-based polymer	¥2,470,000
K. Kan	Study on attosecond electron beam generation using radially polarized electric field	¥9,750,000
M. Gohdo	Development of a spacially resolved time expansion single-shot pulse radiolysis	¥1,820,000

Entrusted Research

Y. Yoshida	MEXT	Osaka University Nanoscience and Nanotechnology Alliance	¥1,800,000

Cooperative Research

Y. Yoshida	Daikin Industries, Ltd.	¥4,536,000
Y. Yoshida	Nisshin International Co.,Ltd	¥0,000

Department of Nanocharacterization for Nanostructures and Functions

Original Papers

[1]Environmental transmission electron microscopy for catalyst materials using a spherical aberration corrector, Seiji Takeda, Yasufumi Kuwauchi, and Hideto Yoshida: Ultramicroscopy, 151 (2015) 178-190.

[2]Nanoscopic Mechanism of Cu Precipitation at Small-angle Tilt Boundaries in Si, Yutaka Ohno, Kaihei Inoue, Kentaro Kutsukake, Momoko Deura, Takayuki Ohsawa, Ichiro Yonenaga, Hideto Yoshida, Seiji Takeda, Ryo Taniguchi, Hideki Otubo, Sigeto R. Nishitani, Naoki Ebisawa, Yasuo Shimizu, Hisashi Takamizawa, Koji Inoue, and Yasuyoshi Nagai: Phys. Rev., 91 (2015) 235315-1--235315-5.

[3]Understanding of the activity difference between nanogold and bulk gold by relativistic effects, Keju Sun, Masanori Kohyama, Shingo Tanaka, Seiji Takeda: J. Energy Chem., 24 (2015) 485-489.

[4]Rational Concept for Designing Vapor-Liquid-Solid Growth of Single Crystalline Metal Oxide Nanowires, Annop Klamchuen, Masaru Suzuki, Kazuki Nagashima, Hideto Yoshida, Masaki Kanai, Fuwei Zhuge, Yong He, Gang Meng, Shoichi Kai, Seiji Takeda, Tomoji Kawai, and Takeshi Yanagida: Nano Lett., 15 (2015) 6406-6412.

International Conferences

[1]Environmental TEM for catalyst materials using a spherical aberration corrector (invited), Seiji Takeda: PICO 2015, Kasteel Vaalsbroek, The Netherlands, April 19-23, 2015.

[2]Basis of high resolution in-situ TEM in materials science (invited), Seiji Takeda: The 1st international conference on Microstructure and Property of Materials & The 8th K. H. Kuo Summer School of Electron Microscopy and Crystallography, HNA Resort Huagang, Hangzhou, China, May 26-30, 2015.
[3]Metal nanoparticulate catalysts in reaction environments (invited), Seiji Takeda: The 1st international conference on Microstructure and Property of Materials & The 8th K. H. Kuo Summer School of Electron Microscopy and Crystallography, HNA Resort Huagang, Hangzhou, China, May 26-30, 2015.

[4]The structures and stability ofbulk oxide and surface oxide film of gold, silver and gold-silver alloy (poster), Keju Sun, Masanori Kohyama, Shingo Tanaka and Seiji Takeda: The 1st international conference on Microstructure and Property of Materials & The 8th K. H. Kuo Summer School of Electron Microscopy and Crystallography, HNA Resort Huagang, Hangzhou, China, May 26-30, 2015.

[5]Environmental Transmission Electron Microscopy Study of Catalytic Nanomaterials (invited), Hideto Yoshida: NIMS Conference 2015, Tsukuba International Congress Center, Ibaraki, Japan, July 14-16, 2015.

[6]*In situ* environmental TEM of catalyst materi-als at the atomic scale (invited), Seiji Takeda, Hideto Yoshida and Kentaro Soma: European Workshop on Advanced In Situ TEM/STEM, Chalmers University of Technology, Gothenburg, Sweden, July 20-23, 2015.

[7]Toward quantitative in situ TEM of materials and devices in gases and liquids at the atomic scale (invited), S Takeda, H Yoshida, K Soma: Microscopy & Microanalysis 2015 Meeting （M&M2015）, Oregon Convention Center, Portland, USA, August 2-6, 2015.

[8]In-situ dynamic environmental TEM of energy conversion processes at the atomic scale (invited), Seiji Takeda: Microscopy Conference 2015 (MC2015), Georg-August-University Göttingen, Göttingen, Germany, September 6-11, 2015.

[9]Environmental TEM Study of Gold and Platinum Nanoparticulate Catalysts (invited), Hideto Yoshida, Yasufumi Kuwauchi, Hiroki Omote, Seiji Takeda: AVS 62nd International Symposium & Exhibition (AVS 62), San Jose Convention Center, San Jose, USA, October 18-23, 2015.

[10]Towards Dynamic Electron Holographic Analysis of Solid State Electrochemical Devices at Operating Condition. (oral), Kentaro Soma, Stan Konings, Genki Kobayashi and Seiji Takeda: The 2nd East-Asia Microscopy Conference (EAM2),The Himeji Chamber of Commerce and Industry, Himeji, Japan, November 24-27, 2015.

[11]In-situ Atomic Scale Analyses of Catalytic Materials by Environmental TEM (invited), Seiji Takeda, Kentaro Soma, Hideto Yoshida and Naoto Kamiuchi: 23rd International Colloquium on Scanning Probe Microscopy (ICSPM23), Hilton Niseko Village, Japan, December 10-12, 2015.

[12]Aberration corrected ETEM study on the effect of moisture on catalysts in gases (invited), Seiji Takeda: The 4th International Symposium on Advanced Electron Microscopy for Catalysis (EMCat2016), The Harnack-House of the MPG, Berlin, Germany, January 27-29, 2016.

[13]Nanostructures of nanoporous gold catalyst prepared by dealloying method (poster), Naoto Kamiuchi, Keju Sun, Ryotaro Aso, Hideto Yoshida, Seiji Takeda: The 4th International Symposium on Advanced Electron Microscopy for Catalysis (EMCat2016), The Harnack-House of the MPG, Berlin, Germany, January 27-29, 2016.

[14]In Situ Environmental TEM study of Materials Processes at the Atomic Scale Using a Cs Corrector (invited), Seiji Takeda, Naoto Kamiuchi, Ryotaro Aso, Kentaro Soma, Hideto Yoshida: MRS Spring meeting 2016, Phoenix Convention Center, Phoenix, USA、March 28-April 1, 2016.

Review Papers

Study of Oxidation and Reduction Processes of Pt Nanoparticles by Aberration-corrected Environmental Transmission Electron Microscopy, H. Yoshida, JOURNAL OF THE CRYSTALLOGRAPHIC SOCIETY OF JAPAN, The Crystallographic Society of Japan, 57[4] (2015), 338-343.

Publications in Domestic Meetings

The Japanese Association for Crystal Growth, Special Lecture 2015	1 paper
The 79th workshop of Nano Probe Technology 167th committee	1 paper
The 31th Analytical Electron Microscopy Meeting	1 paper
Technical seminar of new TEM of FEI	1 paper
The 76th JSAP Autumn Meeting, 2015	1 paper

116th CATSJ Meeting	1 paper
The 29th forum of new material technology in Okayama	1 paper
Workshop on New Energy Materials and Devices 2015	1 paper
KRI workshop 2015	1 paper
The 71th ISIR academic meeting	1 paper
Workshop on nanostructured catalyst, Western Japan Chapter of Catalysis Society of Japan, 2015	1 paper
The 11th Workshop on Excitation Nano Process	1 paper
The 63th JSAP Spring Meeting, 2016	2 papers

Academic Degrees

Master Degree for Engineering Y. Akiyama	Metal-semiconductor nanocontact under applied voltage depending on gas atmosphere
Master Degree for Engineering Y. Tomita	Nanoscale processing of carbon nanotubes by electron beam irradiation

Grant-in-Aid for Scientific Research

S. Takeda	Atomic-scale dynamic analysis of nano-gap electrode interacting with gas molecules	¥4,810,000
N. Kamiuchi	Elucidation of the mechanisms of activation and deactivation on supported metal catalysts by Environmental TEM	¥1,300,000
R. Aso	Dynamic analysis of adsorption and collision of ionized gas molecules at metal surface	¥2,340,000

Entrusted Research

H. Yoshida	Japan Science and Technology Agency	Visualization of the atomic structure and the nanoscale temperature distribution in thermoelectric nanomaterials	¥5,460,000

Contribution to Research

S. Takeda	UBE Scientific Analysis Laboratory, Inc	¥2,000,000
S. Takeda	Nippon Steel & Sumitomo Metal Corporation	¥500,000

Cooperative Research

S. Takeda	Fuji Heavy Industries Ltd.	¥12,000,000
S. Takeda	National Institute of Advanced Industrial Science and Technology	¥0,000
R. Aso	Institute for Chemical Research, Kyoto University	¥600,000

Other Research Fund

H. Yoshida	Osaka University	¥900,000

Department of Theoretical Nanotechnology

Original Papers

[1]Structure, non-stoichiometry, and geometrical frustration of α-tetragonal boron, N. Uemura, K. Shirai, H. Eckert, and J. Kunstmann: Phys. Rev. B, 93 (2016) 104101/1-12.

[2]Observations of secondary defects and vacancies in CZ silicon crystals detached from melt using four different types of characterization technique, T. Abe, T. Takahashi, K. Shirai: J. Cryst. Growth, 436 (2016) 23-33.

[3]Investigations of interstitial generations near growth interface depending on crystal pulling rates during CZ silicon growth by detaching from the melt, T. Abe, T. Takahashi, K. Shirai, X. W. Zhang: J. Cryst. Growth, 434 (2016) 128-137.

[4]Coupling Ferroelectricity with Spin-Valley Physics in Oxide-Based Heterostructures, Kunihiko Yamauchi, Paolo Barone, Tatsuya Shishidou, Tamio Oguchi, and Silvia Picozzi: Phys. Rev. Lett., 115

(2015) 037602/1-5.

[5]Superexchange interaction in the A-site ordered perovskite YMn3Al4O12, Masayuki Toyoda, Takashi Saito, Kunihiko Yamauchi, Yuichi Shimakawa, and Tamio Oguchi Masayuki Toyoda, Takashi Saito, Kunihiko Yamauchi, Yuichi Shimakawa, and Tamio Oguchi: Phys. Rev. B, 92 (2015) 014420/1-7.

[6]Jahn-Teller distortions as a novel source of multiferroicity, Paolo Barone, Kunihiko Yamauchi, and Silvia Picozzi Paolo Barone, Kunihiko Yamauchi, and Silvia Picozzi Masayuki Toyoda, Takashi Saito, Kunihiko Yamauchi, Yuichi Shimakawa, and Tamio Oguchi: Phys. Rev. B, 92 (2015) 014116/1-6.

[7]A-site-driven ferroelectricity in strained ferromagnetic La2NiMnO6 thin films, : Phys. Rev. B, 91 (2015) 134107/1-9.

[8]First-principles investigation of a phase transition in NaxC6O6 as an organic cathode material for Na-ion batteries: Role of intermolecule bonding of C6O6, T. Yamashita, H. Momida and T. Oguchi: J. Phys. Soc. Jpn., 84 (2015) 074703/1-7.

[9]Discharge reaction mechanisms in Na/FeS2 batteries: First-principles calculations, H. Momida, A. Kitajou, S. Okada, T. Yamashita and T. Oguchi: J. Phys. Soc. Jpn., 84 (2015) 124709/1-6.

[10]Crystal structure predictions of NaxC6O6 for sodium-ion batteries: First-principles calculations with an evolutionary algorithm, T. Yamashita, H. Momida and T. Oguchi: Electrochimica Acta, 195 (2016) 1-8.

[11]Impact of Ferroelectric Distortion on Thermopower in BaTiO3, H. Saijo, K. Yamauchi, K. Shirai, and T. Oguchi: J. Phys. Soc. Jpn, 84 (2015) 054701/1-5.

[12]Comparative ARPES study on iron-platinum-arsenide superconductor Ca10(Pt4As8)(Fe2-xPtxAs2)5} (x = 0.25 and 0.42), M. Sunagawa, R. Yoshida, T. Ishiga, K. Tsubota, T. Jabuchi, J. Sonoyama, S. Kakiya, D. Mitsuoka, K. Kudo, M. Nohara, K. Ono, H. Kumigashira, T. Oguchi, T. Wakita, Y. Muraoka, and T. Yokoya: J. Phys. Soc. Jpn, 84 (2015) 055001/1-2.

[13]Quasi-One-Dimensional Nature of the Rashba States of Au Wires on Si(557) Surface, T. Oguchi: J. Electron Spectrosc. Relat. Phenom, 201 (2015) 18-22.

[14]Local electronic states of Fe4N films revealed by x-ray absorption spectroscopy and x- ray magnetic circular dichroism, K. Ito, K. Toko, Y. Takeda, Y. Saitoh, T. Oguchi, T. Suemasu, and A. Kimura: J. Appl. Phys, 117 (2015) 193906/1-6.

[15]Superconductivity and the electronic phase diagram of LaPt2-xGe2+x, S. Maeda, K. Matano, R. Yatagai, T. Oguchi, and Guo-qing Zheng: Phys. Rev. B, 91 (2015) 174516/1-7.

[16]Tetrahedral tilting and ferroelectricity in Bi2AO5 (A=Si, Ge) from first principles calculations, J. Park, B. G. Kim, S. Mori, and T. Oguchi: J. Solid State Chem, 235 (2016) 68-75.

International Conferences

[1]Structure of vacancies in Gd-doped GaN and its detection by XANES spectra (poster), T. A. Nugraha, K. Shirai, S. Emura, and T. Oguchi: 28th International Conference on Defects in Semiconductors, Aalto University Otaniemi campus, Espoo (Helsinki), Finland, 27.-31.7 2015.

[2]Environment Identification of Nitrogen Vacancy in GaN:Gd by X-ray Spectroscopy (oral), Shuichi Emura, Akihiro Koike, Koun Shirai, Kaori Niki, and Takashi Fujikawa: 28th International Conference on Defects in Semiconductors, Aalto University Otaniemi campus, Espoo (Helsinki), Finland, 27.-31.7 2015.

[3]First-principles Study of the Role of Non-stoichiometry on α-tetragonal Boron (invited), Naoki Uemura[1], Koun Shirai[1], Hagen Eckert[2], Jens Kunstmann: Materials Science & Technology, Columbus,

OH, USA, 2015, October 4-8, 2015,.

[4]Theoretical prediction of spin-valley coupling in 5d transition-metal oxides (poster), K. Yamauchi, P. Barone, T. Shishidou, T. Oguchi, S. Picozzi: 20th INTERNATIONAL CONFERENCE ON MAGNETISM.

[5]Rashba splitting and spin-valley coupling in ferroelectric oxides (oral), K. Yamauchi, P. Barone, S. Picozzi: PSI-K 2015 CONFERENCE.

[6]Crystal structure predictions on $Na_xC_6O_6$ for sodium-ion batteries (poster), T. Yamashita, H. Momida and T. Oguchi: Psi-k 2015 Conference, San Sebastian, Spain, September 6-10, 2015.

[7]Microscopic conversion reaction mechanisms of Na/S and Na/FeS2 batteries (poster), H. Momida, T. Yamashita and T. Oguchi: Psi-k 2015 Conference, San Sebastian, Spain, September 6-10, 2015.

[8]Crystal structure predictions of NaxC6O6: First-principles calculations with evolutionary algorithm (poster), T. Yamashita, H. Momida and T. Oguchi: The 18th Asian Workshop on First-Principles Electronic Structure Calculations, Kashiwa, Japan, November 9-11, 2015.

[9]First-principles studies of microscopic reaction mechanisms in sodium secondary batteries (invited), H. Momida, T. Yamashita and T. Oguchi: The 18th Asian Workshop on First-Principles Electronic Structure Calculations, Kashiwa, Japan, November 9-11, 2015.

[10]Reaction mechanism in sodium batteries: First-principles calculations (invited), H. Momida, T. Yamashita and T. Oguchi: International Symposium on Computing Energy Landscape in Material Science and Particles Physics, Kanazawa, Ishikawa, Japan, February 19-20, 2016.

[11]Magnetoelectricity in CaFeO2 and MgFeO2, (invited), T. Oguchi, K. Yamauchi, S. Picozzi: The 1st Pusan-Osaka Meeting on Advanced Matter Physics, Pusan National University, Pusan (Korea), October 16-17, 2015.

[12]Magnetic exchange interaction in A-site ordered perovskite oxides (invited), T. Oguchi, M. Toyoda, K. Yamauchi: Workshop on Frontier Materials Research, Sungkyunkwan University, Suwon (Korea), January 28-29, 2016.

[13]Ab-Initio Study on Reaction Mechanism in Sodium Secondary Batteries (invited), T. Oguchi, H. Momida, T. Yamashita: Workshop on Computational Nano-Materials Design and Realization for Energy-Saving and Energy-Creation Materials, Osaka University, Toyonaka (Japan), March 25-26, 2016.

Review Papers

Charge and discharge mechanisms in sodium-sulfur secondary battery from electron theory, H. Momida, T. Yamashita and T. Oguchi, Kotai Butsuri, AGNE Gijutsu Center, 50[6] (2015), 47-58.

Applications of first-principles calculations to secondary battery material design, T. Oguchi, H. Momida and T. Yamashita, Energy Device, Technical Information Institute Co., Ltd, 3[1] (2015), 55-58.

Contributions to International Conferences and Journals

T. OGUCHI The 18th Asian Workshop on First-Principles Electronic Structure Calculations November 9-11, 2015, Institute for Solid State Physics (International Organizing Committee)

Publications in Domestic Meetings

Annual Meeting of Physical Soceity of Japan	9 papers
Meeging of the Japan Society of High Pressure Science and Technology	2 papers

Grant-in-Aid for Scientific Research

K.Yamauchi	Band engineering of topological insulator by using transition-metal oxides		¥1,170,000

Entrusted Research

T.Oguchi	The Japan Science and Technology Agency	Electronic structure analysis by first-principles calculations	¥16,250,000
T.Oguchi	The Japan Science and Technology Agency	Professional development Consortium for Computational Materials Scientists	¥6,531,000

Cooperative Research

T.Oguchi	Sumitomo Electric Industries, Ltd	¥4,752,000

Other Research Fund

H. Momida	Osaka University	¥700,000
T. Oguchi	Element Strategy Initiative for Catalysis and Battery	¥4,370,000
T. Oguchi	National Institute for Materials Science	¥7,545,000

Department of Soft Nanomaterials

Original Papers

[1]Electron-Accepting p-Conjugated Systems for Organic Photovolta-ics: Influence of Structural Modification on Molecular Orientation at Donor-Acceptor Interfaces, S. Jinnai, Y. Ie, M. Karakawa, T. Aernouts, Y. Nakajima, S. Mori, Y. Aso: Chem. Mater., 28 (6) (2016) 1705-1713.

[2]Naphtho[1,2-c:5,6-c']bis[1,2,5]thiadiazole-Containing p-Conjugated Compound: Non-fullerene Electron Acceptor for Organic Photovoltaics, S. Chatterjee, Y. Ie, M. Karakawa, Y. Aso: Adv. Funct. Mater., 26 (8) (2016) 1161-1168.

[3]Thiophene-Based Tripodal Anchor Units for Hole Transport in Single-Molecule Junctions with Gold Electrodes, Y. Ie, K. Tanaka, A. Tashiro, S. K. Lee, H. R. Testai, R. Yamada, H. Tada, Y. Aso: J. Phys. Chem. Lett., 6 (18) (2015) 3754-3759.

[4]Pyradinodithiazole: An Electron-Accepting Monomer Unit for Hole-Transporting and Electron-Transporting Conjugated Copolymers, Y. Ie, S. Sasada, M. Karakawa, Y. Aso: Org. Lett., 17 (18) (2015) 4580-4583.

[5]Synthesis, Properties, and p-Dimer Formation Behavior of Oligothiophenes Partially Bearing Orthogonally Fused Fluorene Units, Y. Ie, Y. Okamoto, S. Tone, Y. Aso: Chem. Eur. J., 21 (46) (2015) 16688-16695.

[6]Decay of the Exciton in Quaterthiophene-Terminated Alkanethiolate Self-Assembled Monolayers on Au(111), H. S. Kato, Y. Murakami, Y. Kiriyama, R. Saitoh, T. Ueba, T. Yamada, Y. Ie, Y. Aso, T. Munakata: J. Phys. Chem. C, 119 (13) (2015) 7400-7407.

[7]Electron-accepting p-Conjugated Systems Based on Cyclic Imide and Cyano-substituted Benzothiadiazole for Non-fullerene Organic Photovoltaics, Y. Ie, S. Jinnai, M. Karakawa, Y. Aso: Chem. Lett., 44 (5) (2015) 694-696.

International Conferences

[1]Development of Novel Functional Units toward Molecular Architectonics (invited), Y. Ie, Y. Aso: International Workshop on Molecular Architectinics 2015, Shiretoko, Japan, August 3-6, 2015.

[2]Synthesis, Properties, and Electrical Conductance of Insulated Oligothiophenes Having Spiro-Substituted Fluorene (poster), Y. Okamoto, Y. Ie, R. Yamada, S. K. Lee, H. Tada, Y. Aso: International Workshop on Molecular Architectinics 2015, Shiretoko, Japan, August 3-6, 2015.

[3]A Universal Synthetic Methodology for Sub-Micrometer-Length Polythiophenes End-Functionalized

with Anchor Groups (poster), S. Tamba, Y. Ie, Y. Aso: International Workshop on Molecular Architectinics 2015, Shiretoko, Japan, August 3-6, 2015.

[4]Development of Electron-Transporting pi-Conjugated Systems for n-Type OFETs (invited), Y. Ie, Y. Aso: The 7th East Asia Symposium on Functional Dyes and Advanced Materials, Osaka, Japan, September 2-5, 2015.

[5]Synthesis, Properties, and Transistor Characteristics of Electron-Accepting pi-Conjugated Compounds Containing Dicyanomethylene (poster), A. Uchida, Y. Ie, M. Nitani, Y. Aso: The 7th East Asia Symposium on Functional Dyes and Advanced Materials, Osaka, Japan, September 2-5, 2015.

[6]Organic photovoltaic cells with an enlarged open circuit voltage using new fulleropyrrolidine derivatives (poster), M. Karakawa, T. Nagai, K. Adachi, Y. Ie, Y. Aso: The 7th East Asia Symposium on Functional Dyes and Advanced Materials, Osaka, Japan, September 2-5, 2015.

[7]Synthesis and Properties of Thiophene-Tetrazolopyridine-Based pi-Conjugated Compounds (poster), S. Tamba, Y. Ie, Y. Aso: 16th International Symposium on Novel Aromatic Compounds, Madrid, Spain, July 5-10, 2015.

[8]Oligothiophenes with Encapsulating Units for Molecular Wires (poster), Y. Ie, Y. Okamoto, Y. Aso: 16th International Symposium on Novel Aromatic Compounds, Madrid, Spain, July 5-10, 2015.

[9]Low-Bandgap Amorphous Copolymers Based on Dithienosilole and Dioxocycloalkene-annelated Thiophene for Organic Photovoltaic Cells (poster), Y. Ie, J. Huang, M. Karakawa, M. Saito, I. Osaka, Y. Aso: 12th International Symposium on Functional pi-Electron Systems, Seatle, USA, July 19-24, 2015.

[10]Synthesis, and Properties of Oligothiophenes with Encapsulating Units for Single-Molecule Electronics (poster), Y. Ie, Y. Aso: The 10th International Conference on Cutting-Edge Organic Chemistry in Asia, Kaohsiung, Taiwan, November 2-5, 2015.

[11]Synthesis, properties, and OFET characteristics of pi-conjugated systems having tetrazolopyridine (poster), S. Tamba, K. Hagiya, Y. Ie, Y. Aso: 2015 International Chemical Congress of Pacific Basin Societies, Honolulu, USA, December 15-20, 2015.

[12]Design Synthesis, and Properties of Novel Units for Single-Molecular Electronics (oral), Y. Ie, Y. Aso: 2015 International Chemical Congress of Pacific Basin Societies, Honolulu, USA, December 15-20, 2015.

[13]Insulated oligothiophene molecular wires and tripodal anchors for molecular electronics (invited), Y. Aso: 2015 International Chemical Congress of Pacific Basin Societies, Honolulu, USA, December 15-20, 2015.

[14]Synthesis, Properties, and Electrical Conductance of Insulated Oligothiophenes Having Spiro-Substituted Fluorenes (poster), Y. Okamoto, Y. Ie, R. Yamada, H. Tada, Y. Aso: 2015 International Chemical Congress of Pacific Basin Societies, Honolulu, USA, December 15-20, 2015.

[15]Synthesis, properties, structures, and n-type semiconducting transistor characteristics of electron-accepting pi-conjugating compounds containing dicyanomethylene groups (poster), A. Uchida, Y. Ie, M. Nitani, Y. Aso: The 19th SANKEN International the 14th SANKEN Nanotechnology Symposium, Osaka, Japan, December 7-9, 2015.

[16]Naphthobisthiadiazole or Benzothiadiazole based pi-Conjugated Compounds for Non-fullerene Electron Acceptors in Organic Solar Cell (poster), S. Chatterjee, Y. Ie, M. Karakawa, Y. Aso: The 19th SANKEN International the 14th SANKEN Nanotechnology Symposium, Osaka, Japan, December 7-9,

2015.

[17]New p-Conjugated Systems for Single-molecule and Organic Thin-film Electronic Devices (invited), Y. Ie, Y. Aso: International Symposium on Functional Materials, Okinawa, Japan, January 25-29, 2016.

[18]New fulleropyrrolidine derivatives contributing to the enhancement of an open circuit voltage for organic photovoltaic cells (poster), M. Karakawa, T. Nagai, K. Adachi, Y. Ie, Y. Aso: KJF International Conference on Organic Materials for Electronics and Photonics, Jeju, Korea, September 6-9, 2015.

Books

[1]Development of new n-type semiconductors for organic photovoltaics(S. Hayase) Y. Ie, "Photoenergy Conversion Systems and Materials for the Next Generation Solar Cells", CMC Publishing Co.,Ltd, (65-72) 2015.

[2]Electron-deficient conjugated heteroaromatics(T. Nishinaga) Y. Ie, Y. Aso, "Organic Redox Systems", Wiley, (411-443) 2015.

Patents

[1]K20140231 Compositions, 2015-124117

[2]K20150024 Fullerene derivatives and n-type semiconducting materials, 2015-198877

[3]K20150166 UV absorbers, 2015-236085

[4]K20150277 Compounds and their containing organic semiconductor materilas, 2016-046299

[5]G20150095WO Compounds and their containing organic semiconductor materilas, PCT/JP2016/057383

[6]K20100158 n-Type semiconductor materials for organic thin-film solar cells, 2010-232149

[7]K20100289 Nitrogen-containing fused ring compound, polymers of nitrogen-containing fused rings, organic thin films, and organic thin-film devices, 2011-045515

Contributions to International Conferences and Journals

Y. Aso	13th International Conference on the Chemistry of Selenium and Tellurium (Organizing Committee)	

Grant-in-Aid for Scientific Research

Y.Ie	Development of functional pi-conjugated systems for single-molecular photovoltaics	¥10,140,000
Y.Ie	Development and investigation of new functional materials for molecular architectonics	¥3,250,000
M.Karakawa	Function expressin by amorphization of metal oxides	¥2,860,000

Entrusted Research

Y.Ie	Japan Science and Technology Agency	Evaluation of organic field-effect tansistor devices	¥4,160,000

Contribution to Research

Y.Ie	TOKUYAMA SCIENCE FOUNDATION	¥2,000,000

Cooperative Research

Y.Aso	DAIKIN INDUSTRIES, Ltd	¥2,625,000
Y.Aso	ISHIHARA SANGYO KAISHA, LTD	¥0,000
Y.Aso	TOYOBO CO., LTD	¥1,000,000

Department of Bio-Nanotechnology

Original Papers

[1]High thermopower of mechanically stretched single-molecule junctions, Makusu Tsutsui, Takanori Morikawa, Yuhui He, Akihide Arima, Masateru Taniguchi: Scientific Reports, 5 (2015) 11519.

[2]Impact of Water-Depletion Layer on Transport in Hydrophobic Nanochannels, Yuhui He, Makusu Tsutsui, Xiang Shui Miao, Masateru Taniguchi: Analytical Chemistry, 87 (24) (2015) 12040-12050.

[3]Particle Trajectory-Dependent Ionic Current Blockade in Low-Aspect-Ratio Pores, Makusu Tsutsui, Yuhui He, Kazumichi Yokota, Akihide Arima, Sadato Hongo, Masateru Taniguchi, Takashi Washio, and Tomoji Kawai: ACS Nano, 10 (2015) 803-809.

International Conferences

[1]Preparation of Atomically Flat Ni(111) on Mica Substrate , Hiroyuki Tanaka, M.Taniguchi: The 23rd International Colloquium on Scanning Probe Microscopy.

[2]Preparation of metal supported graphene substrate for STM , Hiroyuki Tanaka, M.Taniguchi: PACIFICHEM2015.

[3]Single-Molecule Sequencing Using Nanopores and Nanoelectrodes (invited), Makusu Tsutsui: the 8th Conference of Asian Consortium on Computational Materials Science (ACCMS-8).

[4]Single Molecule Technologies to Identify the Central Dogma , Masateru Taniguchi: 3rd Core to Core Program Conference /4th imec Handai International Symposium.

[5]Acquiring Biological Information of Individuals Using Quantum Mechanics (invited), Masateru Taniguchi: 2015 International Conference on Solid State Devices and Materials(SSDM 2015).

[6]Single-molecule Sequencing Technology To Identify Sequences Of Base Molecules In DNA And RNA And Sequences Of Amino Acid Molecules In Peptides (invited), Masateru Taniguchi: 5th Annual Next Generation Sequencing Asia Congress and co-located 3rd Annual Single Cell Analysis Asia Congress.

[7]Single-molecule electrical sequencing technique (invited), Masateru Taniguchi: The 16th RIES-Hokudai International Symposium.

[8]Acquiring biological information of DNA, RNA, and peptide (invited), Masateru Taniguchi: The 14th SANKEN Nanotechnology International Symposium, ISIR, Osaka University The 3rd KANSAI Nanoscience & Nanotechnology International Symposium The 11th HANDAI Nanoscience & Nanotechnology International Symposium.

[9]Low-aspect-ratio micropore sensors: possibilities and limitations , Makusu Tsutsui, Akihide Arima, Kazumichi Yokota, Masateru Taniguchi, Tomoji Kawai: The 2015 International Chemical Congress of Pacific Basin Societies (PACIFICHEM 2015).

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[4]K20150127 Analysis apparatus of shape distribution of exosomes, cancer screening device, a method for analyzing the shape of distribution of exosomes, and cancer testing method, 2016-038204

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[9]G20100080USCONT Method and apparatus for identifying a nucleotide, and a method for determining the nucleotide sequence of the polynucleotide and equipment, 14/883494

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[17]G20120069EP Control method and apparatus of the moving speed of the material, as well as, the use of these, G20120069EP

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Academic Degrees

Doctor Degree for Science A.Arima	Study on Electrical Analysis of Single-Particles and –Molecules Using Extended-Nanospace in Aqueous Conditions	

Grant-in-Aid for Scientific Research

M.Taniguchi	Single molecule sequencing technology using tunneling currents	¥38,350,000
M.Taniguchi	Creation of micro-heater built-gating nanopore device	¥500,000
M.Tsutsui	Creation of high-performance single molecule thermoelectric materials	¥10,010,000
M.Tsutsui	Creation of a single particle mass measurement method, which is based on the electrophoresis time measurement	¥4,030,000
M.Tsutsui	Creation of a single particle mass measurement method, which is based on the electrophoresis time measurement	¥0,000
H.Tanaka	Single molecule sequencing using graphene	¥0,000
H.Tanaka	Single molecule sequencing using graphene	¥4,420,000
K.Yokota	Elucidation of material transport phenomena in nananospace and single molecule impedance measurements	¥910,000

Entrusted Research

T.Kawai	Japan Science and Technology Agency	Development of InSECT system using nano-micro pore	¥410,885,000

Contribution to Research

M.Tsutsui	Kanasai Research Foundation for technology promotion	¥940,000

Cooperative Research

M.Taniguchi	Quantum Biosystems Inc.	¥8,000,000
M.Taniguchi	Quantum Biosystems Inc.	¥0,000

Other Research Fund

M.Taniguchi	Kyoto University(MEXT)	¥35,754,000

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[1]Investigations of 2,7-diaminonaphthyridine conjugates for monitoring the hairpin probe PCR (poster), R. Verma, F. Takei, K. Nakatani: Pacifichem2015.

[2]Toward DNA-detecting FET devices with ligand-immobilized gate surface (poster), A. Michikawa, R. Verma, N. Sabani, K. Nakatani: Pacifichem2015.

Patents

[1]G20150035WO PCR method and PCR kit, PCT/JP2015/073755

[2]G20120087US Method for detecting single nucleotide polymorphism in nucleic acid, 14/352208

Academic Degrees

Master Degree for Science A. Michikawa	Studies on DNA/RNA mismatch binding molecules having nucleophilic functional group & fabrication of DNA sensor made of Au-SiO2 immobilized with mismatch binding molecules

Grant-in-Aid for Scientific Research

K. Nakatani	Studies on organic reader molecules toward single base resolution in nanopore sequencing	¥1,100,000

Entrusted Research

K. Nakatani	JST	Development of Digital Hairpin Primer OCR for Diagnosis of Hepatitis	¥990,000

Cooperative Research

K. Nakatani	NITTO KASEI co.,ltd.	¥864,000
K. Nakatani	Yamato Scientific co.,ltd.	¥396,000

Comprehensive Analysis Center

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[1]One-Pot Catalysis Using a Chiral Iridium Complex/Bronsted Base: Catalytic Asymmetric Synthesis of Catalponol, T. Suzuki, Ismiyarto, Y. Ishizaka, D. Y. Zhou, K. Asano, H. Sasai: Org. Lett., 17 (2015) 5176.

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[3]Generation, Characterization, and Reactivity of a CuII-Alkylperoxide/Anilino Radical Complex: Insight into the O-O Bond Cleavage Mechanism, S. Paria, T. Ohta, Y. Morimoto, T. Ogura, H. Sugimoto, N. Fujieda, K. Goto, K. Asano, T. Suzuki, S. Itoh,: J. Am. Chem. Soc., 137 (2015) 10870.

[4]Morphological and crystal structural control of tungsten trioxide for highly sensitive NO2 gas sensors, Z. Meng, A. Fujii, T. Hashishin, N. Wada, T. Sanada, J. Tamaki, K. Kojima, H. Haneoka, T. Suzuki,: J. Mater. Chem. C, 3 (2015) 1134.

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Publications in Domestic Meetings

The annual meeting of Crystallographic Society of Japan	1 paper
The annual meeting of Chemical Society of Japan	1 paper
62th Symposium on organometallic Chemsty ,Japan	1 paper

Grant-in-Aid for Scientific Research

T.Suzuki	ultimate asymmetric medical synthesis borrowing reaction	based on hydrogen	¥1,560,000

Contribution to Research

T.Suzuki	Japan Synthetic Rubber Co.,Ltd.	¥500,000

Cooperative Research

T.Suzuki	Panasonic R&D Device solution center	¥552,000

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Original Papers

[1]Radical Ions of Cyclopyrenylene: Comparison of Spectral Properties with Cycloparaphenylene, M.Fujitsuka, S.Tojo, T.Iwamoto, S.Yamago, T.Majima: Journal of Physical Chemistry A, 119 (2015) 4136-4141.

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S.Tojo	The Decomposition of organic pollutants in controlled reaction sites by quantum beam	¥780,000