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The University of Osaka

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

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

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

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

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

Organization Divisions Departments **Division 1 Information & Quantum Sciences Quantum System Electronics** Semiconductor Electronics Advanced Electron Devices Intelligent Media Reasoning for Intelligence Knowledge Systems Architecture for Intelligence **Divison 2 Advanced Materials & Ouantum Functional Materials** Semiconductor Materials and Processes **Beam Science** Metallic Materials Process 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** Structural Molecular Biology Cell Membrane Biology 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 Microbiology and Infections Diseases Laboratory of Atomic Scale Materials Processing Laboratory of Cellulose Nanofiber Materials Laboratories of 3rd Project Laboratory of Cell Membrane Structural Biology **Alliance Laboratory** Department of Quantum Information Photonics (Alliance Laboratory of ISIR, Osaka Univ. and RIES, Hokkaido Univ.)

Department of Disease Glycomics

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

Research Centers

Nanoscience and Nanotechnology Center

.

Functional Nanomaterials and Nanodevices Advanced Nanofabrication Nanocharacterization for Nanostructures and Functions Theoretical Nanotechnology Soft Nanomaterials **Bio-Nanotechnology** Nanotechnology Environmental and Energy Applications Nano-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

<u>Comprehensive Analysis Center</u> <u>Research Laboratory for Quantum Beam Science</u> <u>Center for Research Education and Training</u> <u>International Collaborative Research Center</u> 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	
<u>Service Facilities</u>	Workshop Laboratory for Radio-Isotope Experiments Electronic Processing Laboratory Academia Industry Relations Office Office of Information Network Public Relations Office Library	

ing Office
ities Management Office
ine Group
urement Group
eral Affairs Division
arch Cooperation Division

Staffs' Age (years old) –As of 3.31.2015



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 2014 is 963,885,000yen.
- Donation for Research is accepted after the Judgement of Committee and the amount are as follows.



(Unit : kilo yen , () Number)

Division	Information and	Advanced	Biological and	Nanoscience and
	Quantum	Materials and	Molecular	Nanotechnology
Year	Sciences	Beam Science	Sciences	Center
2014	14,585 (11)	19,288 (19)	3,099 (5)	26,499 (11)
Division Year	Special Projects	Others	Total	
2014	7,921 (4)	1,603 (4)	72,995 (54)	

• Cooperative Researches and Contract Researches in the fiscal year 2014 are as follows: Cooperative Researches are carried out with 59 organizations and the budget for the fiscal year 2014 is 154,783,000 yen. The number of Contract Researches is 42 and the budget for the fiscal year 2014 is 701,618,000 yen.

4) International Research

Department of			
Semiconductor	Purdue University	USA	Novel graphene device fabrication
Electronics			
Department of Advanced Electron	Imperial College	UK	Manufacturing of Oxide TFTs and
Devices	London		integrations
	Peking University	China	Computer Vision
	Microsoft Research Asia China		Computer Vision
Department of	Drexel University	USA	Computer Vision
Intelligent Media	University of Rajshahi	Bangladesh	Computer Vision
	University of Picardie Jules Verne	France	Computer Vision
	Federation University	Australia	Development of Machine Learning
	Australia	Australia	Methods Based on Data Mass
	Universite Joseph Fourier	France	Data Block Mining Method and Its
			application to Log Analysis
			Extension to Sequential Test of
			Statistical Hypotheses Mining
	University of Washington	USA	Development of submodular
			optimization algorithms for machine
Donortmont of			learning
Reasoning for	Peking University	China	Application of machine learning to
Intelligence			computer vision with brain images
Intelligence	Nanyang Technological University	Singapore	Application of machine learning to
			video analysis of crowded scenes
	ETH Zürich		Development of optimization
		Switzerland	algorithms for gene data analysis with
		5 witzerianu	machine learning
			Development of Significant Pattern
			Mining Methods
	University of Copenhagen	Denmark	Development of Significant Pattern Mining Methods

	University of North	USA	Estimation of causal direction in the
Department of	Carolina at Chapel Hill	USA	presence of latent common causes
Reasoning for	University College	UK	Estimation of causal direction in the
Intelligence	London		presence of latent common causes for
			time series data
	LOA, ISTC-CNR	Italy	Definition of artifacts and Unifying
			definition of functions
Department of	TU Delft	The	Definition of artifacts and Unifying
		Netherlands	definition of functions
Knowledge Science	The John Paul II		Definition of artifacts and Unifying
	Catholic University of	Poland	definition of functions
	Lublin		
	Chulalongkorn	Thailand	Machine Learning
	University	i nanana	
	De La Salle	Republic of the	Empathic Computing
	University-Manila	Philippines	
	University of Porto	Portugal	Data mining
	University of Leuven	Belgium	Machine Learning
Department of	imec (Interuniversity	Belgium	Brain signal analysis
Intelligence	Microelectronics		
Interrigence	Centre)		
	University of Bamberg	Germany	Database Systems
	Telecom Paris Tech	France	Embodied Agent
	University of Auckland	New Zealand	Information recommendation
	Carnegie Mellon	IISA	Information recommendation
	University		
Department of Quantum	University Hasselt	Belgium	Development of n-type organic
Functional Materials			semiconductors
	Inner Mongolian	China	Improvement of semiconductor device
Department of	Normal University		characteristics by use of nitric acid
Semiconductor			oxidation method
Materials and Processes	Slovakia Academy of	Slovak Republic	Improvement of crystalline Si solar
	Science		cell characteristics by use of surface
			structure chemical transfer method

			Development of Multifunctional
	Sunmoon University	V	Nanomaterials and Processing
Department of		Kolea	Technology for Eco-friendly
Advanced Hard			Applications
Materials			Academic Exchange in the field of
	Hanyang University	Korea	Nanochemical Engineered New
			Functional Materials
Department of	Holst Centre	Netherlands	Stretchable conductive wiring
Advanced			
Interconnection	imec UGent CMST	Belgium	Stretchable bonding
Materials			
Department of Excited	University College	UV	Mechanisms of photoinduced phase
Solid-State Dynamics	-State Dynamics London		transitions in solids
Department of Accelerator Science	The Advanced Radiation Technology Institute, Korea Atomic Energy Research Institute	Korea	Auantum Beam Science Research
	University of Sherbrooke	Canada	Monte-Carlo simulation study on radiolysis of polar liquids at extreme conditions
Department of Beam Materials Science	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		Study on Combination of Top-down
	Birmingham	UK	and Bottom-up Nano-fabrication
	University of		Synthesis of Novel Block Copolymers
	Queensland	Australia	for Lithographic Applications
Department of Molecular Excitation	National Taiwan University	Taiwan	Photochemistry of Supramolecules
Chemistry	POSTECH	Korea	Photocatalytic Reaction Mechanism
l		1	

			Development of Novel Dual Catalysis
	Bielefeld University	Germany	based on Biocatalyst and
Department of Synthetic			Chemocatalyst
Organic Chemistry		France	Development of Novel
	Paris Sud University		Environmentally Benign Process
	The Hospital for Sick Children	Canada	Suppression of Trinucleotide Repeat
Department of			Expansion by Small Organic
Regulatory Bioorganic			Molecules
Chemistry	Macau University of		Analysis of CUG Repeat Binding
	Science and Technology	China	Molecules by Mass Spectra
	Eindhoven University of	NY .1 1 1	Modulation of functions of 14-3-3
	Technology	Netherlands	proteins
			An EGCG Derivative Effectively
Department of Organic	Kyunghee University	Korea	Induces Apoptosis via
Fine Chemicals			SHP-1-Mediated Suppression of
			BCR-ABL and STAT3 Signalling in
			Chronic Myelogenous Leukaemia
Department of			Production Machanism of Padical SAM
Biomolecular Science	Palacký University	Czech Republic	
and Reaction			Elizynie
	Indian Institute of Technology Madras	India	Spatiotemporal Ca2+ imaging during
			cellular slime mold development: A
			study with ultrasensitive genetically
			encoded indicators
	Weatherall Institute of	UK	The versatility of optical
	Molecular Medicine,		super resolution microscopy
Department of	University of Oxford		super-resolution interoscopy
Biomolecular Science	Department of		
and Engineering	Department of		Molecular engineering to build new
and Engineering	Department of Chemistry, University of	USA	Molecular engineering to build new
and Engineering	Department of Chemistry, University of Alberta	USA	Molecular engineering to build new tools to probe cellular physiology
and Engineering	Department of Chemistry, University of Alberta	USA	Molecular engineering to build new tools to probe cellular physiology Single molecule microscopy in
and Engineering	Department of Chemistry, University of Alberta Technische Universität	USA	Molecular engineering to build new tools to probe cellular physiology Single molecule microscopy in mammalian 3D cell cultures and
and Engineering	Department of Chemistry, University of Alberta Technische Universität Darmstadt	USA Germany	Molecular engineering to build new tools to probe cellular physiology Single molecule microscopy in mammalian 3D cell cultures and plants -Same challenge. Same
and Engineering	Department of Chemistry, University of Alberta Technische Universität Darmstadt	USA Germany	Molecular engineering to build new tools to probe cellular physiology Single molecule microscopy in mammalian 3D cell cultures and plants -Same challenge. Same solution?

			captures life in action
Department of	EMBL(European		
Biomolecular Science	Molecular Biology	Germany	Tools for Manipulating Cell Biology
and Engineering	Laboratory)		
			Mechanism of Bacterial Homeostasis
	University of Hong		Mediated by Transporters and
	Kong	China	Development of New Therapeutic
	8		Strategies to Control Infectious
			Diseases
	National Institute of		Bile-mediated activation of the
	Agronomic Research	France	multidrug efflux genes in Salmonella
	(INRA)		enterica
Laboratory of			Uncovering the molecular basis of
Microbiology and			multidrug efflux pumps involved in
Infectious Diseases	Ghent University	Belgium	resistance
			of Salmonella Enteritidis against
			Ovotransferrin and its peptide
	Linivarcity of Vatarinary	Germany	Salmonella Typhimurium Multidrug
	Madicina Hannover		Efflux Pumps and Triclosan
	Medicine Haimover		Resistance
	Martin Luther	Germany	Structural and Eurotional Analysis on
	University of		Postorial Multidrug Efflux Systems
	Halle-Wittenberg		Bacteriai Multidiug Efflux Systems
	IBM Research	G 1 1 1	Obsevation of scanning thermal
	Laboratory	Switzerland	microscope for oxide nanostucutres
Department of	Indian Institute of		
Functional	Technology,	India	Sn oxide-based gas sensors
Nanomaterials and	Hyderabard		
Nanodevices	Ehwa Woman	17	Obsevation of nano-doman by Kervn
	University	Korea	force microscopy
	Genova University	Italy	Functional Oxide-MEMS
Demontración of			Investigation of microheterogeneity
A dyapaced	Bhabha Atomic	T. J.	and initial process of radiation
Nanofabriaction	Research Centre	maia	chemistry in materials using ultrafast
			pulse radiolysis

Department of Advanced	Institute of Physics of the Academy of Sciences of the Czech Republic Na Slovance	Czech Republic	Development of dosimeter for X-ray beam line
Ivalioration	University of Notre Dame	USA	Radiation chemistry of water
	University of Kentucky	USA	ETEM observation of nanomaterials under catalytic reaction conditions
Department of Nanocharacterization for	Utrecht University	Netherlands	Structural transformation of gold nanorods in gases
Nanostructures and Functions	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
Department of Theoretical Nanotechnology	Korea Institute of Ceramic Engineering and Technology	Korea	Mechanical properties of hard ceramics materials
Department of Soft	Interuniversity Microelectronics Centre	Belgium	Development of high-performance n-type organic field-effect transistors
Nanomaterials	Indian Institute of Chemical Biology	India	Cheical Biology Applications of Organic Electron Acceptors
Department of	Uppsala University	Sweden	Theoretical studies on DNA manipulations
Bio-Nanotechnology	Rutgers University	USA	Theoretical studies on DNA manipulations
Department of 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
Laboratory for Quantum Beam Science	Korea Atomic Energy Research Institute	Korea	Quantum Beam Science

2014/5/9	The 1st SANKEN Techno Salon							
2014/6/11-13	9th Annual Meeting of Japanese Society for Chemical Biology							
0014/7/11	2nd Intl Japan-Korea Seminar on Multifunctional Nanomaterials -Advanced							
2014/ //11	Materials and Devices Interconnection-							
2014/7/20-8/2	The 2st Spying minority in biological phenomena Training Courses							
2014/7/22	Lecture on computer vision							
2014/7/24	Foundations and Principles of AI							
2014/7/28	ISIR and INRA International Joint Symposium							
2014/7/30	JSPS and DAAD International Joint Symposium							
2014/8/1	The 2nd SANKEN Techno Salon							
2014/9/1-5	25th Computational Materials Design Workshop							
0014/0/10	New Industry Support InterMaterials Symposiumn "New Perspective of Advanced							
2014/9/19	Material to Save The World".							
0014/0/26	Symposium at The 52nd Annual Meeting of the Biophysical Society of Japan,							
2014/9/20	Scenario of functions from minority and number fluctuations							
2014/10/10	Foundations and Principles of AI							
2014/10/26-27	Mie Universisty - Osaka University Joint Meeting							
2014/11/7	The 3rd SANKEN Techno Salon							
2014/11/29	SANKEN 75the Aniversary Symposium							
0014/12/10 11	The 18th SANKEN International Symposium / The 13th SANKEN							
2014/12/10-11	Nanotechnology Symposium							
2014/12/11-12	Lecture on computer vision							
2015/12/18	KICET and ISIR Joint Seminar							
2014/12/20	The 3st Spying minority in biological phenomena Workshop							
2014/12/24	The 1st optical spin conversion meeting							
2014/12/25-26	CREST Joint Meeting							
2015/1/13	Foundations and Principles of AI							
2015/1/29	Lecture on computer vision							
2015/2/6	The 4th SANKEN Techno Salon							
2015/2/20-21	ISIR Intra-University Collaboration Meeting							
2015/2/23	Seminar on High-performance Nano-sensor Materials							
2015/2/23-27	26th Computational Materials Design Workshop							
2015/3/18-20	Asian Computational Materials Design Workshop							
2015/3/22	Foundations and Principles of AI							

5) Symposia, Seminars, Workshops and Lectures

2015/3/23	NII Seminar Series on Dimensionality and Scalability
2015/3/27-28	Rare Event Sampling and Related Topics

Other Lectures and Seminars

2014/5/9	Robert E.	University of Alberta	Professor	Molecular engineering to build new
2014/3/9	Campbell	Chrycistry of Alberta	110103501	tools to probe cellular physiology
2014/7/9	Hiroyuki Wado	DENSO	Head of the laboratory	Automotive sensors
2014/7/10	Kouji Tsuda	Graduate School of Frontier Sciences	Professor	Bayes Optimization in Materials Informatics
2014/7/11	Nobuyasu Koga	Institute for Molecular Science	Associate Professor	Understanding the way of protein folding through protein construction
2014/7/11	Yong-Ho Choa	Hanyang University	Professor	Percolation Based Thermal Interface Nanomaterials (TIMs)
2014/7/11	Young-Keun Jeong	Pusan National University	Professor	3D printing technology on ceramics & ceramic base nanocomposites
2014/7/23	Aixin Yan	The University of Hong Kong	Associate Professor	How signals are transduced through the membranes in bacterial two-component systems
2014/8/1	Patricia Kooyman	Delft University of Technology	Associate Professor	Bridging the pressure gap in TEM
2014/8/26	Kiyoyuki Terakura	National Institute of Advanced Industrial Science and Technology	Emeritus Advisor	Mechanism of electric polarization in ferroelectrics
2014/9/12	Xuewu Ge	University of science & technology of China	Professor	Gamma-ray-radiation-induced Graft Polymerization on Poly (ethylene terephthalate) and Its Application
2014/9/12	Mozhen Wang	University of science & technology of China	Professor	The Preparation and Morphological Control of Polymeric Microspheres using Radiation Technique
2014/9/16	Tobias Meckel	Technische Universitat Darmstadt	PD	Single molecule microscopy in mammalian 3D cell cultures and plants -Same challenge. Same solution?

2014/10/13	Hiroshi Nikaido	Department of Molecular and Cell Biology, University of California, Berkeley,	Professor	My life in Microbiology
2014/10/28	Caroline Haupt	Martin Luther University of Halle-Wittenberg	Postdoctor al Fellow	The Bacterial Multidrug Efflux System MdtEF-TolC
2014/11/4	Jean-Jacques Toulmé	The European Institute of Chemistry and Biology, University of Bordeaux	Director, Professor	Aptamers for diagnostic and analytical purposes
2014/11/19	Kun Zhang	Max Planck Institute	Senior Research Scientist	Causal Modeling and Machine Learning: How They Benefit from Each Other?
2014/12/9	Thomas D. Anthopoulos	Imperial College London	Professor	Advanced materials & devices concepts for plastic opto/electronics
2015/1/16	Aixin Yan	The University of Hong Kong	Associate Professor	Microbial secondary metabolite indole stimulates pyocyanin production, biofilm formation, and enhanced antibiotic resistance in P. aeruginosa ATCC27853
2015/1/23	Toshikazu Takatomi	KEK	Engineer	Ultraprecise fabrication of accelerator cavities of RF gun and advanced linacs
2015/1/28	Bi-Chang Chen	Academia Sinica	Assistant Research Fellow	Lattice light sheet microscopy captures life in action
2015/1/29	Eriko Aiba	The University of Electro-Communications	Assistant Professor	A Pianist and Ear of a Pianist
2015/2/3	Peter H. Dederichs	Peter Grunberg Insitiut and for Advanced Simulation	Professor	Friedel Oscillations- In the bulk and on surfaces
2015/2/18	Dae Won Cho	The Institute of Scientific and Industrial Research	Professor	Photochemistry of Cyclometalated Heteroleptic Ir-complexes and Diarylamino-pi-carboranes
2015/2/23	Yong-Nam Kim	Korea Testing Laboratory	Principal Researcher	Traceability and Standardization of Materials Propertie for Advanced

				Systems
2015/2/23	Hee Soo Lee	Pusan National University	Prof.	Design and Development Oxide Perovskite for Solid-Oxide Fuel Cells
2015/3/5	Christian Eggeling	University of Oxford	Associate Professor	The versatility of optical super-resolution microscopy
2015/3/31	Mikio Tanabe	Martin Luther University of Halle-Wittenberg	Group Leader	Structural approach to understand the transport mechanism of the bacterial drug efflux transporter

7) Public Information Activity

Public information activity of ISIR in 2014 is as follows:

- Bulletin of ISIR 2014 (in both Japanese and English)
- Memoirs of the Institute of Scientific and Industrial Research, Osaka University Vol.71 2014 (in English)
- Annual Report of ISIR (in Japanese)
- SANKEN News Letters(in Japanese)
- Report on SANKEN Techno Salon 2014 (in Japanese)
- WWW home-page (<u>http://www.sanken.osaka-u.ac.jp/</u>)

8) Research Reports

The number of scientific and technological papers published in 2014 is 373. The details are described in the part of activity of divisions and facilities.

K.TAKENAKA	Young Scholar Lectures of CSJ	2015/3/28
	The 88th Annual Meeting of Japanese Society for Bacteriology,	0015/2/00
5. I AMASAKI	Excellent Presentation Award	2015/3/28
V VOZAVI	Civic Teck Osaka Application Contest Application / Web Service	2015/2/21
K.KUZAKI	Track Grand Prize	2013/3/21
K.KAIHATSU	Tea Academic Research Society, Poster Award	2015/3/17
T.KANKI	KANKI Information Processing Society of Japan Encouragement Award	
M.NOGI	M.NOGI Award for KANSAI SQUERE	
K.FUJIWARA	The Materials Research Society of Japan, Award for Encouragement	2015/1/0
	of Research	2015/1/9

9) Scientific Awards

	National Institute of Science and Technology Policy, Ministry of		
M.TANIGUCHI	Education, Culture, Sports, Science and Technology NISTEP Award	2014/12/19	
	(The Researchers with Nice Step)		
T. MATSUMURA	The 9th International Workshop on Robust Computer Vision	2014/12/7	
Y. YAGI	(IWRCV9), Best Poster Award	2014/12/7	
	The 15th Annual Pacific-Rim Conference on Multimedia,Outstanding	2014/12/2	
Y.MAKIHARA	Reviewer Award	2014/12/3	
	Japanese Society of Catechinology, Poster Presentation Award of	2014/11/22	
K.KAIHATSU	Excellence	2014/11/22	
N A GO	2014 Award of The Japanese Association for Organic π -Electron	0014/11/01	
Y.ASO	Systems	2014/11/21	
Xianjin Lin			
H. SASAI	Molecular Chirality Asia 2014 Poster Award	2014/10/31	
K. TAKENAKA			
Y. ANDO	Osaka Science Prize	2014/10/29	
T.KONDO	11th Ionizing Radiation and Polymers, Best Poster Award	2014/10/8	
T. KAWAI			
M. TANIGUCHI	The 75st JSAP Autumn Meeting, 2014 Poster Award	2014/10/1	
M. TSUTSUI			
T. SUGAHARA	The Thermoelectric Society of Japan (TSJ) Research presentation award	2014/9/30	
	The Japan Society of Applied Physics(JSAP) Young Scientist Oral	2014/9/17	
K. NAGASHIMA	Presentation Award		
	Japanese Society of Radiation Chemistry, Radiation Chemistry		
I. MAJIMA	Award	2014/9/9	
	The Materials Research Society of Japan, Award for Encouragement	0014/0/0	
K. FUJIWARA	of Research in IUMRS-ICA 2014 Symposium C-8	2014/9/9	
	The Materials Research Society of Japan, Award for Encouragement	2014/0/0	
K. FUJIWARA	of Research in IUMRS-ICA 2014 Symposium C-11	2014/9/9	
K.KISHI			
H. SASAI			
S. TAKIZAWA	H26 Organia Chamistry Wakata Saminar Dostar Award	2014/8/5	
Fernando A.	1120 Organic Chemistry wakate Seminar Poster Award	2014/0/J	
Arteaga			
S.HIRATA			

K. NISHINO	JSPS Exemplary Peer Reviewer Award	2014/7/31
T.KIMURA		
Y. YAGI	The 17th Meeting on Image Recognition and Understanding (MIRU	2014/7/21
Y. MAKIHARA	2014) Excellence Student Award	2014/7/51
D. MURAMATSU		
K.SUGANUMA	Lee Hsun Lecture Award	2014/7/18
K.HAYASHI	12th Physical Pharmaceutical Sciences Forum for Young Scientists	2014/7/15
Fernando A.		
Arteaga		
H. SASAI		
S.TAKIZAWA	Elsevier Best Poster Prize	2014/6/27
T. M. N. Nguyen		
K.KISHI		
M. SUZUKI		
Y.ANDO	Thomson-Reuter Highly Cited Researcher	2014/6/18
T.SEKITANI	Thomson-Reuter Highly Cited Researcher	2014/6/18
T.DOI		
H. SASAI		
S. TAKIZAWA	Symposium on Molecular Chirolity 2014 Destor Award	2014/6/7
Y.YOSHIDA	Symposium on Molecular Chiranty 2014 Poster Award	2014/0/7
J. KODERA		
M.SOKO		
K.SUGANUMA	JIEP PRIZE	2014/5/23
V VA CI	The Commendation for Science and Technology by the Minister of	
	Education, Culture, Sports, Science and Technology	2014/4/15
Y.MAKIHAKA	Prizes for Science and Technology, Research Category	
M.FUJIKAWA	CSJ Student Presentation Award 2014	2014/4/10
T.YANAGIDA		
K.NAGASHIMA	The 61st JSAP Spring Meeting 2014 Poster Award	2014/4/1
T.KAWAI		

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, 2015 is as follows.

Field Course	Science	Engineering	Engineering Science	Pharma- ceutical Science	Information Science and Technology	Frontier Biosciences	Total
Master Course	27	42	13	0	17	-	99
Doctor Course	26	26	4	2	9	3	70
Total	53	68	17	2	26	3	169

Number of students who had obtained Master's or Doctor's Degree in FY2014 is as follows.

Field Degree	Science	Engineering	Pharmaceutical Science	Information Science and Technology	Total
Master's Degree	14	31	0	4	49
Doctor's Degree	6	8	1	1	16
Total	20	39	1	5	65

3. International Exchange

1) Exchange Agreement

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

oFaculty of Natural Science, Otto-von-Gueriche University Magdeburg (Germany)

oPukyong National University, Basic Science Research Institute(Korea)

- Forschungszentrum Jülich GmbH (Germany)
- oUniversity College London (U.K.)
- oCollege of Natural Sciences, Pusan National University (Korea)
- oResearch Institute of Industrial Science, Hanyang University (Korea)

oCollege of Science, National Taiwan University (Taiwan)

oCentre National de la Researche scientifique : CNRS (France)

- oRwth Aachen University (Germany)
- •College of Natural Science, Chungnam National University (Korea)
- oPeking University, The School of Electronics Engineering and Computer Science (China)
- oCollege of Science, National Taiwan Normal University (Taiwan)
- oFaculty of Science, University of Geneva (Switzerland)
- oInner Mongolia Normal University (China)
- °College of Science and Technology, Korea University (Korea)
- ODepartment of Physics, Indian Institute of Technology Delhi (India)
- oUniversity of Augsburg(Germany)
- oKyungwon University ,Gachon Bionano Research Institute(Korea)
- oCollege of Computer Studies, De La Salle University (Philippine)
- oSchool of Environmental Science and Engineering/Department of Chemical
- Engineering, Pohang University of Science and Technology(Korea)
- oDepartment of Chemistry, Korea Advanced Institute Science and Technology (Korea)
- oFaculty of Science, Assiut University(Egypt)
- oInteruniversity Micro Electronics Center (Belgium)
- OUniversity of Bordeaux 1(France)
- oFaculty of Chemistry, Bielefeld University(Germany)
- oThe Biotechnology Institute, University of Minnesota(U.S.A)
- oKorea Institute of Ceramic Engineering and Technology(Korea)

2) Foreign Researchers and Students

The Number of foreign researchers and students staying in ISIR as of March 31, 2015 is 78 in total. Details are, Assistant Professor(include of specially appointed staffs) (1), Specially Appointed lecturer(1), Specially Appointed Associate Professor(2), Specially Appointed Researcher(8), Specially Appointed Technical Staff(1), Part-time Employee (14), Graduate Students (31: Doctor Course, 23, Master Course, 8), Special Research Students (1), Research Students (20).

Their nationalities are; China(35), Korea(7), Thailand(4), Indonesia(2), Bangladesh(5), India(4), France(1), The Netherland(2), Viet Nam(1), Russia(2), Taiwan(4), Philippine(1), Mexico(2), Malaysia (1), Egypt(4), U.S.A.(1), Costa Rica(1), Turkey(1), England(1).

The Number of visiting Research Scholar in 2014 is 43. Their nationalities are; U.S.A.(7), China(9), Korea(8), Thailand(2)Hong Kong(3), Slovakia(2), England(1), Germany(3), France(1), Italy(1), India(2), Switzerland(1), The Nether land(2), Taiwan(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 466 in total.

Number of ISIR staffs who have been working as committee members of International Conferences or Editorial Board of international academic journals are 156 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:	Shuichi EMURA
Specially Appointed Rese	archer: Haruki KIYAMA
Graduate Students:	Yoshihito SUGETA, Kentaro DEHARA,
	Takashi HIRAYAMA
Under Graduate Students:	Masamitsu KIMURA, Ryouki SHIKISHIMA
Supporting Staff:	Akiko WATANABE (2014.8.16-)

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

Fabrication and quantum transport in InAs self-assembled quantum dots

InAs self-assembled quantum dots (QDs) have large g-factors and strong spin-orbit interaction and would offer the spin qubits operating at high speed without controlling magnetic fields. We fabricated InAs self-assembled QD transistors by contacting Ti/Au source and drain electrodes directly to an InAs QD segregated on the surface (Fig.1). Side-getes are made to apply voltage laterally to the QD. A doped metallic GaAs layer buried in the wafer is used as a back-gate to tune the electron number in the QD. In our previous experiments we have demonstrated that the side-gate voltage can modify the lateral confinement potential of QDs and can alter various QD parameters. Figure 2

shows the Coulomb diamonds typical for QD transport. Moreover, we have successfully achieved the side-gate tuning of the tunnel couplings between the QD and leads.



Microscope image of an InAs self-assembled quantum dot (QD) transistor.

Fig. 2 Coulomb diamonds measured in an InAs QD at 0.5 K and zero magnetic field.

JI_{SD}/dV_{SD}

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

Dilute magnetic semiconductors are gathering great interest as a candidate for new functional materials. Nitride-based magnetic semiconductors such as GaCrN and GaGdN 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. In 2014, Sm-doped GaN was grown on GaN(0001) by PA-MBE toward the realization of n-type ferromagnetic semiconductors. It was found that with increasing doping concentration of Sm, the c-axis lattice parameter in the Sm-doped GaN films increased linearly. Photoluminescence spectra of the Sm-doped GaN



films showed narrow lines assigned to the ${}^{4}G_{5/2} \rightarrow {}^{6}H_J$ (J = 5/2, 7/2, 9/2, respectively) intra-4f transitions of Sm³⁺ ions. These provide the evidence that wurtzite-type Ga_{1-x}Sm_xN is coherently grown on GaN(0001).

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 room temperature. In 2014, we examined the effects of growth parameters on crystalline structure and magnetic property in γ '-Fe₄N grown on GaN by using PA-MBE toward the improvement of spin injection efficiency through γ '-Fe₄N/GaN junctions.

Photovoltaic cell based on a new principle

A new photovoltaic cell without a p-n junction is recently proposed. In 2014, we promote to manufacture the substantial cells and make the proof experiments whether or not this operates as a photovoltaic cell (in collaboration with National Institute of Advanced Industrial Science and Technology). In addition to this experiments, we predict the conversion efficiency, based on the first principle (in collaboration with Prof. K. Sato, Faculty of Engineering). We start the proof experiments with GaN/AlGaN/GaN systems under 1 SUN irradiation. The operation of the photovoltaic cell is confirmed. The conversion efficiency reaches about 60 % for an InN/InGaN/InN with the band gap of 1 eV. This value far exceeds Shockley-Queisser limit (a little over 30%) in a photovoltaic cell with the p-n junction. It is ascribed to a hot electron effect.

XAFS

Following GaN:Gd, the identification of the nitrogen vacancy position and furthermore, the three-dimensional coordination environment around the nitrogen vacancy adjacent to the Dy ion doped in GaN by the analysis of the polarization dependence XANES spectra. The XANES spectra simulation is performed by the first principle calculation (in collaboration with Prof. K. Shirai).

Department of Semiconductor Electronics

Professor:	Kazuhiko MATSUMOTO
Associate Professors:	Koichi INOUE,
	Kenzo MAEHASH(Guest Professor,2014,10.1-)
Specially Appointed Asso	ciate Professor:
	Yasuhide OHNO(Guest Assoc. Prof., 2014.11.1-)
Assistant Professors:	Yasushi KANAI, Takao ONO (2015.1.1-)
Guest Researcher:	Masato MIYAKE
Graduate Students:	Takashi IKUTA, Satoshi OKUDA,
	Takeshi OE, Kohei SEIKE, Masatoshi NAKAMURA,
	Yusuke ISHIBASHI, Masayuki OKANO
Under Graduate Students:	Kaho KAMADA, Ryota HAYASHI, Yuki MORI
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

Selective Detection of Lectins with Glycan-Modified Graphene Field-Effect Transistors (GFETs) for Highly Sensitive Influenza Virus Sensor

We have studied GFETs with channels modified by two types of sialylglycopeptides (SGPs), which have selective sensitivity distinguishable between Sambucus-sieboldiana (SSA) and



Fig. 1. (a) Schematic of graphene modifications for specific detection of SSA and MAM, and (b) signal current of the SSA-sensitive GFET.

Maackia-amurensis (MAM) lectin, to develope new detectors for specific human and avian influenza virus, respectively. As the results, the negative charges within the Debye length increased with the concentration of selectively binding lectin, and then large shift of drain current was observed in contrast to the case of nonspecific proteins. The graphene modified with SGPs has ability for influenza virus sensor with high sensitivity and specificity.

Gas-sensing Properties of GFETs Dependent on the Substrate Surface

For the application of **GFETs** to high-sensitive gas-sensors, effects of substrate surface conditions have been studied. Before the preparation of GFET, three types of pretreatments of SiO₂/Si substrates were examined: (1) the surface was annealed in H₂ atmosphere, (2) was coated by an Al₂O₃ thin layer, and (3) was partially etched by CF₄ reactive Time-dependent responses ions. of points charge-neutral (CNP) in the transistor characteristics were measured in the air and O₂-gas exposure. The highest sensitivity was obtained in the sample



Fig. 2. (a) Time dependent characteristics of GFETs during 14 hours after the air exposure, and (b) charge neutral point (CNP) sift of GFETs with substrates pretreated in the different ways.

treated by CF_4 -reactive etching. In addition, the distinct O_2 concentration dependence was observed for GFETs with the three pretreatments.

Carbon Nanotube Single-Electron Transistors (CNTSETs) with Charge Storage

Carbon single-electron nanotube transistors (CNTSETs) have been fabricated with Au floating dots as charge storages in the gate-insulating Al₂O₃ layer, to study the possibility of the CNTSET operation as single-electron memories. In the transfer characteristics. the remarkable shift of the current oscillation called as the Coulomb oscillation was observed depending on the sweeping direction of the back-gate voltage in the range between -0.2 to 0.5 V. The shift is attributed to the charge injection into the Au floating dots from the CNT channel. In addition, a staircase relation was observed between the charging voltages



Fig. 3. (a) Schematic of CNTSET with charge storage, (b) transfer characteristics of the device, and (c) a staircase relation between charging voltages and Coulomb peak positions.

and the peak positions. The numerical estimation based on this staircase relation revealed that a single-electron charging occured into the Au dot. Our devices are one of the candidates for CNTSET-based single-electron memories, which can be the digital operating and ultra-low-power consumption devices.

Department of Advanced Electron Devices

Professor:	Tsuyoshi SEKITANI
Associate Professor:	Kouichi SUDOH
Specially Appointed As	sociated Professor: Takafumi UEMURA(2015.2.1-)
Assistant Professors:	Teppei ARAKI(2014.10.1-),
	Shusuke YOSHIMOTO(2015.3.16-)
Specially Appointed Re	searcher: Takafumi MATSUMOTO(2015.2.1-)
Technical Assistance:	Tamaki OKA(2014.12.1-)
Supporting Staffs:	Michi UEDA(2014.11.1-),
	Tomoko TAKAHASHI(2014.11.1-)
	Taki HONMA(2014.11.1-)

Outlines

We study science that fuses the basic science and advanced technologies required to precisely control the molecular structure, electronic state, and physical properties of various electrical functional materials and to apply these technologies to realizing flexible electronics and photonics. The goals of our laboratory are to study various topics from theories based on basic science, including mathematics, physics, process technology, circuit/system design, and information technology to electronic systems that contribute to society.

Current Research Projects

Large-area, flexible active matrix sensors for Cyber-Physical Systems

We have developed large-area, ultraflexible, and ultrathin electronic sensors. Our works focus on integration technologies of organic electronics comprising organic thin-film transistors (TFTs), light-emitting diodes (LEDs), and photodetectors (PDs) manufactured on thin-film flexible polymeric plastic substrates, which are imperceptible active matrix sensors. Here I would like to demonstrate the applications of imperceptible sensors for sophisticated wearable electronics and real-time health monitoring of civil infrastructures. These sensors serve as an important part of seamless

cyberspace/real-wo rld interfaces that are commonly referred to as cyber-physical systems (CPSs).

On the basis of our initial work on manufacturing different flexible organic devices,



including TFTs, LEDs, and PDs, we developed organic flexible electronics for applications that use large-area sensors, actuators, memories, and displays [1,2].

For example, by taking advantage of an ultraflexible and compliant amplifier that can amplify biological signals by 500, we developed 1- μ m-thick multi-channel active matrix electrocardiogram and electromyogram monitoring systems. Ultrathin electronics with a total thickness of approximately 1 to 2 μ m support a bending radius of less than 10 μ m.

We have also demonstrated wide range of new applications, including real-time health monitoring of civil infrastructures using all-printed large-area sensor systems.

[1] S. Lee, et. al., Nature Communications 5, 5898 (2014). [2] M. Melzer, et. al., Nature Communications 6, 6080 (2015).

Department of Intelligent Media

Professor:	Yasushi YAGI
Associate Professor:	Yasushi MAKIHARA (2014.6.1-)
Assistant Professors:	Yasushi MAKIHARA (2014.4.1-2014.5.30)
	Ikuhisa MITSUGAMI, Fumio OKURA (2015.2.16-)
Specially Appointed Lect	urer: Daigo MURAMATSU
Specially Appointed Assis	stant Professor: Al Mansur (2014.4.1-2014.10.30)
Postdoctoral Researchers:	Mitsuru NAKAZAWA
	Rasyid AQMAR (2014.4.1-2015.1.15), Masataka NIWA
	Hazem EL-ALFY, Seiichi TAGAWA (2014.4.1-)
	Wei LI (2014.7.1-)
Graduate Students:	Takuya KAMIMURA, Kazuhiro SAKASHITA
	Chika INOSHITA, Chengju ZHOU, Andrey GRUSHNIKOV
	Kohei SHIRAGA, Ken'ichiro TANAKA, Ruochen LIAO
	Zasim UDDIN (2014.10.1-), Yuma IMURA
	Tsukasa OKADA, Takuya TANOUE
	Takahiro MATSUMURA, Taro IKEDA, Sho IKEMOTO
	Kazuma KIKUCHI, Takuhiro KIMURA
	Tomonori HASHIMOTO
Research Students:	Zasim UDDIN (2014.4.1-2014.9.30)
	Yang YU (2014.10.1-), Chuehhan LO (2014.4.1-2015.3.31)
Under Graduate Students:	Chihiro AOKI, Saaya IKUMA, Jun-ichi KAMIMURA
	Kensaku SHIBATA, Atsuyuki SUZUKI
Secretaries:	Masako KAMURA, Noriko YASUI
	Masako SUGIMOTO (2014.7.16-)
	Kumiko NAKAGAWA (2014.9.16-)
Supporting Staffs:	Aya IIYAMA, Yoko IRIE, Yoshimi OHKOHCHI
	Mika IGUCHI, Yumi TOGO (2014.7.16-2015.2.28)

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

Photometric Stereo for Optically Thick Translucent Objects

This paper presents a photometric stereo method that works for optically thick translucent objects exhibiting subsurface scattering. We show that the original surface normal convolved with the scattering kernel corresponds to the blurred surface normal that can be obtained by a conventional photometric stereo technique. Based on this observation, we cast the photometric stereo problem for optically thick translucent objects as a deconvolution problem.



Fig.1 Original image (left) and estimated surface normal map (right)

Estimating Depth of Layered Structure based on Multispectral Speckle Correlation

We proposed a new trial to estimate the depth of the dynamic region using speckle analysis based on its two properties: (1) the temporal stability of the speckle pattern and (2) the wavelength dependency of transmittance of the laser. We estimate the depth by computing correlations of speckle patterns using multispectral lasers.



Fig.2 Measurement devise

Quality-dependent Score-level Fusion of Gait, Head, and the Height Biometrics

This paper describes a quality-dependent score-level fusion framework of gait, head, and the height biometrics from a single walking image sequence. We 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. Moreover, we propose a method to estimate the optimal weights for arbitrary qualities from a limited training pairs of the optimal weights and the qualities, based on Gaussian process regression with a nonlinear kernel function.



Fig.3 Quality-dependent fusion

Head Orientation Estimation using Gait Observation

We propose a method to estimate the head orientation of a pedestrian from low-resolution images, where existing facial texture-based approaches do not work. We firstly generate size-normalized silhouette images of pedestrians and extract Gait Energy Image (GEI) from the silhouette images as a gait feature. Finally, we generate a discriminant model to classify their head orientation.



Fig.4 Head orientation estimation

Department of Reasoning for Intelligence

Professor:	Takashi WASHIO
Associate Professors:	Shohei SHIMIZU, Yoshinobu KAWAHARA
Assistant Professor:	Mahito SUGIYAMA
Visiting Researcher:	Tsuyoshi UENO
Graduate Students:	Lu WANG, Naoki TANAKA, Takeru KAMON
Under Graduate Students:	Yoshito BABA, Akira OKA
Supporting Staff:	Hiroko OKADA, Yuki ASANO

Outlines

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

Current Research Projects

Knowledge discovery from extremely high dimensional data

Data consisting of massive variables (extremely high dimensional data) representing numerous events and/or states became available by developments of computer network, ubiquitous sensing and scientific measurement technologies. Examples are medical patients data on their 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 study novel techniques to estimate some important information and discover useful knowledge from such data acquired from large scale and complex structured systems. In this year, we studied 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 estimation, 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. In this year, we developed a method for learning causal orders in the presence of latent confounders and considered to apply the method on brain imaging data. Existence of latent confounders is a major difficulty in causal discovery.

Combinatorial approach to knowledge discovery from high-dimensional data

Intelligent information processing technologies for large-scale and high-dimensional data (so called, *Big Data* technologies) grow increasingly important due to recent accelerating technical progresses in data acquisition and accumulation. It is often the case that data used in such processing has explicit combinatorial structures, such as groups or connectivity among variables. We study theories and techniques for developing fast algorithms that make more interpretable or more accurate intelligent data processing by using such structures based on the discrete convexity, such as submodularity. In this year, we mainly developed fast algorithms for structured sparse learning, a machine learning technique with combinatorial structures in data. And, we applied these algorithms to several real-world problems in gene data analysis or 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. In this 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
Associate Professors:	Yoshinobu KITAMURA, Kouji KOZAKI
Assistant Professor:	Ryu TAKEDA (2014.10.1-)
Specially Appointed Assi	stant Professor: Yuki YAMAGATA
Specially Appointed Reso	earcher: Munehiko SASAJIMA (-2014.10.31)
Graduate Students:	Satoshi NISHIMURA, Takaaki SUGIYAMA
	Yuki YAMAGATA (2014.10.1-), Takeshi MASUDA
	You KOBAYASHI, Kyohei TADA
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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 Instruction Robust Against Noise

One of the fundamental functions for robots that interact with humans in real world is the robustness against noise. We improve the robustness as follows: 1) rejection of sound event from behind of the robot, 2) rejection of non human voice sound, and 3) speaker tracking. The first is achieved by localizing sound sources correctly and filtering them by direction. We measured acoustic transfer functions between microphones embedded on the robot and sound direction in an anechoic room for considering the influence of the robot's shape to localization. We then developed a localization method that considers the mutual effect between robot's ego-noise and

acoustic transfer functions and reduces detection errors of sound source compared with previous methods. The second one is achieved by classification based on a Gaussian Mixture model that discriminates human voices from noises. For the last one, we have also implemented speaker tracking based on face and mouth



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

recognition using software IntraFace.

Knowledge Acquisition through Dialogues

To acquire new knowledge from an interlocutor's utterance is one of intelligent abilities that human beings have. Current dialogue systems can talk with humans on the basis of knowledge designed by its system developper, but do not have ability to obtain new knowledge. Especially, since to completely describe knowledge in various local domains is difficult, a technique to acquire such knowledge in accordance with usage during dialogues. This year, we tackled an issue to acquire knowledge on unknown words that appear in user utterances. We regarded words that do not belong to any classes in the system's ontology as unknown, and that they belong to either class at its lowest level. To detect the class interactively, we exploit a tree structure of the ontology to generate appropriate questions and try to minimize the number of questions required

to detect the class. We also investigated several issues to aquire acoustic and language models for automatic speech recognizers, they will be required for spoken dialogue systems.



Fig.2 Example question to detect class of unknown word

Considerations of Ontological Theories and Developments of Ontology-based Applications in Domains

We study fundamental theories of ontological engineering and practical use of them. The research issues include following 3 topics. 1) Theories about the fundamental issues on ontology from both scientific and engineering viewpoints, 2) Development of software tools an environment for ontology building/utilization based on the ontological theories, and 3) Developments of ontologies and applications using them in domains.

Currently, we develop ontologies and applications in several domains such as clinical medicine, functions, actions, and biomimetics. For instance, we developed a web-based application to browse a disease ontology published as Linked Open Data (LOD), which is widely used for publishing and sharing data on the Web. It allows the users to browse causal chains of diseases with related data in other LODs and 3D images of anatomical parts in which abnormal state the diseases appear.



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

Department of Architecture for Intelligence

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	Akiko YAMAMOTO(2015.2.15-)

Outlines

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

Current Research Projects

Constructive Adaptive User Interfaces

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

technology enables automatic acquisition of human feelings, and automatic music composition system adapted to personality and emotion of its user.



Intelligent Tutoring System

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

Intelligent Ubiquitous Sensor-Networks

In recent years, progress in computer technology, the appearance of IPv6, the development of various radio technology including IEEE802.11, and the practical use of radio-tags like RFID have greatly activated studies of ubiquitous computing like sensor-networks. But, the purpose of many proposed ubiquitous systems is to present information of the virtual-world like the Internet to humans living in the real-world by using physical

properties like monitors and loudspeakers, etc. On the other hand, our purpose is to construct a framework to enable flexible and real-time interaction between humans and the real-world. Keyword is resonance. Each human has his own natural frequency, which is a metaphor for personality or daily habitual behaviors. In the proposed framework, each human behavior reacts with the environment and the environment performs sensor-data mining and extracts each human's natural frequency.

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

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





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
- · Plastic deformation behaviors of porous Mg with directional pores
- · Development of Ag-based inks and characterization of their basic properties
- · Clarification of Sn whisker growth mechanism and developing high-temperature solders
- Direct observation of ultrafast structural phase transition of Si using time-resolved transmission electron diffraction
- · Ultrafast dynamics of holes injected into Si valence band using two-photon photoemission spectroscopy
- · Development of L-band RF photocathode
- · Characterization of free-electron laser coherence
- · Development of resist processes for extreme ultraviolet lithography
- · Chemical reactions induced in condensed matter by quantum beam

Department of Quantum Functional Materials

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	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.

Spin-electricity conversion induced by spin injection into the topological surface states [Phys. Rev. Lett. 113 (2014) 196601-(1-5)]

By employing the spin pumping technique to utilize the ferromagnetic resonance, we have succeeded in observing the spin-electricity conversion on the surface of bulk-insulating topological insulators. In this experiment, we pumped spins into the surface states and observed the electromotive force to show up as a result of the spin-momentum locking. This is one of the first reports to experimentally demonstrate the potential of topological insulators for spintronics applications.

Electrical detection of the spin polarization due to charge flow in the surface state [Nano Lett. 14 (2014) 6226-6230]

By injecting current from a nano-fabricated ferromagnetic contact into a bulk-insulating topological insulator, we found that the interface resistance depends on the direction of the spin polarization. This is the first successful transport experiment of the spin injection into the topological surface state.

Development of efficient top gates on topological insulator thin films

[Appl. Phys. Lett. 104 (2014) 161614-(1-5)]

The tunability of the chemical potential for a wide range encompassing the Dirac point is important for many future devices based on topological insulators. We have developed a protocol to fabricate highly efficient top gates without degrading the film quality

on bulk-insulating $(Bi_{1_x}Sb_x)_2Te_3$ thin films epitaxially grown on sapphire substrates. Important ingredients of the protocol are the in-situ deposited Al₂O₃ capping layer and a low-temperature deposition of SiN_x dielectric layer using hot-wire CVD. Using the fabricated top gate, we have succeeded in ambipolar gating of the surface states, which means that we can control the Fermi level through the Dirac point to both electron- and hole-doped sides.



Fig. 1: Picture of a top-gate device made of MBE-grown thin films of bulk-insulating topological insulator $(Bi_{2-x}Sb_x)_2Te_3$ and SiN_x dielectric deposited at low temperature.

Discovery of a new superconductor derived from topological insulator heterostructure [Phys. Rev. B 90 (2014) 220504(R)-(1-5)]

We have discovered a new superconductor derived from a topological insulator. Importantly, the specific-heat behavior of this new superconductor gives evidence for unconventional superconductivity. This is the first "superconducting topological insulator" material to present bulk signatures of unconventional (and hence topological) superconductivity.



Fig. 2: (a) Crystal structure and (b) superconducting transition of the new superconductor $Cu_x(PbSe)_5(Bi_2Se_3)_6$.

Discovery of topological proximity effect in a topological insulator hybrid

[Nature Communications 6 (2015) 6547-(1-6)]

We discovered a novel phenomenon termed "topological proximity effect", which occurs between a metallic ultrathin film and a three-dimensional topological insulator. Specifically, we grew one bilayer of bismuth metal on top of the three-dimensional topological insulator TlBiSe₂, and by using spin- and angle-resolved photoemission spectroscopy, we found evidence that the topological Dirac-cone state migrates from the surface of TlBiSe₂ to the attached one-bilayer Bi. This discovery points to a new route to manipulating the topological properties of materials.

Department of Semiconductor Materials and Processes

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Undergraduates:	Shunta FUJIE
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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) approach of Si nanoparticles to Li ion batteries and hydrogen generation.

Current Research Projects

Nitric acid oxidation of Si method for improvement of crystalline Si solar cell characteristics by surface passivation effect [paper 7]

We have investigated effects of formation of an ultrathin silicon dioxide (SiO₂) layer using the nitric acid oxidation of Si (NAOS) method and subsequent ammonia (NH_3) plasma the treatment on single crystalline Si solar cell characteristics and the surface chemical structures, respectively. The NAOS SiO₂ layer formed between Si and silicon nitride (SiN) improves the conversion efficiencies from 16.6 to 17.5% for p-Si-based solar cells (Fig. 1). The improvement is attributed to elimination of interface states, but not to fixed charges because the flat band-voltage of the Al/SiN/Si MIS diodes isn't largely changed by formation of a NAOS SiO₂ layer at the SiN/Si interface. The



Fig. 1 I-V curves of the p-Si-based solar cells with the Ag/SiN/n⁺-Si/p-Si/Al structure: a) without a NAOS SiO₂ layer, b) with a NAOS SiO₂ layer at the SiN/Si interface.

minority carrier lifetime of the NAOS SiO₂/p-Si structure is greatly improved from 12 to 45 μ s (or 35 μ s) by heat treatment in oxygen at 800°C (or 600°C). In the absence of a NAOS SiO₂ layer, the NH₃ plasma treatment forms an SiN layer of 0.3 nm thickness on the Si surface. In the presence f a NAOS SiO₂ layer, on the other hand, only 0.1 monolayer of SiN is formed on the surface, and at the Si interface, silicon oxynitride species is produced. It is concluded that the NAOS SiO₂ layer prevents direct nitridation of Si substrates, and thus avoids introduction of plasma damage in Si.

Improvement of minority carrier lifetime and Si solar cell characteristics by nitric acid oxidation method [paper 4]

The minority carrier lifetime of single crystalline Si increases by the formation of an ultrathin silicon dioxide (SiO₂) layer by use of the nitric acid oxidation of Si (NAOS) method. With the NAOS method using 68 or 98wt% HNO₃ solutions, large increases in the lifetime are observed while the enhancement of the lifetime is low for the 40 wt% HNO₃ NAOS method. In the case of the hydrogen-terminated Si surfaces formed by hydrofluoric acid (HF) treatment, the initial minority carrier lifetime is high, but it returns to the value before the HF treatment by keeping in air for 5 days. In the case of the NAOS method, on the other hand, the enhanced lifetime remains unchanged with time kept in air. This stability is attributed to



Fig. 2 I-V curves of the n-Si-based solar cells with the Ag/SiN/p⁺-Si/n-Si/n⁺-Si/SiN/ Ag bifacial structure: a) without a NAOS SiO₂ layer ,b) with a NAOS SiO₂ layer at both the SiN/Si interfaces.

high atomic density of the NAOS SiO_2 layer which prevents diffusion of oxidizing species. The atomic density of the NAOS SiO_2 layer increases with the HNO₃ concentration, which leads to an increase in the valence band discontinuity energy at the SiO₂/Si interface. When the NAOS SiO₂ layer is inserted between the Si substrate and a silicon nitride anti-reflection layer for n-Si-based pn-junction solar cells, the conversion efficiency is increased from 17.2 to 18.9% (Fig. 2). The internal quantum efficiency in the short wavelength region (300~600 nm) is improved by the NAOS SiO₂ layer.

Fabrication of Si nanoparticles from Si swarf and application to solar cells [paper 6]

Si nanoparticles with diameter of 1–20 nm have been fabricated from Si swarf by use of a beads milling method. Treatment with dilute hydrofluoric acid stabilizes Si nanoparticles, and the thickness of the SiO₂ layer formed by leaving nanoparticles in air for one week is only 1.2 nm. p-Si nanoparticles/crystalline n-Si structure shows rectifying behavior, indicating formation of pn-junction. Treatment with nitric acid followed by heating at 900°C greatly decreases series resistance, showing that the ultra-thin SiO₂ layer formed by nitric acid oxidation melts and is bound to surrounding nanoparticles. p-type Si nanoparticles/n-type crystalline Si structure shows rectifying behavior and the photovoltaic effect, indicating that Si nanoparticles are applicable to solar cells.

Department of Advanced Hard Materials

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Supporting Staff:	Yuka HAMANA (2014.7.16-2015.3.31)

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

Plastic deformation behaviors of porous Mg with directional pores

Porous metals with oriented, elongated pores have attracted much interest, because they exhibit various unique features such as their light weight, permeability of fluid, and energy and sound absorption. Thus, their various properties have been studied intensively. In the present work, we focused on porous Mg with directional pores, which exhibit superior light-weight properties, and studied its plastic deformation behaviors. It was revealed that in the quasi-static compression perpendicular to the pores, the flow stress monotonically increased with increasing strain. In contrast, a distinct peak appeared at ~20-25% strain in the compression parallel to the pore direction. Such unique peak also appeared in the high strain rate compression $(1.9 \times 10^3 \text{ s}^{-1})$ parallel to the pore direction. As a result, superior impact energy absorption of 30 kJ kg⁻¹ was achieved. The crystal plasticity finite-element modeling and the analysis by the X-ray pole figures revealed that the interaction between the crystallographic texture and unidirectional pores resulted in the appearance of peak stress.

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

Heterogeneous composite structure and interface has been development in a bulk binary SnO₂-TiO₂ ceramic through self-organized spinodal phase separation route to add different semiconductor properties. For this purpose, small amount of Fe₂O₃ was doped to this system by reaction sintering technique. The addition of Fe enhanced spinodal phase decomposition with nano-scale lamellar structures through one step sintering processes (Fig.1), and the structure could be controlled by the process conditions. It was found that the formation started from selective Sn diffusion into TiO₂ particles (Fig.1 c), and then inter-diffusion of the both Sn



Fig.1 Lamella formation through spinodal phase separation for $5\text{mol}\%\text{Fe}_2\text{O}_3$ doped $\text{SnO}_2\text{-TiO}_2$ binary ceramics: SEM (a) and TEM (b) images of sample sintered at 1450°C for 24h, partially-formed lamella at 1360°C (c), and SEM images at 1450°C for 10min.

and Ti to form uniform lamella through the whole bulk structure. It was expected that the semiconductor characteristics could be controlled not only by the addition of Fe but also by the oxygen partial pressure during sintering.

Multifunctionalization of Titania Nanotubes through Structure Tuning.

Nanotubular titania (TiO_2) TNT) Nanotube. has been synthesized through low-temperature solution chemical route, and its structure has been modified by doping elements such as Cr, V, Nb and so on. All these doped TNTs exhibited typical nanotubular structure with a diameter of 10 to 20 Optical nm (Fig.2). absorption spectra exhibited these TNTs had impurity level among the bandgap depending on the dopants. Organic dye molecule (methylene blue, MB) removal test revealed that the doping



Fig.2 TEM images of Cr and V doped TNTs, and photocatalytic performances of these doped TNTs under the visible light irradiation.

elements to TNT enhanced its molecular adsorption performance. Further these doped TNTs exhibited good photocatalytic performance under the both UV and visible (>400 nm) lights. These results imply that the structure modification of one-dimensional nanostructured oxides is a promising way to develop high performance advanced environmental materials.

Department of Advanced Interconnection Materials

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	Fujii,

Outlines

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

Current Research Projects

Growth and Extension of One-Step Sol–Gel Derived MoO₃ Nanorods

Aiming a printable gas sensor device, a simple sol–gel solution route for the synthesis of α -phase molybdenum trioxide (α -MoO3) nanorods is investigated in terms of growth mechanism with controlling the citric acid decomposition rate. The single-phase and single-crystal nanorod arrays of MoO3 grown in random directions from a silica glass substrate had mean diameters and lengths of 10 and 500 nm, respectively. The longest nanorods was about 600 nm by sintering at 673 K for 15 min in an ambient atmosphere. The growth and phases of the nanorods are connected to disassemble steps of the Mo

metal-citric acid complex in the sol-gel precursor solution.



Metal nanowires transparent conductive film and application

Metal nanowires, silver nanowires (AgNWs) and copper nanowires (CuNWs), have been simply synthesized with wet chemical methods in large-scale and high yield. These nanowires were rapidly coated on various substrates by easy printing technology. And then post-treatment was used to improve and optimize the conductivity and

transmittance of film. A transparent electrode consisting AgNWs showed a low sheet resistance of 15 Ω /sq with a transmittance of 90% on PET substrates. It was 15 Ω /sq with a transmittance of 82% for CuNWs a) film. A semi-transparent sensor based in the AgNWs film has been fabricated by a simple sandwich structure to detect the human motion, such as pulse, heartbeat, breathe.



High temperature die-attach of Ag paste with SiC sub-micron addition

Die-attach is the most critical assembling technology to fabricate power-devices usable at high temperature above 200°C, because of the large mismatch in the coefficient of thermal expansion (CTE) between semiconductor die and metal lead frame. Ag paste sintering is one of the best candidate for the joining targeting high thermal stability in electronic packaging. The microstructure of sintered Ag creates a nano-porous network that is suitable to relax the thermomechanical stresses between the die and substrate. However, the stability of the porous network is questioned when the operating temperature is equal or higher than the sintering temperature of 250°C. We have solved the problem by adding sub-micron SiC ceramic particles to stop the excessive sintering at high temperature. The figure bellow indicates the different ways of microstructure

development at 250°C with and without SiC nano-particle addition. The ceramic additive works to keep the network structure of sintered Ag bonding layer, and thus realizes a better thermal stability.



Ag thin-film direct bonding by stress migration and hillock generation

We have proposed a direct Ag film bonding method that can be processed in a

considerably low temperature without applying any pressure. This method utilizes the stress migration and hillock growth on sputtered Ag films for bonding. We have investigated the bonding processes in detail, and our TEM observations have revealed recrystalization occurs around the contacting hillocks, generated by migrated atoms through the boundary of columner grains in Ag films.



Department of Excited Solid-State Dynamics

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Outlines

For fabricating highly functional nano-structured devices in future technology, it is essential to establish the ways to control structures and compositions of materials at the atomic level. In this department, we aim to establish advanced technologies for controlling the modes of atomic binding in solids via excitation-induced atomic reactions. For this purpose, we elucidate the fundamentals of underlying physics concerning the excitation-induced processes by using extensive experimental studies:

1) the primary processes of the photoinduced structural changes,

2) ultrafast carrier dynamics in semiconductors and carbon materials

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 carrier dynamics in semiconductors (IV and III-V) and carbon materials. Considerable attention is focused to the elucidation of elemental processes of the many-body interaction following the electronic excitation and of the ultrafast dynamics in femtosecond time regime of the excited carriers using two- photon photoemission spectroscopy.

Current Research Projects

Ultrafast carrier dynamics in semiconductors

In order to elucidate the dynamics of photogenerated carriers, which play crucial roles in several photoinduced reactions in solids and on surfaces, it is essential to study the ultrafast carrier dynamics with resolving their evolutions in momentum and energy



Fig. 1 Time evolution of two-photon photoemission intensity images as functions of energy and parallel momenta (emission angle), measured for Ge(111)-c(2x8).

spaces. Use of femtosecond laser for pump and probe pulses has a strong advantage for resolving the carrier dynamics directly in energy and momentum spaces.

By probing electrons populated in the conduction band of semiconductors, the surface of which is characterized by STM, we have directly elucidated not only the ultrafast processes of inter- and intra-valley relaxation of highly excited bulk electrons but also the transition of bulk electrons to unoccupied surface bands (SB) located in the bulk band gap. A typical result is shown in Fig.1, where the time evolution of electrons injected by 1.57-eV pulses on Ge(111)-c(2x8), is imaged as functions of energy and parallel momenta (emission angle). Due to the selection rules for the optical excitation process, the nascent distribution of hot electrons injected in the Γ -valley is imaged along the normal direction. Most of the Γ -valley electrons are then transferred to the L-valley and then relaxed within the valley towards the bottom of the bulk conduction band. The result also demonstrates the transition of some bulk electrons to the unoccupied SB, followed by the relaxation within the SB. These results can provide an important key to greater understanding of photoinduced surface effects on semiconductor surfaces.

Direct probing of the elemental process of the electron-phonon interaction in solids

Electron-phonon coupling (EPC) is one of the most important phenomena in the solid state physics. We, for the first time, succeeded to probe the dispersions of the phonons that scatters the valence electron in the HOPG graphite by means of the angle-resolved photoelectron spectroscopy (ARPES) with resolving the momentum and energies of the electron and phonon[S. Tanaka *et al.*, Sci.Rep. 3 (2013) 3031]. Figure 2 shows the dispersions of phonon in the single-crystalline graphite; where the differentiate of the photoelectron intensity by the binding energy is plotted in the grey scale as a function of the parallel momentum of the photoelectrons taken at photon energies of 7.1eV(left) and 11.1eV(right). The dispersions obtained agree with the theoretical calculation (lines) but only few branches are observed depending on the photon energy. The measurements directly indicate the matrix elements consisting of the initial, middle, final states and the electron-phonon and electron-photon interaction Hamiltonian those cannot otherwise achieved. This method will lead a deeper understanding of the electron phonon interaction not only the carbon nanomaterials but also many materials of interest.



Fig. 2 Dispersions of phonons to scatter the electron at the valence band of the single crystalline graphite: ARPES results taken at hv=7.1eV (Left) and 11.1eV (Right)

Department of Accelerator Science

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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

Upgrade of the THz-FEL using L-Band Electron Linac

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 μ m (2 to 12 THz). Following development of the high power operation of the FEL in last year, named the 27MHz mode, we study for further increasing the FEL power by means of optimization of the linac and the beam transport system for

the FEL. In the conventional operation mode, called the 108 MHz mode, an electron pulse of an 8 µs

duration is injected from the electron gun and an electron beam of bunches continung at the 108

MHz frequency is generated using the sub-harmonic buncher system. The optimum injection current is 0.6 A in this mode and the bunch charge of the electron beam transported to the FEL is approximately 1 nC. As the basic idea of the 27 MHz mode is that the charge per bunch is increases four times while the average beam current is maintained the same, we set a target value of 2.4 A for Therefore, we set the goal of the development of the grid pulser system with the frequency of 27 MHz would be possible to drive the gun with the peak current of 2.4 A. The developed grid pulser is possible to acheive this beam current, but the optimum peak injection current is 1.6 A at this moment. In case of more injection current operation, the RF powers in the subharmonic buncher cavities are seriouly disturbed, and then it is difficult to produce a high-quality beam. The reason of that is under exploring.



Fig.1. The output energy of the FEL macropulse produced by the 27 MHz grid pulser. The peak energy of 27 MHz mode is 4 times larger than that of 108 MHz mode, and these are enhanced to 1.5 times compared with those by the last year.

As the result of beam tuning with the injection beam current of 1.6 A, the injected bunch charge at the FEL beamline is 4 nC. This is 4 times compared to the previous operation, thus, the nominal goal has been already achieved. By using this beam, the output intensity of the FEL is 1.5 times increased. The maximum pulse energy was acheived at the wavelength of 67 μ m with the macropulse energy of 26 mJ, which corresponds to the micropulse energy of over 200 μ J. Assuming the micropulse duration of 20 ps, the peak FEL power is over 10 MW. As the result of continuing beam tuning, the macropulse energy at the previous 108 MHz operation mode was also increased over 10 mJ. At the 27 MHz mode, the number of generated FEL pulses is reduced fourth of previous 108 MHz mode. Thus, the micropulse energy is 16 times increased. This result suggests that the FEL operation may reach a new region of the high-power operation and the understanding of the mechanism to expain this result is future task.

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. The best focus has been updated using a handmade off-focus parabolic mirror with both focal length and effective diameter of 1.27 mm. Figure 2 is shown the beam profile measured by a knife edge scanning method. The beam is focused along z axis with almost round shape where z axis is pararel to the optical axis and x, y

axes are perpendicular to the optical axis. Diameter within 200 µm is ensured for 5 mm along z axis. At a wavelength of 100 µm FWHM for the best focus point reaches 167 µm which is comparable to the diffraction limit of 127 µm. The estimated electric field exceeding 10 MV/cm allows us trying evolve nonlinear to responses in materials. As shown in Fig. 3 discharge phenomena can be observed for the focused



THz light. Without a short wavelength laser, novel excitation phenomena will be found by this 'low energy' intense far infrared light.



Fig. 3 Several discharge phenomena observed by the focused THz FEL. The maximum electric field is estimated up to 10 MV/cm.

Department of Beam Materials Science

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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. At high temperature condition, the processes are supposed to dramatically accelerate. Therefore, the use of a highly time-resolved technique will become important. Although we have succeeded to construct a ps pulse-probe system, the practical use was restricted because of an instable synchronization system and an inefficient spectroscopy system. In this work, the intrinsic problems were fairly improved by updating each component. Temporal behavior of a hydrated electron (e⁻aq) was measured at room temperature as shown in Fig. 1. 2D transient absorption in both of wavelength and time domains could be quickly and clearly obtained in 3 min./scan. Accordingly, time dependent behaviors at elevated temperatures were also







Fig. 2. Time behaviors of e_{aq} at high temperature and high pressure conditions.

measured as shown in Fig. 2. It turned out that the new system enables to perform pulse-probe analysis at high temperatures, or even supercritical condition quite efficiently.

Distinct Differential Sensitivity to Superoxide-Mediated Signal Transduction of SoxR

The [2Fe-2S] transcription factor, SoxR, functions as a sensor of oxidative stress in *E. coli*. Unlike *E. coli*, however, the majority of SoxR regulons lack the genes typically involved in O_2^- resistance and detoxification. *P. aeruginosa* SoxR was shown to be activated by the endogenous, redox-cycling antibiotic compound pyocyanin. *P. aeruginosa* SoxR, a homolog with 62 % sequence identity to *E. coli* SoxR, exhibited physic-chemical properties



Fig.3 Crystallographic structure of SoxR. Close-up region near the iron-sulfur cluster

similar to that of *E. coli* protein. Similar to *E. coli* SoxR, O_2^- reacts with [2Fe-2S]⁺ of *P. aeruginosa* SoxR. However, the sensitivity of the *E. coli soxRS* response to O_2^- , with a rate constant, is 10-fold higher than that of *P. aeruginosa*, suggesting that SoxR proteins play distinct regulatory roles in the activation of O_2^- . Although it is remarkable conserved among SoxR homologues, the structure of *E. coli* SoxR contains hypervariable stretch of three residues RSD motif and two lysine residues in the vicinity of [2Fe-2S] (Fig.3). When *P. aeruginosa* SoxR was mutated to replace to A92 with K, the rate constant of O_2^- with the A91K mutant was found to increase using a mutagenic

approach. In contrast, changing (RSD \rightarrow LQA) in *E. coli* SoxR (LQA \rightarrow RSD) in *P*.

aeruginosa SoxR had no effect of the oxidation of O_2^- , respectively. These data support the involvement of lysine 92 in the specific protonation of the proximal oxygen of the peroxide intermediate to generate H₂O₂.



Location Control of Metal Nanoparticles by using Self-Assembly Template

Currently, lithography technology continues to be the mainstream technology used in the semiconductor industry for the fabrication of silicon devices at less than 30 nm half-pitch. However, it is very difficult to obtain sub 10 nm feature sizes for mass production by using lithography techniques. Therefore, it is essential to develop a new concept for scalable technologies and different novel techniques for nanolithography. We investigated location control of Au nanoparticles on a nanoscale reaction field by using self-assembly techniques. The position control of Au nanoparticles have been successfully fabricated by self-assembly such as block copolymer phase separation and

self-assembly monolayers (SAMs). This method is suitable for self-assembled nanolithography applications in electronics, optics, biosensing, bioimaging and so on.



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

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Outlines

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

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

Current Research Projects

Multi-beam Chemistry

Multi-beam chemistry has been studied using pulse radiolysis-laser flash photolysis combined method, two-color two-laser photolysis, and so on. From these studies, we have clarified various reaction processes of excited states of short-lived intermediates. This year, we have investigated excited state properties of naphthalene diimide (NDI) radical anion in the excited states by means of femtosecond laser flash photolysis. Especially, electron transfer processes from the excited NDI radical anion were investigated in detail. From this study, distance and free energy change dependence of the electron transfer rates became clear. In addition, we have realized time-resolved resonant Raman spectroscopy by combination of pulse radiolysis and pulse laser. By applying this method, we have clarified the structural changes of stilbene derivatives upon one-electron oxidation and reduction processes. The substituent effects on the bonding order of the radical ion species have been clarified.

Solvent accessibility of the fluorescent molecule monitored by triplet blinking

The solvent accessibility of the fluorescent molecule was probed by measuring the lifetime of a fluorescent molecule in the triplet excited state (τ_T), which is reflected in the duration of the off time during the blinking of the fluorescence (τ_{off}). DNA site specifically modified with fluorescent molecule, methylene blue (MB) and Rhodamine 6G (R6G), were synthesized. τ_T and τ_{off} were accessed by transient absorption measurement and fluorescence correlation spectroscopy (FCS), respectively. It was demonstrated that the more a fluorescent molecule is exposed to a solvent, the faster its triplet excited state is quenched by molecular oxygen, resulting in a decrease of τ_T and τ_{off} . DNA conformational change between a duplex and hairpin structure was successfully monitored by the blinking triggered by the changes in the solvent accessibility of the fluorescent molecule.

Development of photo-functional materials and methods for chemistry and biology

Our current interests lie in creating materials and methods to examine and regulate biological phenomena in cells, as well as to convert energy of light, based on principals of photochemistry. In particular, we are now developing imaging and regulation methods with photo-functional nano-probes in vitro and in vivo. Moreover, we are now creating novel photo-functional materials for the energy conversion based on electron transfer reaction.

Red fluorescence probe of intracellular ¹**O**₂ **during photodynamic therapy (PDT)**

Singlet oxygen (${}^{1}O_{2}$) has a critical role in the cell-killing mechanism of PDT. Monitoring formation and reaction rate of ${}^{1}O_{2}$ during is urgently required since the total formation amount of ${}^{1}O_{2}$ is directly related to the therapeutic effect of PDT. We have synthesized a new far-red fluorescence probe of ${}^{1}O_{2}$, namely, Si-DMA, composed of silicon-containing rhodamine and anthracene moieties as a chromophore and a ${}^{1}O_{2}$ reactive site, respectively. In the presence of ${}^{1}O_{2}$, fluorescence of Si-DMA increases 17 times. With the advantage of negligible self-oxidation by photoirradiation and selective mitochondrial localization, Si-DMA is particularly suitable for imaging ${}^{1}O_{2}$ during PDT. For the first time, ${}^{1}O_{2}$ generated during PDT has been successfully visualized with a spatial resolution of a single mitochondrial tubule.

Department of Synthetic Organic Chemistry

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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

Pd-catalyzed Enantioselective Intramolecular α-Arylation of α-Substituted Cyclic Ketones: Facile Synthesis of Functionalized Chiral Spirobicycles

Chiral ligands and organocatalysts with a spiro skeleton have received considerable attention in asymmetric catalysis because of their unique structural properties and high asymmetric induction efficiency. However, enantioselective synthesis of optically pure spirobicyclic compounds remains a formidable task because the chiral catalysts must control not only the enantiodiscrimination but also the formation of the quaternary carbon center. We have developed the facile synthesis of chiral spirobicycles **2** through the Pd-catalyzed intramolecular α -arylation of α -substituted cyclic ketones **1** (Scheme 1). The functionalized spiro compound **2a** (R = Me) could be converted into a chiral acid–base organocatalyst **3** for the aza-Morita–Baylis–Hillman reaction.



Scheme 1. Enantioselective Synthesis of Functionalized Chiral Spirobicycles

Efficient Synthesis of Functionalized Molecules Using Pd Enolate Umpolung

Pd enolates are known not to exhibit any reactivity toward a nucleophile but to react with electrophiles such as aldehydes. Nucleophilic interception of the Pd enolate is therefore promising to be a powerful synthetic method of functionalized carbonyl compounds. We have recently found that a spiro bis(isoxazoline) ligand, SPRIX,

enables unusual nucleophilic attack on a Pd enolate. This time, we developed a new catalytic transformation based on the Pd enolate umpolung, i.e. cyclative haloacetoxylation of alkynyl cyclohexadienone substrates 4. Treatment of 4 with a Pd-i-Pr-SPRIX catalyst in the presence of excess amounts of LiCl or KBr in a 3:7 mixture of acetic acid and toluene under an oxygen atmosphere afforded bicyclic products 5 bearing haloalkene and α-acetoxy carbonyl moieties vields in good (Scheme 2).



Scheme 2. Haloacetoxylation Using Pd 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 mismatch binding ligands, and 2) in vitro selection of RNA aptamer binding specific nucleic acid structure. Because DNA is not only a genetic materials but also an important organic materials consisting of C, H, O, N, and P atoms with ability of spontaneously forming a double helix. To use DNA as precision organic materials in nano-technology, we have studied on the chemical properties of DNA and on the synthesis of chemically modified DNA.

Current Research Projects

Screening of RNA-binding Molecules by FID and SPR Assays

MicroRNA (miRNA) is involved in many biological processes including development, differentiation and carcinogenesis. miRNA is now broadly recognized as an important drug target for the treatment of various diseases. A small molecule that modulates the specific miRNA pathway can be a drug candidate as well as biological tool. We have applied the fluorescence indicator displacement (FID) assay to screen a large chemical library for a molecule that binds to a specific miRNA precursor. Selected compounds were farther screened by SPR



assay. From sensor grams of SPR, we can know a little more about interactions worked between RNAs and compounds. We have recently screened compounds library of synthetic 8-substituted adenine derivatives, and the results indicated that 5'-aminoadenosine derivative having a kinked structure is favorable for the selective binding to pre-miR-29a compared with that to dsRNA [**Original Paper 3**]. Although molecular design to specific pre-miRNA is one way, screenings are alternative way to find RNA-binding molecules.

Modulation of RNA structures and functions by RNA-binding small molecules

We have developed the small-molecule ligands that recognize and specifically bind to mismatched base pairs in DNA. Among those ligands, NCTn (Naphthyridine Carbamate Tetramer) has shown to bind to CGG/CGG sequences in RNA and induces particular conformational changes in RNA.



NCT6, one of the NCTs derivatives, can connect two RNA hairpins by binding to the hairpin loop containing (CGG)₃ sequence. Förster resonance energy-transfer study of two RNA hairpins labeled with different fluorophores showed increases in FRET ratio in the presence of NCT6, indicating that the two RNA hairpins are close each other. A loop-loop interaction is found in complex RNA molecules and is important in folding of RNA. Small molecules that induce a loop-loop interaction will provide tools for modulating RNA structures and functions [**Original Paper 1**].

Modulation of binding properties of amphiphilic DNA to lipid bilayer membrane.

DNA is a promising functional molecule to modify and design lipid membrane functions. In order to use DNA in a hydrophilic-hydrophobic interface including lipid membrane, we have developed an amphiphilic DNA having dodecyl phosphotriester linkages (dod-DNA).



We demonstrated the binding of a series of amphiphilic dod-DNAs to the lipid bilayer membrane. The dod-DNAs have one to three dodecyl groups either at the 5'-end or middle of the DNA strand. Surface plasmon resonance (SPR) assay and fluorescent microscopy showed that dod-DNA having three dodecyl groups at each end strongly bound to lipid membrane due to the slow dissociation rate and the dod-DNA can be used as a linear template for molecular arrangement on the membrane surface [**Original Paper 2**].

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 mechanochemical basis as well as development of diagnosis and therapy for diseases.

Current Research Projects

Anoikis inducing activity of a 3,12-unsubstituted fusicoccin derivative

Contrary to the natural fusicoccane diterpene glycosides, such as fusicoccins (FC: 12-hydroxylated) and cotylenins (CN: 3-hydroxylated), an unnatural 3,12-unsubstituted FC derivative (**1**) exhibited potent anoikis inducing activity on A549 cells (human lung adenocarcinoma epithelial cells). It also inhibited cell migration of A549 cells by affecting F-actin localization.

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, a new MexB selective



Fig. 1. Structure of 1



Fig. 2. A new MexB inhibitor

inhibiter **2** has been obtained.

Detection of single base mismatch by tolane-modified peptide nucleic acid

The detection of single nucleotide polymorphism in a target gene is important for estimating the potential of developing a specific disease or predicting severe side-effects of drugs. Peptide nucleic acid (PNA) can discriminate a single mismatched base in a target gene sequence, but this specificity often decreases if the mismatched



Fig. 3. Structure of Tolane **3**.

base is near a terminus. To improve the sequence specificity of PNA, we synthesized a series of PNAs derivatized with an intercalator via an amide linkage at the N-terminus. As a result, PNA conjugated with our newly synthesized tolane derivative (Tolane **3**, Fig. 3) improved duplex binding specificity to ssDNA up to 5.7 $^{\circ}$ C (Table 1). PNA-tolane derivatives can possibly stabilize matched PNA/DNA duplexes by recognizing the nearest-neighbor base pairs.

		Tm(°C)		
Entry	PNA sequence (N-C)	DNA	DNA	ΔTm
		Match ¹⁾	Mismatch ²⁾	
PNA-Control	H ₂ N-TTCCCTCTCTA-Lys	56.6 ± 0.9	49.4 ± 0.9	7.2
PNA-Tolane 3	Tolane 3 -TTCCCTCCTCTA-Lys	62.9 ± 0.3	50.0 ± 0.6	12.9

Table 1. UV melting temperature analysis of PNA/DNA duplex.

 $^{1)} 5'-ATGTCCTAGAGGAGGG\underline{A}ATAA-3', \ ^{2)} 5'-ATGTCCTAGAGGAGGG\underline{C}ATAA-3',$

Microautophagy regulates embryonic patterning through signal transduction

Rodent embryos at perigastrutation stage have a cylindrical structure in which the epiblast is surrounded by the visceral endoderm (VE), a stratified epithelium that separates the embryo proper from maternal tissues. The VE is therefore highly active in endocytosis and has a well-developed endocytic apparatus for this purpose. The delivery of endosomes to the large apical vacuoles occurs via microautophagy; unlike orthodox vesicular transport, this endosome-lysosome interaction does not involve fusion between endosomal and lysosomal membranes. The assembly of large apical vacuoles in VE depends upon the small GTP-binding protein Rab7. In Rab7-deficient VE, endocytic markers are concentrated in numerous endosome-like structures scattering in the cytoplasm, but do not reach the lysosomal compartment, which becomes highly fragmented. Subcellular defects are associated with developmental phenotypes at gastrulation. The mutant embryo initiates the mesoderm differentiation at the proximal posterior region of the epiblast, however, the primitive streak is not well organized but remains at the initial site of differentiation. Wnt- β -catenin signal plays a major role in the gastrulation. In the *rab7* mutant embryo, *Wnt3* expression is normal, however, the expression of Axin2, the direct target of the canonical Wnt signaling, is almost absent. Deletion of the *rab7* function only in VE results in the similar defects in mesodermal tissues like in the systemic gene knock-out, suggesting that the Rab7 function is implicated in the canonical Wnt pathway through non cell autonomous mechanism. These findings suggest that the microautophagy regulates the embryogenesis and tissue morphogenesis by promoting the canonical Wnt signaling pathway.

Department of Structural Molecular Biology

Associate Professor:	Toshihide OKAJIMA
Assistant Professors:	Kenji TATEMATSU, Tadashi NAKAI

Outlines

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

Current Research Projects

Reaction mechanism of radical SAM enzyme QhpD

Quinohemoprotein amine dehydrogenase (QHNDH) is contained in various Gram-negative bacteria, and catalyzes oxidative deamination of primary amines for their assimilation. The smallest γ subunit in three subunits $\alpha\beta\gamma$ has a covalently bound quinone cofactor,



Fig.1 Presumed reaction mechanism of QhpD

cysteine tryptophylquinone (CTQ), derived from Trp and Cys residues, and three intra-peptidyl thioether crosslinks formed between Cys and Asp/Glu residues, which are generated through multi-step posttranslational modification. QHNDH structural genes *qhpABC* constitute an operon, *qhpADCBEF*, together with several nearby genes. Within these genes, we have demonstrated that *qhpD* gene codes a radical SAM enzyme that formed the thioether crosslinks. In this study, we further elucidate challenging reaction catalyzed by a radical SAM enzyme [Original Paper 2].

Spectroscopic data and the analyses of iron and sulfur contents suggested the presence of three [4Fe-4S] clusters in the purified and reconstituted QhpD. In the presence of a reducing agent, QhpD catalyzed the multiple-turnover reaction of reductive cleavage of SAM into methionine and 5'-deoxyadenosine and also the single-turnover reaction of intra-protein sulfur-to-methylene carbon thioether bond formation in γ subunit bound to QhpD, producing a multi-knotted structure of the

polypeptide chain. Three thioether bonds in the γ subunit were formed sequentially from the N-terminal to C-terminal. Homology modeling and mutagenic analysis revealed several conserved residues indispensable for both *in vivo* and *in vitro* activities of QhpD. Based on the modeled structure for the QhpC/QhpD complex, we proposed a possible mechanism of the sequential formation of multiple thioether bonds (Fig. 1).

Interactions of neonicotinoid insecticides with insect nicotinic acetylcholine receptor

Neonicotinoids are insecticides that target insect nicotinic acetylcholine receptors (nAChRs). nAChRs are ligand-gated ion channel that belongs to Cys-loop superfamily.

Despite of their worldwide use, neonicotinoids are recently suspected to cause colony collapse disorder (CCD) of honey bee. The possible risks to pollinators make it

extremely urgent to understand the mechanisms underlying their actions on insect nAChRs. We therefore elucidated X-ray crystal structures of the *Lymnaea stagnalis* acetylcholine binding protein (*Ls*-AChBP) and its Gln55Arg mutant, more closely resembling insect nAChRs, in complex with commercial neonicotinoids and analogues. Gln55 of loop D is substituted to Arg residue that is conserved in insect nAChRs [Original Paper 1].

Overall structures of *Ls*-AChBP complexed with neonicotinoids are consisted of pentameric ring as shown in Fig. 2. The biding sites of neonicotinoids located at each subunit boundary. In the Gln55Arg mutants, cyano and nitro groups of the bound ligands directly interacted with the introduced Arg55 side chain (Fig. 3). Unexpectedly, it is found that several neonicotinoids interacted also with Lys34 in loop G of the β 1 strand in the crystal structure of the Gln55Arg mutant (Fig. 3). Basic residues introduced

into the chicken α7 nAChR at positions equivalent to AChBP Lys34 and Arg55 enhanced agonist actions of reducing neonicotinoids. while the actions of ACh. (-)-nicotine and DN-IMI. Thus, not only the basic residues in loop D, but also those in loop G on the $\beta 1$ strand are determinants of the actions of neonicotinoids. These novel findings provide new insights develop to neonicotinoids safe that for are environments.



Fig.2 Overall structure of AChBP



Fig. 3 Interactions with neonicotinoid-binding site

Department of Cell Membrane Biology

Professor:	Kunihiko NISHINO (2015.2.16- 2015.3.31)
Associate Professor:	Tsuyoshi NISHI
Postdoctoral Fellow:	Shoko NISHI
Graduate Students:	Seiji YAMASAKI, Katsuhiko HAYASHI
Research Student:	Allison NEUGEBAUER (2014.10.1-2015.3.31)
Under Graduate Student:	Keita KAWASHIMA
Supporting Staff:	Sumie MATSUOKA

Outlines

Living cells are separated from the outer environment with the lipid bilayer. Transporters and channels are important for transmembrane transport of essential nutrients, ions and toxic wastes. Multidrug efflux pumps are widely distributed in living organisms from mammalian to bacteria as a host-defense mechanism in cellular level. These pumps are not only conferring multidrug resistance of cancer cells and pathogenic bacteria but also cause hereditary diseases through the mutation. The purposes of our laboratory are to elucidate the molecular structures and the molecular mechanisms of these xenobiotic exporters and the roles of these exporters in cellular functions.

Especially we are focusing on the transporters that are secreting the lipid mediators such as sphingosine 1-phosphate to develop the transporter-oriented drugs.

Current Research Projects

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

Sphingosine 1-phosphate (S1P) is one of the most important lipid mediators that is produced by phosphorylation of sphingosine, degradative product of ceramide. S1P is

essential for cell migration such as lymphocyte, preosteoclast cells and endothelial cells mammalian. in Lymphocytes S1P recognized gradient between blood plasma and secondary lymphoid tissues and migrate into blood stream (Fig. 1). We have been trying to identify the



Fig.1 Schematic model of the S1P supply into blood plasma and migration of lymphocytes

physiologically functional S1P transporter(s) that supply S1P into blood plasma in mammalians. We identified that zebrafish *Spns2* is a physiologically functional S1P transporter and essential for myocardial precursors migration to form normal heart in zebrafish. Human and mouse *Spns2* orthologues have S1P transport activity as similar extent to zebrafish *Spns2*. *Spns2* transcripts were detected in vascular endothelial cells and S1P secretion were abolished in the vascular endothelial cells prepared from SPNS2-defecient mice. Consequently, blood plasma S1P concentration of SPNS2-defecient mice was reduced to approximately 60% of that of wild type. Although about a half of S1P remaining in blood plasma, the blood of SPNS2-deficient mice contained significantly fewer lymphocytes. However, lymphocytes in SPNS2-defecient mice thymus express more S1P receptor protein (S1P1) and show a high migration activity at a lower S1P concentration. In addition to the endothelial cell specific SPNS2, we identified N-terminal truncated form of SPNS2-S1 into CHO-cells, SPNS2-S1 is located in intracellular organella and does not show S1P export activity.

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

Construction of the rapid screening methods for S1P transporter inhibitor

S1P transporter should be a good candidate for development of immunosuppressive drugs without severe side effect. However, quantification methods of S1P are time consuming or expensive for high throughput screening. We tried to develop the simple assay method using fluorescent-labeled S1P. This fluorescent-labeled S1P was secreted from various culture cells and was not a substrate of SPNS2. However, fluorescent-labeled S1P was secreted from erythrocytes and inhibited by glyburide as well as S1P. S1P and fluorescent-labeled S1P show competitive inhibition kinetics to each other for their export from the cells. This assay method is applicable to the 96-well microtiter plate procedure using fluorescent imager. We are developing this method for screening the inhibitors of S1P transport from the erythrocyte cells.

Department of Biomolecular Science and Engineering

Professor:	Takeharu NAGA	AI	
Associate Professor:	Tomoki MATSUDA		
Assistant Professors:	Yoshiyuki ARA	I, Masahiro NAKANO	
Specially Appointed Asso	ciate Professor:	Tetsuichi WAZAWA	
Specially Appointed Assistant Professor:		Megumi IWANO	
Specially Appointed Researchers:		Koldenkova Vadim PEREZ,	
		Kunito YOSHIDA, Guirong BAI	
JSPS Postdoctoral Fellow	ship for Foreign	Researcher: Dhermendra Kumar TIWARI	
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	Shigenori INAC	GAKI, Syoji KAWAKAMI,	
	Yohei AOYAGI	, Hajime SHINODA, Hiroki TAKAUCHI,	
	Jenny Rose Cru	z TRINIDAD, Thitikorn PHANUPRAYOON	
Under Graduate Students	: Mai ASHITANI	I, Ryoko SETO	
Research Student:	Nadim MD. HOS	SAIN	
Supporting Staffs:	Kazuyo SAKAI, Aya HISATOMI		

Outlines

The "cooperative" functioning of a nanosystem composed of a small number ofelemental 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

Fluorescence live imaging has become an essential methodology in modern cell biology. However, fluorescence requires excitation light, which can sometimes cause potential problems, such as autofluorescence,

phototoxicity, and photobleaching.

Furthermore, combined with recent optogenetic





(A) Luminescence of recombinant Nano-lantern proteins. This image was taken by home digital camera (B) Emission spectra of Nano-lanterns and *Renilla* luciferase
tools, the light illumination can trigger their unintended activation. Because luminescence imaging does not require excitation light, it is a good candidate as an alternative imaging modality to circumvent these problems. The application of luminescence imaging, however, has been limited by the two drawbacks of existing luminescent protein probes, such as luciferases: namely, low brightness and poor color variants. 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. The color change and the enhancement of brightness were both achieved by bioluminescence 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. The rapid dynamics of endosomes and peroxisomes were visualized at around 1-s temporal resolution, and the slow dynamics of focal adhesions were continuously imaged for longer than a few hours without photobleaching or photodamage. In addition, we extended the application of these multicolor Nano-lanterns to simultaneous monitoring of multiple gene expression or Ca^{2+} dynamics in different cellular compartments in a single cell.



Fig.2 Inhomogeneous expression of pluripotency markers in a single colony of ES cells.



Fig.3 Simultaneous analysis of Ca²⁺ dynamics in mitochondria and the nucleus.

(A) Dual-channel live bioluminescence imaging of Mito-CNL(Ca²⁺) (green) and ONL(Ca²⁺)-H2B (magenta) in HeLa cells. (B) Simultaneous analysis of Ca²⁺ dynamics in the mitochondria (blue circle in A) and the nucleus (red circle in A).

Redox sensor proteins for highly sensitive direct imaging of intracellular redox state

Intracellular redox state is a critical factor for fundamental cellular functions, including regulation of the activities of various metabolic enzymes as well as ROS production and elimination. Genetically-encoded fluorescent redox sensors, such as roGFP and Redoxfluor, have been developed to investigate the redox state of living cells. However, these sensors are not useful in cells that contain, for example, other colored pigments. We therefore intended to obtain simpler redox sensor proteins, and have developed oxidation-sensitive fluorescent proteins called Oba-Q (oxidation balance sensed guenching) proteins. Our sensor proteins derived from CFP and Sirius can be used to monitor the intracellular redox state as their fluorescence is drastically quenched upon oxidation. These blue-shifted spectra of the Oba-Q proteins enable us to monitor various redox states in conjunction with other sensor proteins.

Division of Next Industry Generation

Outlines

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

The departments are:

-Department of New Industrial Projection

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

-Department of New Industry Generation System(s)

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

-Department of Intellectual Property Research

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

Department of New Industry Generation System

Specially Appointed Professor: Mototsugu OGURA

Outlines

ISIR, Osaka University (professor Yasushi Yagi, director of ISIR) has executed JSPS Brain Circulation program and JSPS Core to Core program.

On July Oxford Workshop was held where is one of European core to core cites, On Decemebr, 2nd JSPS core to core program conference and also 3rd JSPS Brain Circulation program conference(/3rd imec Handai International Symposium) was held at Osaka Grand Front, whole progress have been shared.

In pararell, in Osaka univ. COI(Center of Innovation) program, the collaboration agreement were contracted between 23companies and 9 research academia, then "Fostering of super-Nipponjin by human power activation" development has been started under one roof followed by kick-off meeting on July, then 2nd Handai Workshop on November, then annual report meeting on March were held ,respectively.

Results

Oxford Workshop at Martin School, The university of Oxford

Oxford Workshop was held at Martin School, The University of Oxford, on July 24 and 25 where local committees were profs. Sonia Contera, and Sonia Trigueros. In this workshop, total 15 papers were presented where covered the technological fields of imec executive Healthcare devices, CNT drug safety screening, Biosensing nontoxicity, Graphene FETs, biosensors, flexible and stretchable technologies(UTCP, OTC), and organic semiconductor devices. Interesting topics were given as topological quantum insulators of Bi2Te3, Bi2Se3 which will turn heat into electricity, or electricity into cooling(refrigerator) given by prof. Yulin Chen, univ. Oxford, and transparent nanofiber paper with 15-50nm diameters given by prof. Masaya Nogi. Above all imec 5 speaker greatly contributed this workshop including key note speech.

Total participants were 27 on July 24, 21 on July 25, respectively, composed of Univ. Oxford, Osaka Univ. imec, and Univ. de Bourgogne.



Welcome word prof. Sonia Contera Oxford workshop snap w

whole participants at Oxford Martin School

• 2nd JSPS Core to Core program conference, 3rd JSPS Brain Circulation program conference On

Decemebnr 12(Friday), 2nd JSPS core to core program conference and 3rd JSPS Brain Circulation program conference(/3rd imec Handai International Symposium) were held at the international

conference room of Osaka Grand Front where Jo De Boeck imec CTO&senior vice president, Chris Van Hoof imec fellow, Paul Blom professor & director, Max Planck Mainz lab., professor Sonia Contera, Oxford univ.were joined. Each participant were totally 38, 41, including foreigner nationality, respectively.

Technical topics were 8 papers for bio electronics, organic electronicsat core to core, were 6 papers for flexible, organic, bioe-electronics/life science at brain circulation, respectively. Imec well contributed to these conference, which is strong partnerwith ISIR, then many students and assistant professors who have been at imec had active discussion with invited speakers. The Brain Circulation program that isblateral program ended at H26 fiscal year, but we definitely keep to collaborate for various topics based on collaboration framework agreement.



Welcome word by Jo De Boeck imec CTO& senior vice president, and discussion



After5 meeting together with invited speakers



whole participants

Department of Intellectual Property Research

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

Outlines

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

We gained new 5 external grants from the Japanese Society of Eucommia / 10th research grant (1), the 160th committee on plant biotechnology "industry-university cooperation activity strengthening program (2), the Senshu Ikeda Bank / Consortium-based Research & Development Grant Program (3), and Small and Medium-sized Enterprise Agency (4, 5). To create new products, empirical studies were also carried out.

Current Research Projects

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

To promote the use of intellectual property owned by the university, we have been developing new methods to explore the possible partners of joint research in the industry by patent-related information survey. We conducted the specific case studies of the new methods for finding the companies with high professional and specialized properties as joint research partners.

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

-Development of manufacturing technology for tableting mold with low sticking characteristics (supplementary research)

-Development of Laser lighting technology

Symposium on Promoting Urban Greening and Urban Agriculture

We held a symposium on urban-greening and urban-agriculture for constructing the sustainable city on Nov. 19th, 2014. It was cosponsored by The Osaka University Research Association of Industry and Science, Thera-Projects Associates, and Research Institute of Environment, Agriculture and Fisheries (Osaka Prefecture). More than 250 people attended the symposium and discussed the



Symposium on Urban Agriculture

importance and the strategy for urban greening/agriculture.

New Element Technologies to Enable the Value Adding of Natural Materials

We started a new project to develop 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 (Osaka University and Osaka Prefecture Research Institute of Environment, Agriculture and Fisheries) and local government (Osaka city).

We have continued the research on Eucommia tea (Tochu/Du-zhong tea) to develop new technologies to upgrade the usefulness.

Symposium on Genetically Modified Plants

We carried out a symposium to learn plant biotechnology and genetically-modified (GM) plants on March 28th, 2015, which was supported by the 160th committee of plant biotechnology (Japan Society of the Promotion of Science). Four lectures and scientific-experiments lessons were given to disseminate accurate information about the theme. About 50 people including teachers of junior high school and high school participated.



The symposium was composed of lectures (left) and demonstration of scientific experiment (right)

Laboratory of Microbiology and Infectious Diseases

Associate Professor: Specially Appointed Assistant Professor: Visiting Professor: Graduate Students: Supporting Staff: Kunihiko NISHINO Mitsuko NISHINO Yoshimi MATSUMOTO Katsuhiko HAYASHI, Seiji YAMASAKI Aiko FUKUSHIMA, Aya IGARASHI

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

Effect of methylglyoxal on multidrug-resistant *Pseudomonas aeruginosa*

Honey has a complex chemistry, and its broad-spectrum antimicrobial activity varies with floral source, climate, and harvesting conditions. Methylglyoxal was identified as the dominant antibacterial component of manuka honey. Although it has been known that methylglyoxal has antibacterial activity against gram-positive bacteria, including methicillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococcus, there is not much information describing its activity against gram-negative bacteria. In this project, we report the effect of methylglyoxal against multidrug-resistant Pseudomonas aeruginosa (MDRP) using 53 clinically isolated strains (Table 1). We also assessed the effect of deleting the five multidrug efflux systems in P. *aeruginosa*, as well as the efflux systems

Table 1. Susceptibility of MDRP strains to antimicrobial compounds

	MIC (µg/ml)			
Strain	MGO	IPM	АМК	CPFX
MDRP1, 31, 75, 100	512	128	1024	64
MDRP2	512	32	128	32
MDRP4	256	128	1024	64

(Front Microbiol. 2014 Apr 17;5:180)



Fig. 1. Effects Effects of methylglyoxal on the growth of *E. coli*, *S. enterica*, and *P. aeruginosa*.

(Front Microbiol. 2014 Apr 17;5:180)

in *Escherichia coli* and *Salmonella enterica* serovar Typhimurium, on MICs of methylglyoxal (Fig. 1). Our results indicate that methylglyoxal inhibits the growth of MDRP and is not recognized by drug efflux systems (*Front Microbiol.* 2014 Apr 17;5:180. doi: 10.3389/fmicb.2014.00180).

AcrB, AcrD, and MdtABC multidrug efflux systems are involved in enterobactin export in *Escherichia coli*

Escherichia coli produces the iron-chelating compound enterobactin to enable growth under iron-limiting conditions. After biosynthesis, enterobactin is released from the cell. However, the enterobactin export system is not fully understood. Previous studies have suggested that the outer membrane channel TolC is involved in enterobactin export.

There are several multidrug efflux transporters belonging to resistance-nodulation-cell division (RND) family that require interaction with TolC to function. Therefore, several RND transporters may be responsible for enterobactin export. In this study, we investigated whether RND transporters are involved in enterobactin export using deletion mutants of multidrug transporters in E. coli (Fig. 2). Single deletions of acrB, acrD, mdtABC, acrEF, or mdtEF did not affect the ability of *E. coli* to excrete enterobactin, whereas deletion of *tolC* did affect enterobactin export. We found that multiple deletion of *acrB*, *acrD*, and *mdtABC* resulted in a significant decrease in enterobactin export and that plasmids carrying the *acrAB*, acrD, or mdtABC genes restored the decrease in enterobactin export exhibited by the $\Delta acrB$ acrD mdtABC mutant. These results indicate that AcrB, AcrD, and MdtABC are required for the secretion of enterobactin (Fig. 3) (PLoS One. 2014 Sep 26;9:e108642).



Fig. 2. Requirement of AcrB, AcrD, and MdtABC drug efflux systems for enterobactin export. Enterobactin was prepared from the supernatants of cultures of each multiple RND transporter mutant and analyzed by RP HPLC. (*PLoS One.* 2014 Sep 26;9:e108642)



Fig. 3. Proposed model of enterobactin export in *E. coli*. Enterobactin is synthesized in the cytoplasm and exported to the periplasm by EntS. The RND transporters AcrB, AcrD, and MdtABC capture enterobactin in the periplasm and then export it to the growth medium throughout the outer membrane channel TolC.

(PLoS One. 2014 Sep 26;9:e108642)

Laboratory of Atomic Scale Materials Processing

Takeshi YANAGIDA
(Visiting Professor from 2015.1.1)
Kazuki NAGASHIMA
Fuwei ZHUGE
Yong HE
Gang MENG
Ayako FUJIWARA
Keiko TSUKADA

Outlines

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

Current Research Projects

Flux induced Crystal Phase Transition on Indium-Tin Oxide Nanowire Growth

Single crystalline metal oxide nanowires formed via a vapor–liquid–solid (VLS) route provide a platform not only for studying fundamental nanoscale properties but also for exploring novel device applications. However, it has been difficult to control the crystal phase of metal oxides during the VLS nanowire growth. Here we show that a material flux critically determines the crystal phase of indium-tin oxide nanowires grown via the VLS route. The crystal phases of indium-tin oxide nanowires varied from the rutile structures (SnO₂), the metastable fluorite structures (In_xSn_yO_{3.5}) and the bixbyite structures (Sn-doped In₂O₃) when only the material flux was varied. This trend can be interpreted in terms of the material flux on the critical nucleation at the liquid–solid (LS) interface. Thus, precisely controlling the material flux allows us to design the crystal phase and properties in the VLS nanowire growth of multicomponent metal oxides.



Flux dependent composition and crystal phase variation in indium-tin oxide nanowire



Material dependence on the growth rate of oxide nanowires

Nanoscale Size-Selective Deposition of Nanowires by Micrometer Scale Hydrophilic Patterns

Controlling the post-growth assembly of nanowires is an important challenge in the development of functional bottom-up devices. However, it is still a challenging issue to align selectively heterogeneous nanowires at desired spatial positions on the substrate. Here we report a size selective deposition and sequential alignment of nanowires by utilizing micrometer scale hydrophilic/hydrophobic patterned substrate. Nanowires dispersed within oil were preferentially deposited only at a water/oil interface onto the hydrophilic patterns. The diameter size of deposited nanowires was strongly limited by the width of hydrophilic patterns, exhibiting the nanoscale size selectivity of nanowires deposited onto micrometer scale hydrophilic patterns. Such size selectivity was due to the nanoscale height variation of a water layer formed onto the micrometer scale hydrophilic patterns. We successfully demonstrated the sequential alignment of different sized nanowires on the same substrate by applying this size selective phenomenon.



Concept of post-growth nanowire alignment using microscale patterned water/oil interface

Heterogeneous nanowire array using the size selective rule of nanowire alignment

Effect of Radial Dopant Inhomogeneity on Thermoelectric Property in B-Doped Si Nanowires

Thermoelectric power generation holds great promise for waste heat recovery. In general, the thermoelectric conversion efficiency is determined by the Seebeck coefficient, the electrical conductivity and the thermal conductivity. Recently, it has been reported that the thermal conductivity is drastically reduced via the phonon scattering at the nanowire surface, implying the potential for the highly efficient thermoelectric device using nanowires. In this study, to further increase the thermoelectric conversion efficiency, we investigate the effect of radial dopant inhomogeneity on the Seebeck coefficient in B-doped Si nanowires. We found that the Seebeck coefficient for an inhomogeneously doped Si nanowire were higher than that of homogeneously B-doped Si nanowires. The field effect measurements revealed that the dopant inhomogeneity induced hole mobility enhancement is a critical factor to increase the overall electrical conductivity of nanowires without decreasing the Seebeck coefficient value. Thus, intentionally tailoring radial dopant inhomogeneity promises a way to modulate the thermoelectric power factor of semiconductor nanowires.



Single nanowire device for evaluating the electrical and thermoelectric properties



Dopant inhomogeneity dependence on the Seebeck coefficient of B-doped Si nanowire

Laboratory of Cellulose Nanofiber Materials

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

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

Paper memory

Ultra flexible resistive random access memory (ReRAM) based on silver nanoparticle-decorated cellulose nanopaper was successfully developed by collaboration with Accos. Prof. Takeshi Yanagida, Assis. Prof. Kazuki Nagashima (Laboratory of Atomic Scale Materials Processing), and Prof. Takuya Kitaoka (Kyushu university). The paper ReRAM (Fig. 1) achieved the stable nonvolatile memory effects with ON/OFF resistance ratio of 10⁶ and the long data retention time over 10⁴ s. 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 ReRAM is expected as a highly flexible nonvolatile memory, and breaks new ground in creating next-generation information recording paper.



Fig. 1 Paper ReRAM.

Miniaturized flexible antenna printed on high-*k* nanopaper

Antenna is essential in wireless communication, and the widespread use of portable electronic devices has promoted demand for smaller antennas. We successfully downsized antennas by using a high dielectric constant (k) nanopeper composite. The flexible nanopaper composite prepared by mixing a small amount of silver nanowires with cellulose nanofibers had a k of 726.5 at 1.1 GHz. The dipole antenna printed on the nanopaper composite was downsized by a half, compared with that printed on the

original nanopaper or plastic film. The miniaturized nanopaper antenna retained its flexibility and sensitivity, and has potential as a component in flexible and wearable wireless communication devices.



Fig. 2 High-*k* nanopaper composite (left) and miniaturized antenna on high-*k* nanopaper (right).

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:	Sumie MATSUOKA, 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 2014, as a clue to elucidate the AcrAB-TolC whole system structure, 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 fixed AcrB-AcrA fusion proteins using various linkers. All of these linker proteins showed drug export activity under the acrAB-deficient conditions



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, c. western blot analysis

regardless of the length of the likers. These results suggest that equal amount of AcrA with AcrB is enough for drug export function. In addition, we acquired fusion protein suitable for crystallization successfully by minimizing a cytoplasmic part of the linker that are showed with yellow in the figure 1.

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

Guest Professor: Guest Professor: Visiting Academic Staff: Technical Assistant: Supporting Staff: Naoyuki TANIGUCHI Kazuaki OHTSUBO Congxiao GAO, Hiroaki KOREKANE Junko IIJIMA, Emmanuel Siota PALACPAC Yuko TANAKA

Outlines

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

Current Research Project

The Role of Glycosylation in Pathology of Pulmonary Emphysema

Cigarette smoking is the major risk factor for chronic obstructive pulmonary disease (COPD), a deadly condition kills more than 3 million people worldwide each year. Yet, despite the irreversible cell damage caused by tobacco smoke, only around one in five lifelong smokers go on to develop COPD, indicating that some people have genetic factors that predispose them to the condition whereas others harbour DNA variants that offer protection. We showed that wiping out a gene called alpha1,6-fucosyltransferase (FUT8), which makes a simple sugar



structure known as 'core fucose' that helps maintain alveolar structure, led to lung-destructive characteristics in mice. While exposing Fut8 heterozygous mice to cigarette smoke, the mice experienced a rapid influx of inflammatory cells in the lungs and developed emphysema after only three months, which is much shorter than wild type mice. Proteins involved in the so-called Smad pathway, which control the activity of enzymes that break down the extracellular matrix along the lung alveoli wall, help drive this lung destruction process. From more than 100 clinical samples, we found that people with lower FUT8 activity had worse lung function on average and experienced more acute exacerbations of COPD than others with elevated FUT8 levels.

Functional Analyses of Protein Glycosylation in Pathogenesis of Diabetes Mellitus

A connection between diet, obesity and diabetes exists in multiple species and is the basis of an escalating human health problem. We reported that elevated concentrations of free fatty acids caused nuclear exclusion and reduced expression of the transcription factors in beta cells. This resulted in a deficit of GnT-4a glycosyltransferase expression in beta cells. Protection from disease was conferred by enforced beta cell-specific GnT-4a protein glycosylation and involved the maintenance of glucose transporter expression and the preservation of glucose transport. We observed that this pathogenic process was



active in human islet cells obtained from donors with type 2 diabetes; thus, illuminating a pathway to disease implicated in the diet- and obesity-associated component of type 2 diabetes mellitus.

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

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

Identification of ENPP3 as a new regulator for glycan biosynthesis

A brain-specific β1,6-*N*-acetylglucosaminyltransferase GnT-IX has a broad GlcNAc

transfer activity towards *N*-linked and *O*-mannosyl glycans. Based on purifying, identifying, and characterizing ectonucleotide pyrophosphatase/phosphodiesterase (ENPP) 3 as an intrinsic inhibitory factor for GnT-IX in Neuro2a cells, we found that the enzyme inhibits GnT-IX via ENPP3-mediated hydrolysis of the nucleotide-sugar donor substrate UDP-GlcNAc, with the resulting generation of UMP, a potent competitive inhibitor of GnT-IX. Such a novel regulatory mechanism of glycan biosynthesis would be responsible for altering the total cellular glycosylation profile and modulating cellular functions.



Korekane H, Park JY (2013) 288: 27912-27926

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. 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, Kohei FUJIWARA
Guest Research Fellow:	Alexis BOROWIAK (2014.7.15-2015.7.14)
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	Shouta YAMASAKI, Tatsuya HORI, Tsubasa SASAKI,
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Under Graduate Students	: Satoshi TSUBOTA, Hisoka NAKAZAWA
Research Students:	LI Mingyu
Technical Supporting Sta	iff: Aya IWAKI
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

Control of domain size of metal-insulator electronic phases in VO₂ thin films

VO₂ has attracted much attention for leading to inovative electronic devices because of its metal–insulator transition (MIT) with orders of magnitude change in resistance over room temeprature. In this system, the metallic and insulating domains often coexist randomly around the transition temperature, and each domain works as an essential element invoking first order MIT and strongly influences the macroscopic transport

characteristic. Domain size is important parameter to an control thier transport. In this year, we found that domain size decreased with increasing film thickness in Fig.1(a)-(d) boundary and the domain of dislocations, consisted suggesting that the domain size would be controllable by film thickness. The mechanism of the generatin of dislocations relating with domain size could be explained by the energy



Fig. 1 Optical micrographs of VO_2 films on TiO_2 (001) substrates at 300 K with thicknesses of (a) 10 nm, (b) 15 nm, (c) 25 nm, and (d) 50 nm in the heating process. The metallic domains shown in these images are darker than the insulating domains. (e) Comparison of experimental domain size and calculated one depending on film thickness

release of shear stress generated by competition between the pinning layers at near-interface on substrate and the near-surface separated from the substrate. The model based on this consideration well fits to the experimental data as seen in Fig 1(e). This understanding enables us to more precisely design the size and configuration of these domains and their transport properties.

Investigation of transport dynamics in nanoscale phase-separated (La,Pr,Ca)MnO₃ using THz-TDS

Strongly correlated electron oxides, for example (La,Pr,Ca)MnO₃ (LPCMO), show many exotic properties such as colossal magnetoresitence accompanying with the insulator-metal transition (IMT). The domain revolution, corresponding to the temperature-induced change of metal fraction X(T) is mutually correlated with the dc conductivity ($\sigma_{dc}(T)$). We have established a reliable technique for investigation of transport dynamics through the IMT using THz time domain spectroscopy (THz-TDS). The THz conductivity in the frequency range of 0.5–2.4 THz: $\sigma_{THz}(\omega,T)$ curves, have been obtained in the temperature range from 10 K to 250 K for an LPCMO film (Fig. 2). To describe the $\sigma_{THz}(\omega,T)$ behavior corresponding to the coexistence regime, we have proposed the insulator-metal composite model. This model enabled us to quantitatively estimate the transport dynamics, *i.e.*, concurrent evaluation of $\sigma_{dc}(T)$ and X(T) values for the LPCMO film using the obtained fitting parameters, as shown in Figs. 3.



LPCMO film (in the cooling process)

Fig. 3 (a) Estimated values of $\sigma_{dc}(T)$; (b) Evolution of metal fraction X(T) for an LPCMO film (in the cooling process)

Synthesis of layered ferrite thin film and their electric filed control

REFe₂O₄, which is a topic of discussion among charge-ordering, ferroelectricity arising from charge-ordering and multiferroic properties, is promising electronics material. A single-phase and single crystalized YbFe₂O₄ thin film have been successfully

synthesized on YSZ(111) substrate by pulsed-laser We observed current switching deposition. phenomenon in YbFe₂O₄ thin films by applying a high electric-field stress. The dope carriers into YbFe₂O₄ channel was attempted in electrostatic manner through field-effect-transistor (FET) configuration. Thereby, we fabricated electric double layer transistor (EDLT) with carefully chosen ionic-liquid electrolyte as a gate dielectric using EMIM-MeSO₄. The electrostatic operation enabled us to attain 2% degree of conductivity modulation.



Fig.4 (a) Capacitance of each ionic liquid at 100 mHz (b) Channel response (conductivity modulation in %) for V_G scanning for YbFe₂O₄-FET used ionic liquid EMIM-MeSO₄, respectively.

Department of Advanced Nanofabrication

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Specially Appointed Researcher:	Masao GOHDO
Guest Professors:	Atsushi OGATA, Hitoshi KOBAYASHI
Guest Associate Professor:	Hiromi SHIBATA
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	Taiki IGAHARA, Itta NOZAWA, Liang LI
	Satoshi NISHII, Suguru YAMASO
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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

Upgrade of RF (radio-frequency) gun based accelerators

The RF gun based accelerator facilities have been upgraded and renewed for the study of fundamental dynamic processes in matter occurring on femtosecond time scales over sub-nanometer (even atomic) spatial dimensions. One of the accelerators is the RF gun based linac with beam energy of 32 MeV. Beam ports have been upgraded for femtosecond/attosecond pulse radiolysis. A prototype of time-resolved relativistic-energy electron microscopy with beam energy of 5 MeV has been constructed with improved RF gun. A new RF gun with the highest repetition rate of 1 kHz has been developed under the collaboration with KEK.

Electron bunch length measurement using interferometer on basis of sensitivity model

Generation of an ultrashort electron beam is essential for attosecond pulse radiolysis. Electron bunch length measurement using interferometer on basis of sensitivity model was conducted by analyzing frequency-dependent "sensitivity" of the interferometer. Frequency spectra of the interferometer with a MCT (HgCdTe) infrared detector were measured using an infrared light source. Interferogram obtained by the same interferometer for coherent transition radiation emitted from ultrashort electron bunch was analyzed for the bunch length measurement. The experimental interferogram agreed to that expected on basis of the sensitivity of the interferometer, resulting in generation and detection of 8.9 fs electron bunch. In the future, development of broadband detection system and generation of attosecond electron beam will be

conducted.

Study of initial process and decomposition process of n-dodecane using femtosecond pulse radiolysis

S/N ratio in femtosecond pulse radiolysis was improved by expanding wavelength and stabilizing analysis laser. Generation process of alkyl radicals in n-dodecane was successfully observed with optical path length 1 mm at 240 nm. It was found that Alkyl radicals are generated during 3 ps. It was found that the generation behavior of alkyl radicals agreed well with that of dodecane radical cation at 800 nm. Direct decomposition from the excited radical cation to the alkyl radical was suggested. We were able to obtain an overview of radiation chemistry in n-dodecane from initial process to the products. Not only understanding of the degradation mechanism of extraction agent solvent in the nuclear fuel reprocessing, but also development of radiation-resistant polymer material, it is considered to be give a design-guideline to resist-development for next-generation semiconductor nanofabrication, this knowledge is very important for it.

Progress of transient absorption measurement in pulse radiolysis and preparation of femtosecond electron and laser sequential pulse radiolysis

It has been suggested that the excited radical cation is the starting point of decomposition of n-dodecane. However the excited radical cation has not be observed directly in NIR-VIS region. In order to clarify the role of excited radical cation in radiolysis of n-dodecane, an electron beam and laser two stage pulse radiolysis measurement system is developed. Radical cation which is generated by a first femtosecond electron beam induce the excited radical cation by a second femtosecond laser, and alkyl-radicals must be monitored by a third femtosecond analysis light. These experiment will do in 2015.

Development of a femtosecond pulse electron microscopy

A femtosecond pulsed electron microscope has been developed using a photo-cathode RF electron gun. This year, the incident path for light excitation was installed as an external trigger for inducing the structural change in sample. The low energy dispersion and low emittance electron beam is very important for applying to the electron microscope. It is necessary to optimize the various electronic optics such as a photocathode RF gun and a solenoid magnet for emittance compensation for precise beam alignment. Until now it had been depend on the processing accuracy, but the design of incident optics was changed for attaching an adjustment mechanism in the system.

Development of a femtosecond electron pulse diffraction and new high-duty photocathode RF electron gun

In order to generate the femtosecond electron pulse for the femtosecond pulsed electron microscope, the charge of electron bunch is suppressed. Therefore, it is necessary to accumulate for measuring sufficient contrast images for some minutes. The electron gun of repetition frequency of 1 kHz is developed for that. There is problems that heat quantity become 100 times and high repetition high power RF source is not available. A new photo cathode RF electron gun which have an additional cooling water channel and

a design for suppressing the electric field at cavity surface was made by the collaboration with KEK. The femtosecond electron diffraction system was constructed by using the new electron gun. By generating a high quality electron beam, the diffraction image of thin gold single crystal target were successfully obtained in a single shot measurement.

Development of a single shot femtosecond pulse radiolysis

The equivalent velocity spectroscopy method is developed to solve the time resolution degradation due to speed difference in a sample of electron and light. A single-shot pulse radiolysis measurement system which is incorporated time information into the position of analysis light pulse is developed by precisely controlling the angle of the electron beam pulse and analyzing light pulse. In order to suppress the accumulation of irradiation effect in a easily decomposing samples by electron beam irradiation, the development of single-shot pulse radiolysis has been demanded.

Department of Nanocharacterization for Nanostructures and

Functions

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Assistant Professor:	Naoto KAMIUCHI, Ryotaro ASO
Specially Appointed Rese	archer: Keju SUN
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	Takehiro TAMAOKA, Yosuke AKIYAMA, Yuto TOMITA
Supporting Staff:	Noriko TAKASE

Outlines

The analysis of nanostructures in nanomaterials and evaluation of its properties by transmission electron microscopy (TEM) are indispensable for the improvement and development of new functional materials. Especially, the in-situ analysis of nanostructure and the estimation of formation process of nanodevices will become more important in the near future. Our group has developed environmental transmission electron microscopy (ETEM), which enables us to observe solid-gas reactions in-situ in high resolution. We have studied the morphology of platinum nanoparticles (PtNPs) supported on metal oxides under catalytic reaction conditions and the formation process of carbon nanotubes (CNTs).

Current Research Projects

Oxidation and Reduction Processes of Platinum Nanoparticles in Pt/CeO₂ Catalyst

Platinum nanoparticles (PtNPs) supported on CeO₂ exhibit high catalytic activity for oxidation reaction CO at room temperature. The shapes and orientations of PtNPs with respect to metal oxide support may play an important role for the acceleration of catalytic reaction, whereas the reaction mechanism is not elucidated. In-situ observation of Pt/CeO2 catalyst at atomic scale under reaction conditions is necessary in order to understand the oxidation and reduction processes. In this research, the catalyst of Pt/CeO₂ prepared by the Deposition-Precipitation (DP) method was investigated by Cs-corrected ETEM observation under oxidation and



Fig. 1 Oxidation and reduction of Pt nanoparticles.

reduction conditions at room temperature. Figure 1 shows ETEM images of Pt/CeO₂ catalyst. Oxidation and reduction of the topmost surface of PtNPs were studied in-situ in reactive gases environments (O₂, CO, and H₂O vapor). Atomic layers of Pt oxides started forming on the preferential facets of PtNPs at the early stage, followed by oxidization of the entire surface of the PtNPs. The surface Pt oxides are promptly reduced to Pt in vacuum or by adding a small amount of CO or H₂O gas



Fig. 2 Oxidation and reduction on the surface of Pt nanoparticles

to dominant O_2 . The oxidation and reduction processes depend on the gas partial pressures as illustrated in Figure 2. This study brought invaluable insight at the atomic scale into the states of the surface of PtNPs that is exposed to activated gases.

Structural Analysis of Nanoparticulate Catalysts in Carbon Nanotube Growth

Carbon nanotubes (CNTs) can be grown from nanoparticulate catalysts prepared on substrate surfaces via chemical vapor deposition (CVD) growth. The structures of CNTs are affected by the shapes of nanoparticulate catalysts in the CNTs growth. this research. the structures In of nanoparticulate catalysts in Co-catalyzed CNTs growth were elucidated by in-situ ETEM observations. CNTs were synthesized at 550°C by CVD growth with Co nanoparticle catalysts under acetylene gas. Figure 3 shows the lattice fringe partly observed in nanoparticulate catalysts in growth of CNTs, indicating the hcp Co or Co₃C nanoparticulate catalysts. Figure 4 illustrates the two inhomogeneous structure models of nanoparticulate catalysts on Co-catalyzed CNTs growth. The model assumes that the Co₃C extends fully in the bottom part of a nanoparticle. In the other model, the Co₃C extends only around the bottom part of a nanoparticle. The difference in catalytic structures affects the growth rate of CNTs. This study provides insightful strategies to control the structural variations in CNTs.



Fig. 3 Lattice fringe partly observed in nanoparticulate catalysts in growth of CNTs.



Fig. 4 Inhomogeneous structure model of nanoparticulate catalyst in Co-catalyzed CVD

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Department of Theoretical Nanotechnology

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Associate Professor:	Koun SHIRAI	
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	Hiroaki SAIJO, Hiromichi HIRANO	
Undergraduate Student:	Takumi FUKADA	
Supporting Staffs:	Minako KAKIUCHI (-2015.3.31)	
	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

Novel Electronic Properties Driven By Spin–Orbit Coupling

Novel electronic phases and properties originated from spin-orbit coupling (SOC) have attracted much attention because of their interesting microscopic mechanisms and potential applications to next-generation devices. Bismuth is a semimetal in the bulk state while in the thin-film form, it reveals quantum well states depending on the thickness and spin-polarized surface states observed by recent angle resolved photoemission spectroscopy (ARPES) measurements and first-principles calculations. Quite recently, very weak Rashba-like spin



Fig. 1 One-dimensional edge state of Bi surface observed by ARPES (intensity) and first-principles calculation (solid line).

split band structure has been discovered for Bi thin films by an ARPES experiment and was successfully explained as a one-dimensional (1D) states appearing at the edges of triangular bi-layer structure grown on Bi surface by our first-principles calculations. The 1D states show Rashba split due to SOC and have almost equal magnitude of spin components along both surface normal and parallel directions perpendicular to the edge.

Materials Design Utilizing Atom Dynamics

Integrated study of the ground-state properties and atom dynamics is one of the main research subjects in our group. In this year, a progress has been achieved in the following issue. Boron carbide is predicted to be a high- T_c superconducting material. However, in experiment, the material behaves as semiconductor, and the superconductivity has never been observed. Thus far, the discrepancy between the prediction and experiment was a long-standing issue. We have solved this discrepancy. The problem was the presence of special type of defects, which prevents the crystal from behaving as metals. The existence of this defect explains many discrepancies between theory and experiments.

Theoretical Prediction of Thermoelectric Performance in Ferroelectric Oxides

Ferroelectric materials show the intriguing properties by breaking the space inversion symmetry in the crystal structure. Barium titanate is known as the representative ferroelectric system, which shows the large polarization at room temperature. In this study we theoretically predicted its high thermoelectric performance caused by the polar ionic distortion. Our electronic calculation results show that the electron-doped barium titanate has a strong anisotropy in the Fermi surface, which leads to a high Seebeck coefficient along the polarization axis. Its future device application is anticipated.

Charge and discharge reaction mechanisms in sodium-sulfur secondary battery

We have studied electronic structures and phase stabilities of S and Na poly-sulfide crystals by first-principles calculations in order to clarify charge and discharge mechanisms reaction and voltage characteristics of solid Na/S batteries. S crystal as a pristine cathode consists of ring-type S₈ structural units, and the van der Waals interactions between the S₈ rings are found to be important for the cohesion of the S crystal. Formation energy analyses show that several types of Na₂S_x are generated in the cathode depending on Na concentrations. By analyzing phase stabilities of Na-S



Fig. 2 Calculated voltage-capacity curve of solid Na/S battery.

system, we predict voltage–capacity curves and reaction equations of a solid Na/S battery. The calculated voltage curve has three plateau regions originating form different types of Na_2S_x products. Our results are consistent with recent experiments for Na/S batteries.

Magnetism in A-site-ordered perovskite oxides

The A-sire-ordered perovskite AA'₃B₄O₁₂ are derivatives of simple perovskite ABO₃ by occupying the A sites with two different A and A' cations and exhibit many interesting electronic properties. We have investigated the electronic structures of YMn₃Al₄O₁₂ and LaMn₃V₄O₁₂ that commonly includes Mn ions at the A' sites but shows different types of magnetic spin structures. We found that the change in Mn valence alters Mn–O–Mn super-exchange interaction, which then leads to the different spin orderings.

Department of Soft Nanomaterials

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	Ayana UCHIDA, Yuji OKAMOTO
Specially Appointed Res	earcher: Shreyam CHATTERGEE
JSPS Postdoctoral Resea	rcher: Shunsuke TAMBA
Supporting Staff:	Keiko YAMASAKI
Technical Assistant Staff	: Juanjuan PANG (2014.4.1-2014.10.31),
	Yumi HIROSE (2014.7.1-)

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 field-effect transistors (OFETs). We previously reported that a compound 1-containing π -conjugated system showed high electron mobility. To improve the air stability of OFETs, a series of electron-deficient π -conjugated systems 2–5 has been synthesized and their properties were investigated.

All the compounds exhibited typical electron-transporting characteristics in OFETs. air. 4 Under and 5 maintained the same order of electron mobilities. On the other hand. the electron mobility 2 of and 3 drastically decreased against that under vacuum. X-ray diffraction measurements indicate that 4 and 5



Fig. 1 Electron-deficient π -conjugated compounds based on carbonyl-bridged unit.

maintained air stability, irrespective of the crystallinity of the thin-films. Accordingly, the thermodynamic stability originating from the low-lying lowest unoccupied molecular orbital energy level contributed to the high air stability [Original Paper 4] (Fig. 1).

The development of donor-acceptor (D-A) copolymers has become a straightforward approach for p-type semiconductor materials in organic photovoltaics (OPVs). We previously reported that compound C₆-containing D-A copolymers (DTS-C₆). To further increase the PCE, the influence of the polymer molecular weight and the alkyl chain length in the acceptor unit on the polymer properties and photovoltaic performance was investigated.

Furthermore, the optimization of thin-film fabrication was also performed. As result. the а bulk-heterojunction (BHJ) solar cells based on DTS-C₆ and PC71BM can achieve a PCE of 7.85%, which is the highest value reported for amorphous copolymers in conventionally а structured device [Original Paper 5] (Fig. 2).



Fig. 2 Chemical structures of D–A copolymers for OPV application.

Methanofullerene derivatives, [6,6]-phenyl- C_x -butyric acid methyl ester (x = 61 or 71) (PC₆₁BM, PC₇₁BM), have been employed as typical n-type semiconductors in BHJ OPVs. On the other hand, we demonstrated the p-type function of PCBMs in BHJ solar

cess systems with strongly electron-accepting π -conjugated system **BCN–HH–BCN**. The charge carrier dynamics of the blend film were investigated by transient absorption measurements, which show the formation of PC₆₁BM radical cations and **BCN–HH–BCN** radical anions [Original Paper 1] (Fig. 3).



Fig. 3 Donor function of PC_xBM in BHJ solar cells

In the collaboration research with a company, several fulleropyrrolidine derivatives with fluorine atoms were newly synthesized and their potentials for OPV n-type materials were evaluated. The photovoltaic active layers in OPV cells were fabricated using a commercially available D–A type polymer, PTB7, as a p-type material. It was found that the fluorine atom introduced to these fulleropyrrolidines contributed to increasing the V_{oc} 's of the OPVs compared with the corresponding non-fluorine derivatives (Figs. 4 and 5).



Fig. 4 Chemical structure of fulleropyrrolidines. Fig. 5 J–V curves of OPV cells using fulleropyrrolidines.

Department of Bio-Nanotechnology

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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

Thermoelectric transport in atom-sized contacts

Single-molecule junctions are zero-dimensional nanostructure considered as a promising thermoelectric material that can achieve high thermopower by utilizing the steep rise in the electronic density of states at the frontier molecular orbital levels. In this year, we utilized the microheater-embedded mechanically-controllable break junctions (MCBJs) for single-molecule thermoelectric transport measurements. We performed simultaneous measurements of conductance and thermovoltage of Au–1,4-benzenedithiol–Au junctions at room temperature in vacuum. We found that the average thermovoltage is conductance independent. This is in fact a unique property intrinsic to molecular junctions having a large carrier injection barrier at the

electrode-molecule contacts; or in other words molecular tunneling iunctions. Meanwhile, we observed sharp change in the thermopower with the junction configurations during mechanical stretching of the metal-molecule-metal structures. The resultant thermoelectric figure of merit changed vastly from 0.0001 to over 1. This result indicates the importance to designing not only the molecular structure but also the electrode-molecule contact structure to develop a high-performance single-molecule thermoelectric device.



Fig.1 Microheater-embedded MCBJ

Development of capturing devices for atmospheric particulate matter

Solid-state nanopores are considered as а promising sensing device for environmental monitoring and bioanalytical

applications. It consists of a nanometer-sized hole formed in a thin membrane made of SiO₂ or SiN. For the use of this technique in a practical manner, it is necessary capture to measuring objects and drive those to the sensing of part а



Fig. 2 The capturing devices for atmospheric particulate matter. The microfluidic channel is filled with electrolyte solution and particles are captured through its microspore's meniscus. The particles are driven by the electrophoresis voltage and are separated by micro-slits according to that size before being sensed by a nopore.

nanopore from the sample many foreign substances are contained. Also, the implementation of decontamination processing part is preferable for a long term use of devices. For this aim, we integrated capturing and separation components into the chip de-vices of a nanopore. The capturing components consist of microspores on a micro-fluidic channel where electrolyte solution fills up, and particles are captured through those meniscuses. The captured particles are driven by the electrophoresis voltage and are separated by micro-slits according to that size before being sensed by a nopore (Fig. 2). We demonstrated the capturing and size-separation of Bacillus subtilis through the observation by using fluorescence microscope.

Preparation of atomically flat Pt(111) substrates for graphene growth

Although quasi freestanding quasi-free-standing epitaxial graphene can be obtained on Pt(111), it is well know that the cleaning of Pt(111) single crystal surface costs almost desperate efforts of sputtering and annealing cycles. We have succeeded in obtaining atomically flat and clean Pt(111) surfaces by deposition of Pt on solid substrates of Al₂O₃(0001) and YSZ(111), respectively.

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 Bi₂Se₃ and Bi₂Te₃ 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. In this 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 .

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

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. In this 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 Technology for Single Nucleotide Polymorphisms (SNP)

The technique for promptly detecting the genetic mutation is expected as а 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 fluorescence. The by allele-specific hairpin primer



PCR (AS-HP-PCR) method is the simple method to increase the allele specificity without optimized 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 (RT)- polymerase chain reaction (PCR).

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

Department of Nanosystem Design

Guest Professor: Shigeru MASUDA (2014.5.1-2015.3.31)

Outlines

Many studies on devices such as organic thin film solar cells and organic semiconductors have been reported. Not only the characteristics of organic semiconductors themselves (crystallinity and carrier mobility) but also the interfaces of metal electrode/organic semiconductors and insulator/organic semiconductors (carrier injection and transportation) play key roles in these devices. In this study, electronic states of a metal/organic semiconductor/metal/Si structure have been investigated under bias applied between two metal electrodes. Electronic states have been measured by Penning ionization electron spectroscopy (PIES), ultraviolet photoelectron spectroscopy (UPS), and photoelectron emission microscopy (PEEM). The Fermi level is thought to shift and occupied states change under bias between the electrodes. Band bending was analyzed by PIES and UPS with focused irradiated He beams and UV light, respectively, and the spatial distribution was measured by PEEM. These complemental experiments are original. Collaboration with Professor Kobayashi with achievements in solar cell research is essential to establish the base of the electronic characteristics.

Achievements

Dibenzopentacene (DBP) was used as a model organic molecule. A thin DBP film was fabricated on Au(111), and was investigated by PIES and UPS. The peaks assigned to the π orbitals of 8bg(HOMO), 7bg+7au, 6au and 6bg, and a σ orbital were observed in the UPS and PIES spectra. A metal/organic semiconductor/metal/Si structure was fabricated at Professor Kobayashi's laboratory and has been optimized to investigate with PIES and UPS under bias applied between two metal electrodes. We have also performed the PIES and UPS measurements with focused He beam and UV light, respectively, and PEEM measurements.

Department of Nanosystem Design

Guest Associate Professor: Osamu NAKAGAWARA (2014.6.16 - 2015.3.31)

Outlines

Fabrication of 3D functional metal oxide nano-hetero structures and their application for the energy conversion devices

Current Research Project

Development of nano-devices based on functional oxide materials has been conducted with the emphasis on the exploration of their potential application in nano-electronics. By combining self-organization phenomena and epitaxial thin film growth, fabrication method of the highly integrated and 10nm scale functional oxide nano-pillar system has been established. For an example, this technique was applied for transparent semiconductor oxides toward energy conversion devices.

Department of Nanodevice Characterization

Guest Professor: He Peng (2014.4.1-2014.6.30)

Outlines

With the development of flexible and wearable devices, the requirements of transparent electrodes have been an urgent issue in these days. Carbon nanotube, graphene, metal mesh and metal nanowires have been studied as alternative materials of traditional ITO films. Among these, transparent electrode based on silver nanowire (AgNW) networks is being studied intensively and attracting commercial interest owing to their great potential for flexible, cost-efficient, and large-scale fabrication. Although bulk silver exhibits very low electrical resistivity, the conductivity of AgNW networks is limited by the contact resistance between wires due to the residual of polyvinylpyrrolidone (PVP) layer. Heat, pressure treatment and photonic sintering have been used to enhance the contact between nanowires. However, high temperature limited the use of flexible polymer substrates, pressure damaged the devices. Low temperature and without post-treatment techniques are required. In this work, a simple washing process is used to remove the PVP layer on surface of AgNW, and elucidated the effect of PVP layer on the performance of AgNW film.

Achievements

AgNW was synthesized by one-step polyol method with PVP as the capping agent. After the synthesis step, the as-prepared AgNWs were washed with ethanol. It is found that the thickness of PVP layer on the surface of AgNW has been decreased with the washing cycles from over several to tens nanometer in thickness to only 2.4 nm. And the resistance of AgNW has been decreased from hundreds to below 20Ω / with transmittance over 85%. Moreover, the washing temperature was increased, the thickness of PVP layer has been decreased to below 1 nm. Furthermore, the N, N-dimethylformamide solvent has been confirmed a good washing agent to remove PVP layer form the surface of AgNW. These results indicated that the washing process was a simple method to fabricate the AgNW film at room temperature without post-treatment.

Also, Prof. He, towards the laboratory of students and staff, introduced the research activities, student life and university study-abroad-policy of Harbin Institute of Technology (HIT). The development and research direction of joining materials in HIT has been presented in detail by prof. He. It can be said that a great deal to contribute to the joint research of both of Osaka University and HIT in the future.

Department of Nanodevice Characterization

Peerapon VATEEKUL (2014.7.1 – 8.18)

Outlines

Recently, emotion recognition has gained a lot of attentions particularly in the domain of music recommendation since music can induce emotions. In this research, we aim to employ Electroencephalograph (EEG) signal to predict emotions with music stimulus. Moreover, we improve a prediction accuracy by inventing a new classification algorithm called "Item-Based Learning Approach".

Achievements

Music Emotion Prediction Using EEG Data

Emotion recognition is an attempt to understand human's emotions, such as sad or happiness, and boring or exciting. Nowadays, it has been realized that there is a strong relationship between emotions and brain activity, called EEG. This relationship has been studied in this research through two experimental data sets. The first data set is a standard benchmark called DEAP, while the second one is collected by our team at Numao Laboratory. WaveguardTM EEG cap was prepared for capturing brainwave of 15 subjects, with Polymate AP1532 amplifier and APMonitor brainwave recorder software. From the study, the results showed that there is a strong relationship between emotions and brainwave, so the human's emotions can be somewhat predicted using EEG.

Item-Based Learning Approach

There were some prior attempts to predict emotions using EEG. To further improve the accuracy, we propose a new classification technique based on the item-based collaborative filtering and called "EEG-CF." There are three contributions in our method: (*i*) a new similarity score for CF is computed using EEG data, (*ii*) a mechanism to deal with unrated items, and (*iii*) an outlier removal using the EEG-based distance. The experiments were conducted on two data sets: DEAP (dense) and our data set (sparse). The results in Figure 1 show that EEG-CF is superior to other techniques.



Figure 1. Comparing our method (EEG-CF) in the last bar to other techniques on valence (left) and arousal (right) in terms of accuracy (F1).
Department of Nanodevice Characterization

Guest Professor: Stanislav JURECKA (2014.9.1-10.3)

Outlines

Professor Kobayashi's laboratory has developed the fabrication method of black Si surfaces by forming an Si nanocrystal layer using the surface structure chemical transfer (SSCT) method. It is important to reveal the relationships between the microscopic structure of the Si nanocrystal layer and reflectivity by observing the structure of the Si nanocrystal layer. The nitric acid oxidation of silicon (NAOS) method, the defect passivation etch-less (DPEL) cleaning method, H₂ annealing, thermal oxidation, and their combinations are used as passivation methods of the Si nanocrystal layer. The minority carrier lifetime of the Si substrates is measured after the surface passivation. The photocurrent density is maximized by controlling the structure of an Si nanocrystal layer. The photovoltage also increased by elimination of the surface defects.

Achievements

An Si surface with ultralow reflectivity was fabricated by forming an Si nanocrystal layer with the SSCT method. The surface structures were observed by the scanning electron microscopy and the atomic force microscopy after various SSCT treatment periods. The minority carrier lifetime was measured and solar cells were fabricated with the Si wafers having ultralow reflectivity due to an Si nanocrystal layer. The monocrystalline Si was passivated by the NAOS method, the DPEL cleaning method, H₂ annealing, thermal oxidation, and their combinations. The best passivation process has been investigated by comparison of these data.

Department of Nanodevice Characterization

Guest Professor: Harald Gröger (2014.10.7-2014.11.27)

Outlines

Helicenes are polycyclic aromatic compounds with nonplanar screw-shaped skeletons formed by ortho-fused benzene or other aromatic rings. In current organic chemistry, optically active helicenes and other related helical molecules have received considerable attention due to their high potential as catalysts, liquid crystals and molecular devices. However, efficient enantioselective synthesis of helicenes, in particular, oxahelicenes, has been rather limited.

Achievements

Vanadium complex catalyzed enantioselective synthesis of oxa[9]helicene

Herein, we have developed a vanadium catalyzed enantioselective domino oxidative coupling/intramolecular cyclization of polycyclic phenol, 2-hydroxybenzo[c]phenanthren derivatives **1**. The vanadium complex (R_a ,S)-**3** works as a redox and Lewis acid catalyst to promote this sequential reaction to give oxa[9]helicenes **2** in up to 86% yield and 94% ee. The enantiopure **2a** (R = H) was readily obtained by a single recrystallization of the product and the absolute configuration of resulting **2a** was determined to be (*M*)-form by X-ray crystallographic analysis.



Department of Nanodevice Characterization

Guest Professor : Emil PINCIK (2014.12.1-2015.1.30)

Outlines

Professor Kobayashi's laboratory has developed the surface structure chemical transfer (SSCT) method, the nitric acid oxidation of silicon (NAOS) method and the defect passivation etch-less (DPEL) cleaning method as new chemical methods to increase energy conversion efficiencies of silicon solar cells. Si surfaces and interfaces are investigated by spectroscopic and electrical methods after treatments using these methods. The relationships between the microscopic properties of an Si nanocrystal layer and solar cell characteristics are investigated. It is also important to reveal the mechanism of the ultralow reflectivity by investigation of the Si nanocrystal surface. The passivation method to achieve a high photovoltage of solar cells and high minority carrier lifetime with the Si substrates treated by the SSCT method is investigated. The Si surfaces after the NAOS method, the DPEL cleaning method, H₂ annealing and thermal oxidation are investigated by spectroscopic methods.

Achievements

Local reflectivity of Si surfaces with ultralow reflectivity fabricated by the SSCT method was observed, and the relationship of the reflectivity with its mechanism and solar cell characteristics have been analyzed. The minority carrier lifetime and solar cell characteristics were measured for Si wafers treated with the NAOS method, the DPEL cleaning method, H₂ annealing and thermal oxidation with various treatment periods and combination after forming an Si nanocrystal layer. The surfaces and interfaces have been investigated using IR spectroscopy and deep level transient spectroscopy (DLTS). The passivation mechanism of the Si nanocrystal layer is clarified by analysis of these data.

Department of Nanotechnology Characterization

Visiting Research Scholar: Jungkweon CHOI (2015.2.2-2015.3.2)

Outlines

The structures of various *para*-substituted biphenyls (Bp-X; X = -OH, -OCH₃, -CH₃, -H, -CONH₂, -COOH, and -CN) and their radical anions (Bp-X[•]) were investigated by time-resolved resonance Raman spectroscopy combined with pulse radiolysis. The inter-ring C1-C1' stretching modes (v₆) of Bp-X were observed at ~1285 cm⁻¹, whereas the v₆ modes of Bp-X[•] with an electron donating or withdrawing substituent were significantly up-shifted. The difference (Δf) between the v₆ frequencies of Bp-X and Bp-X^{•-} showed significant dependence on the electron affinity of the substituent and exhibited a correlation with the Hammett substituent constants (σ_p).

Achievements

We performed the comparative investigation of the structures of Bp-X and Bp-X^{•-} with electron donating or withdrawing substituents at the *para* position using TR^3 spectroscopic measurements combined with pulse radiolysis. Theoretical calculations for the structures of Bp-X and Bp-X^{•-} are also conducted and compared with the experimental results. The structure of Bp-X[•] is significantly affected by the electron affinity of the substituent, while Bp-X has a twisted structure regardless of the type of substituent. In addition, the differences (Δf) between the v₆ frequencies of Bp-X and Bp-X^{•-} clearly show a linear correlation with the the Hammett substituent constants (σ_p) for both electron donating and withdrawing groups. From the theoretical and experimental results, we show that Bp-X[•] substituted with an electron donating and withdrawing group at the para position has a slightly twisted structure, whereas Bp-H⁻⁻ has a planar geometry. The twisted structure of Bp-X^{•-} is due to the localization of the unpaired electron and negative charge on one benzene ring. Moreover, the unpaired electron and negative charge in Bp-X^{•-} substituted with an electron donating group are located on the unsubstituted benzene ring, whereas those in Bp-X^{•-} substituted with an electron withdrawing group are located on the substituted benzene ring.

Department of Nanotechnology for Industrial Applications

Visiting Professor: Ralescu Anca Luminita (2014.2.3-2014.4.30)

Outlines

In recent years, techniques of artificial intelligence (AI), machine learning (ML) and statistics (S) are applied to the field of nano-technology. An example is a method to solve a Schrödinger equation by using non-linear regression. However, no generic and clear guide on effective use of these techniques has been provided in the nano-technology. This is because of the difficulty to transform models developed in biology, chemistry and physics into a united representation. Accordingly, the AI/ML/S techniques are rather used in ad-hoc manner. In this study, first, we reviewed the applications of these techniques in the nano-technology, and second, evaluated the effectiveness of the techniques in the nano-technology including molecular design.

Achievements

We confirmed a technological movement to develop novel sensing devices by applying nano-technologies. For example, study on single molecule measurement and DNA/RNA sequencing, study on electronic devices using nano-process, study on electro-microscope using quantum beams and energy conversion by applying nano-scale devices are conducted in our nano-technology center. Upon our extensive investigation, we found a perspective that many of these new sensing devices output signals contaminated by large noises caused by the nano-scale sensing processes. To reduce the noise effects and effectively enhance the accuracy of the measurement, we derived a conclusion that the extensive applications of machine learning methods using statistical modeling are highly required.

Department of Nanotechnology for Industrial Applications

Guest Professor:

Daniel Arenas (2014.05.01-07.01)

Outlines

Sillenites, such as $Bi_{12}SiO_{20}$ and $Bi_{12}GeO_{20}$, have been studied for decades due to their numerous nonlinear-optics properties. They consist of oxygen tetrahedra, centered by a metal cation, that are interconnected by a bismuth-oxygen framework. Recently, new sillenites such as $Bi_{25}FeO_{39}$ and $Bi_{25}InO_{39}$, have gained recent attention due to their photocatalytic properties. It is difficult to understand the cause of their physical properties since the structure and the stoichiometry of these new sillenites remains controversial. Earlier Raman studies suggested that the trivalent compounds, $Bi_{25}Fe^{+3}O_{39}$ and $Bi_{25}In^{+3}O_{39}$, have more inhomogeneous disorder in their bismuth oxygen framework compared to the tetravalent compounds: $Bi_{12}Si^{+4}O_{20}$ and $Bi_{12}Ge^{+4}O_{20}$. Preliminary electron diffraction data showed streaks that confirmed the existence of disorder in the trivalent compounds. The purpose of visiting the Nanocharacterization Department at ISIR was to analyze the streaks in the electron diffraction data using multi-slice simulation software, gather additional experimental data, and to learn from Professor Takeda's broad expertise in this subfield.

Scientific Achievements

The electron diffraction patterns of three sillenite compounds were investigated. Streaks in the diffraction patterns of $Bi_{25}FeO_{39}$ and $Bi_{25}InO_{39}$, not observed in $Bi_{12}SiO_{20}$, confirmed a short-range deviation from the average structure. The origin of the streaks was investigated by analyzing the data using multi-slice simulations, with the MacTempas software, to test different structural models. The analysis suggests that the streaks are caused by short-range ordering of oxygen-vacancies. The results are important because oxygen vacancies may play a role in the catalytic processes. These results, combined with previous Raman studies, will hopefully generate more interest in the synthesis and characterization of these compounds.

We are proud to report that our results was published in the journal "AIP Advances", from the American Institute of Physics, as "Electron diffraction study of the sillenites Bi₁₂SiO₂₀, Bi₂₅FeO₃₉ and Bi₂₅InO₃₉: Evidence of short-range ordering of oxygen-vacancies in the trivalent sillenites". The Guest Professor was the corresponding author and Professor Seiji Takeda was a co-author. Also the Guest Professor remained an additional month in Professor Takeda's laboratory and wrote a manuscript for a related project. The Guest Professor published the manuscript "First-principles study of the phonon modes in bismuth sillenites" in Physical Review B and thanked ISIR for its support.

Broader Impacts Achievements

The Guest Professor also participated in a seminar series with the graduate students in Takeda's laboratory. During 8 weeks, every week, the graduate students gave a 10 minute presentation in English about their research. At the end of the Guest's stay, the graduate students presented their research to the entire research group and showed wonderful English-presentations skills. As final words, the Guest Professor would like to say that his experience as a visiting faculty in ISIR was a very rewarding experience. He learned more about Japanese culture and came to appreciate the hard-work ethic in the Japanese scientific community. He hopes to continue his collaboration with Professor Takeda and Associate Professor Yoshida for the rest of his career.

Nanofabrication Shop

Director, Professor: Technical Staff: Hidekazu TANAKA 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 80 fabrication requests from 9 laboratories in 2014. Fig. 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 requests.

There is no novel fabrication request in 2014, we performed further fabrications to make thin silicon film. Fig. 2 shows the silicon wafer which has thin film parts. A part looking beige has the thickness of 30nm.

Participation in "nanotech 2015"

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 2015" which was held on 28th to 30th of January in 2015.



Fig.1 The transit of requests since 2005.



Fig.2 Silicon thin film. Beige parts are 250µm in diameter, thin film parts of thickness 30nm.

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 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 994, decreased 84 comparison with last year. Thin-film nano structure analyser, LED lithography system and Focused Ion beam system were much used.



Nanotechnology Open Facilities

Yoichi YOSHIDA (-2014.7.1)
Hidehiro YASUDA (2014.7.2-)
Hidekazu TANAKA
Masateru TANIGUCHI
Hirotarou MORI
Keita KOBAYASHI
: Akira KITAJIMA
Kimihiro NORIZAWA (-2015.3.31)
Miki KASHIWAKURA
Kouji HIGUCHI
Takashi TANIGUCHI
Cong Que DINH (-2014.6.30)
Kazumi KONDA (2014.4.1-)
Kyoko SHIMOMITSU
Keiko ENMI
Yoshimi MAEGAWA (2014.4.8-)
Chieko UETANI (2014.8.4-)

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 157 research themes in 2014.

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 157 research themes (except for technical consulting and non-publish the fruits) have been supported in the program in 2014. 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
Specially Appointed Assista	ant Professor: Mitsuko NISHINO
Technical Staff:	Takanori TANAKA,
	Tsuyoshi MATSUZAKI, Hitoshi HANEOKA,
	Yosuke MURAKAMI
Technical assistant Staff:	Takeshi ISHIBASHI, Tsunayoshi TAKEHARA
Support Staff:	Etsuko TANI

Outlines

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

Current Research Projects

Iridium-catalyzed oxidation: development and applications

Development of catalytic reaction using clean oxidant is one of the most important themes in modern organic synthesis. In addition, desymmetrization of *meso* diols is the efficient methods for the synthesis of chiral building blocks. We have developed the catalytic tandem asymmetric reaction based on desymmetrization of *meso* diols. Furthermore, we applied this method for the synthesis of catalponol.



Catalytic asymmetric synthesis of catalponol 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:	Tamotsu YAMAMOTO, Akira TOKUCHI,
	Kumiko KUBO
(Concurrent members)	
Professors	Goro ISOYAMA, Yoichi YOSHIDA, Takahiro KOZAWA
Associate Professors:	Ryuko KATO, 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 A	ssistant Professors: Jungkwegn CHOI

Specially Appointed Assistant Professors: Jungkweon CHOI

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 ⁶⁰Co 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, ⁶⁰Co γ-ray sources)

The results of operation for L-band linac: total score 3,414 hours, 236 days, 47 themes.

<u>L-band linac</u>: the linac was operated for 236 days, 3,414 hours (Fig.1). A serious trouble arose in the klystron due to the leakage of cooling water from a pinhole on the water tube. The water tube was replaced and the recovery was tried, but it failed. Thus a new klystron, which has been kept in our laboratory, was equipped instead of the damaged klystron. A new klystron must be purchased as soon as possible. The thyratron in the modulator was replaced with semiconductor to get a stable switching, however, the several troubles have occurred. The improvement for this is still under way. The cathode in the injection system was replaced after 16 months operation, but the new cathode had a trouble after one month



Fig.1 Operation of L-band linac

operation. So the replacement of the cathode was carried out again. The replacements of the parts due to troubles such as the ball valve, the flowmeter, the chilling unit of water circulation system and the fan-belt of air conditioner, were carried out. The malfunction arose also in the phase shifter of the low power stage. This is still under inspection. The replacements of the rf-amplifiers relating to sub-harmonic buncher from traditional electron-tube based circuit to semiconductor based circuit were carried out several years

ago, however, the stable operation could not be achieved due to the trouble of FET unit. We eventually found the trouble to be due to the temperature-compensation circuit and the improvements were carried out for three sub-harmonic buncher circuits. We hope the stable operation will be achieved.

<u>RF-gun S-band linac:</u> The operation of the RF-gun S-band linac could not be achieved, since the movement of this linac from the linac building to the cobalt building was scheduled.

<u>Cobalt-60 facility:</u> This facility was used in 76 days, 1,144 hours, for 21 subjects and the users were not only the member of ISIR but also the researchers of other faculties, as shown in Fig.2.

Management (Joint use & Radiation safety management)

Accepted subjects relating from the joint-users are 47 in total (Fig.3). Specially programmed academic meetings were held four times (Sept. 1st, 2014/ Sept. 3rd, 2014/ Dec, 9th, 2014/ Dec, 11th-12th, 2014) and the annual debrief session was held on Feb, 7th in 2015. Also cooperated workshop with Korea, group of KAERI, was held twice.

(Jan, 26th, 2015/ Feb, 25th 2015) Visitors were more than 215. The training regarding radiation safety management was carried out for the registrants in May 15th 2014. 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 (TR³) is useful to characterize the structural and electronic properties of short-lived intermediates. The oxidizing species in aqueous solutions were studied by TR³ measurement during the pulse radiolysis. The TR³ spectra of (SCN)₂^{•-} was observed between 200 – 1500 cm⁻¹. **Application of positron annihilation spectroscopy**

The study of capture process of cesium in cray minerals was carried out using positron annihilation spectroscopy (PAS). The PAS related parameters such as the lifetimes of positron and the Doppler broadened energy spectrum of annihilation gamma-rays showed different behavior in different type of cray minerals. The further investigation will be carried out. Another investigation relating to fused polytetrafluoroethylene was carried out by PAS and we found that the structural changes of amorphous region and crystal surface indeed reflect on the lifetimes of ortho-positronium.







Fig.3 Accepted subjects.

Center for Collaborative Research Education and Training

Professor Yoichi YOSHIDA
Professor Seiji TAKEDA
Professor Takashi Washio
Associate Professor Kouji SEGAWA
Associate Professor Sinobu TAKIZAWA
Professor Yoishi ANDO
Professor Tetsuro MAJIMA
Associate Professor Teruo KANKI
Assistant Professor Koichi MORIYAMA

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 eight collaborative laboratories are working. Researchers and students who belong to the collaborative research projects stay at a collaborative laboratory on each side and perform the collaborative research.

PU-ICT lab.

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

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

KU-AMR lab.

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

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

POSTECH-PMR lab.

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

1. TiO₂ photocatalysts

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

UCL-ESS lab.

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

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

DLSU-ICT lab.

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

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

AU-SOC lab.

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

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

BU-SOC lab.

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

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

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.

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 FY2014 from ISIR were Prof. H. Tanaka (Vice Chair), Prof. Y. Yagi, and Prof. T. Oguchi. Our members of this Alliance as of April 2014 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. T. Yanagida
- (G2) Energy materials and devices research group (7 members)Prof. H. Kobayashi (Group Leader), Prof. K. Suganuma, Prof. S. Takeda, Prof. K. Tanimura, Prof. M. Numao, Assoc. Prof. Y. Honda, Assoc. Prof. T. Suzuki
- (G3) Medical materials, devices, and system research group (10 members)Prof. K. Nakatani (Group Leader), Prof. N. Kato, Specially Appointed Prof. A.Yamaguchi, Prof. Y. Yagi, Prof. M. Taniguchi, Prof. T. Nagai, Prof. K. Komatani, Assoc. Prof. T. Okajima, Assoc. Prof. T. Nishi, Assoc. Prof. K. Nishino
- (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), Hajime ASAHI, Yoshio ASO, Hidekazu TANAKA, Yoichi ANDO, Jun TAKEYA, Tamio OGUCHI, Takashi WASHIO

Outlines

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

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

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

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

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

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

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

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

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

Current Research Projects

Fabrication of Diluted Magnetic Semiconductor Nano-Structures

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

Carbon Nanotube Nano Memory

Owing to the small diameter of the carbon nanotube (CNT), the electric field concentration was induced around the nanotube. Therefore, we could get the higher electric field even at the lower applied voltage. Using this phenomenon, CNT was surrounded by two dielectric layers of Si₃N₄/SiO₂ for the memory structure. In this carbon nanotube nanomemory, only 2V is necessary for the write in and read out process. This is 10 times smaller value than the conventional planar type memory. By reducing the gate length down to 10nm, and all rounded structure was formed. In this device, one by one memory effect was observed even at room temperature. Using the smaller size of the device, single charge memory effect could be detected even at room temperature.

Graphene Bio Sensor

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

Molecular Electronic Materials

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

Construction of Transition Metal Oxide Nano Structured Devices

We discovered micro-scale phase separation in VO2 thin films on TiO2(001)

substrates and the abrupt resistive changes against temperature. Furthermore, we have constructed two-terminal multistate memory elements based on VO₂/TiO₂ 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 VO₂. The memory mechanism is based on current-induced creation of metallic clusters by self-heating of micrometric suspended regions and resistive reading via percolation.

Basic Research of Topological Insulators and Superconductors

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

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

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

First-principles Studies on Materials Properties

We have investigated the spin-orbit driven magnetic crystalline anisotropy of transition-metal multilayers such as FePt and CoPt on the basis of first-principles calculations. The origin of the shape anisotropy is also studied. We have elucidated the microscopic mechanism for the ferroelectric polarization originating from spin-orbit coupling in multiferroic Ba₂CoGe₂O₇.

An Estimation Method of Quantum States for Quantum Experiments

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

New Energy Material • **Devices Research Group**

Professors:

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

Outlines

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

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

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

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

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

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

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

Current Research Projects

Non heating fabrication of transparent conductive electrodes for solar cell

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



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

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

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

Operand environmental transmission electron microscopy observations show that the morphology of Au nanoparticles supported on CeO_2 depends on the partial pressures of CO and O₂. Adsorption of CO molecules stabilizes the gold nanoparticles with faceted shape. On the other hand, Au nanoparticles become rounded in O₂. In addition, we have found that adsorbed CO molecules caused the {100} facets of gold nanoparticles to reconstruct during CO oxidation.

Inference of mechanical effects among structural members on fuel cells

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

Asymmetric tandem reactions using iridium-catalysis

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

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

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

Degradation process of PEM has been studied with electron pulse radiolysis technique. The samples were prepared by loading substrate(S) into Nafion. Decreasing water content in Nafion reduced generation of OH^{\bullet} adduct of S, whereas the amount of products due to one-electron oxidation was not changed, suggesting that OH^{\bullet} was mostly generated from the water-SO₃⁻ ionic clusters.

Solar cells using Si nanoparticles

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

Medical Treatment Materials, Devices, and System Research Group

Professors:

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

Outlines

This research group focused attention on development of gene/drug delivery system, modulation of protein functions by organic small molecules, an imaging device with polyhedral mirror, gene detection method and system, bioactive substances transporter, single-molecule electrical analysis system, high-sensitive Ca²⁺ sensor, and a tool for describing human activity.

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

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

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

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

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

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

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

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

Current Research Projects

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

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

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

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

Shape from Single Scattering for Translucent Objects (Yagi)

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

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

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

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

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

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

Development of Improved Hairpin Primer PCR Method (Nakatani)

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

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

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

Development of high-sensitive Ca²⁺ sensor with blue, green and red color variants (Nagai)

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

Environmental Harmonized Materials and Devices Research Group

Professors:

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

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

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

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

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

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

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

Beam-induced Chemistry of Nanomaterials (MAJIMA)

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

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

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

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

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

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

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

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

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

Study of Primary Processes of Radiation Chemistry in Condensed Matter

(KOZAWA)

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

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

Activities of Facilities

Workshop

Director Professor: Yoshio ASO

Technical Staff:

Machine Shop: Masayoshi OHNISHI, Yuki MATSUSHITA, Michiaki KAKUICHI 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: 191 jobs (203 jobs in the previous year). Glassworks: 117 jobs (113 jobs).

Laboratory for Radio-isotope Experiments

Professor:

Goro ISOYAMA

Outlines

This laboratory is specially designed for biochemical and molecular biological experiments using the radioactive compounds labeled with ³H, ¹⁴C, ³²P, ³³P or ³⁵S. 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.

In this year, three continued projects were applied for use of this laboratory. Contributions of the facilities to the research projects are described in the section of the department of cell membrane biology and beam materials science.

Electronic Processing Laboratory

Professor:	Kazuhiko MATSUMOTO
Associate Professor:	Shigehiko HASEGAWA
Associate Professor:	Koichi SUDOH
Associate Professor:	Kenzo MAEHASHI

Outlines

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

The equipment and systems are an anechoic chamber, a small-size clean room, 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, and a wire bonding system.

This laboratory is utilized for experimental researches of surface structure analysis and electrode formation, for the measurements of electronic and other properties of various materials and also for the fabrication of photonic, electronic and molecular devices. Guidance to the users to the equipments and systems as well as the daily maintenance and repair of them were conducted. In the year of 2014, the equipment and systems were used from 5 laboratories and facilities.

Library

Professor:	Katsuaki SUGANUMA
Librarian:	Takako WADA
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,	2015)
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	Number of books	Journals	Newspapers
Japanese	5,164	165 titles	5 titles
Foreign	19,576	502 titles	1 title

Facilities Managment Office

Professor:	Ta
Supporting Staff:	Ka

Takahiro KOZAWA 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 2014, the following 15 researchers used Nanotech Open Laboratory.

Prof. Yusuke MORI	Graduate School of Engineering
Prof. Keisuke MORISHIMA	Graduate School of Engineering
Prof. Yoji SHIBUTANI	Graduate School of Engineering
Prof. Kohji MINOSHIMA	Graduate School of Engineering
Assoc. Prof. Kaori HIRAHARA	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. 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 KOOZAKI
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 7.

And we have offered poster printing services for ISIR researchers. Total number of poster printing was 587.

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)	SA	AN	KEN	Techno-Salon	
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Ordinal	Date	Number of Participants
1^{st}	May 9, 2014	70
2^{nd}	Aug.1, 2014	74
3 rd	Nov.7, 2014	84
4 th	Feb.6, 2015	63

2) Introduction of new technologies through the web site

3) Publication of a booklet "Research 2014" for introduction of ISIR's research activities to industry sectors

4) Publicity of ISIR's technologies at exhibitions etc.: 5 exhibitions and 3 lecture-meetings

Use of Company Research Park

Number of Use: 20 companies (28 rooms) [new use: 5 companies] **Coordination of Joint Research etc.** 5 joint researches were established.

Support for External Funding

Support for New Industry Creation Study Groups

3 study groups

Public Relations Office

Director, Professor:	Yoichi YOSHIDA
Professors:	Masayuki NUMAO (-2014.9.30),
	Masateru TANIGUCHI (-2014. 9.30),
	Goro ISOYAMA, Tetsuro MAJIMA,
	Akira OIWA (2014.10.1-), Yoshio ASO (2014.10.1-)
Associate Professors:	Shohei SHIMIZU (-2014.9.30),
	Tomoki MATSUDA(-2014.9.30),
	Hideto YOSHIDA(-2014.9.30),
	Jinfeng YANG, Masakazu TANE (2014,10.1-),
	Toshihide OKAJIMA (2014,10.1-)
Specially Appointed As	ssociate Professor: Shijo NAGAO
Assistant Professors:	Hiroki YAMAMOTO (-2014.9.30),
	Kenichi FUKUI, Yusuke HIGUCHI,
	Mahito SUGIYAMA (2014.10.1-),
	Kazumichi YOKOTA (2014.10.1-)
Staff:	Noriko MATSUMOTO
Technical Staff:	Yuka OKUMURA
Temporary Staff:	Atsumi ITO, Hideki SHIMADA (2014.6.1-2014.9.16)

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.

Activities

The number of visitors in ICHO Festival:	319
The number of visits and visitors:	16 visits and 482 visitors
Press release (by head office of Osaka Univ.) :	17
Press conference:	26
The number of coverages:	119
Issue of ISIR's 75th Anniversary Memorial Magaz	ine (2014.10)

Technical Division

Director:Takanori TANAKAGroup Leaders:Hiroaki MATSUKAWA, Noriyuki OGAWAChiefs:Masayoshi OHNISHI, Senjin AIHARA, Shouichi SAKAKIHARAStaff:Tsuyoshi MATSUZAKI, Yuka OKUMURA, Yuki MATSUSHITA,
Kazuya FURUKAWA, Hitoshi HANEOKA, Yosuke MURAKAMI,
Tamotsu YAMAMOTO, Kimiaki TANIHATA, Kumiko BABA

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.
- 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

	Safety and Security seminar (June)	Participants: 45 persons
	Craft lecture for children (Aug.)	60 persons
	The 3 rd Alliance (IMRAM, RIES, CRL, IMCE and ISIR	() technical
	Symposium (Nov.)	70 persons
	Exhibition of event in Saito City (Nov.)	186 persons
	Some Trainings and Conferences	Total 35
•	Some licenses and Awards	Total 78

Administrative Office (31-March , 2015)

Director :	Toshio SANDA			
General Affairs Division				
Staffs:	Tadashi NAKAGAWA			
	Yutaka KUROKUI			
	Natsuko HORII			
	Kazuko HANAMI			
	Tomomi HIGASHIO			
	Kazumi HAYASHI			
Supporting Staffs:	Mitsuru NISHISAKO			
	Mie SHIMOE			
	Noriko SASAKAWA			
Research Cooperatio	on Division			
Staffs:	Junko YOSHIZAKI			
	Osamu NISHIMURA			
	Takeshi SHIODA			
	Tamaki UEBAYASHI			
	Misa TOKUMOTO			
	Ayaka IMAMURA			
	Mayu ESAKA			
	Yasuko MUTSUI			
	Masako MORITA			
	Aiko SATO			
	Misato KUBO			
	Etsuko UNO			
Supporting Staffs:	Kazune OTANI			
	Kuniko NISHIMOTO			
	Yasuhiro UCHIDA			
	Naoko MEKARU			
	Yumi WADA			

List of Achievements

Department of Photonic and Electronic Materials Original Papers

[1]Electrically tunable spin filtering for electron tunneling between spin-resolved quantum Hall edge states and a quantum dot, H. Kiyama, T. Fujita, S. Teraoka, A. Oiwa, and S. Tarucha: Applied Physics Letters, 104 (2014) 263101-1-263101-4.

[2]Single photoelectron detection after selective excitation of electron heavy-hole and electron light-hole pairs in double quantum dots, K. Morimoto, T. Fujita, G. Allison, S. Teraoka, M. Larsson, H. Kiyama, S. Haffouz, D. G. Austing, A. Ludwig, A. D. Wieck, A. Oiwa, and S. Tarucha: Physical Review B, 90 (2014) 085306-1-085306-5.

[3]Tuning the electrically evaluated electron Landé g factor in GaAs quantum dots and quantum wells of different well width, G. Allison, T. Fujita, K. Morimoto, S. Teraoka, M. Larsson, H. Kiyama, A. Oiwa, S. Haffouz, D. G. Austing, A. Ludwig, A. D. Wieck, and S. Tarucha: Physical Review B, 90 (2014) 235310-1-235310-4.

[4]Ferromagnetic interactions and martensitic transformation in Fe doped Ni-Mn-In shape memory alloys, D. N. Lobo, K. R. Priolkar, S. Emura, and A. K. Nigam: Journal of Applied Physics, 116 (2014) 183903-1-183903 -8.

[5]Importance of structural distortions in enhancement of transition temperature in FeSe1–xTex superconductors, Kapil E. Ingle, K. R. Priolkar, Anand Pal, Rayees A. Zargar, V. P. S. Awana and S. Emura: Superconductor Science and Technology, 28 (2015) 015015-1-015015-6.

[6]Photoluminescence related to Gd3+:N-vacancy complex in GaN:Gd multi-quantum wells, M. Almokhtar, S. Emura, A. Koide, T. Fujikawa, and H. Asahi: Journal of Alloys and Compounds, 628 (2015) 401-406.

[7]Structural and defect characterization of Gd-doped GaN films by X-ray diffraction and positron annihilation, A. Yabuuchi, N. Oshima, B. E. O'Rourke, R. Suzuki, K. Ito, S. Sano, K. Higashi, Y.-K. Zhou, and S. Hasegawa: Journal of Physics: Conference Series, 505 (2014) 012023-1-012023-4.

[8]Hall resistivity and transverse magnetoresistivity generated in simultaneous presence of spinpolarized current and external magnetic field in a nonmagnetic bipolar conductor YH2, Masamichi Sakai, Hiraku Takao, Tomoyoshi Matsunaga, Yusuke Tanaka, Tatsuya Arai, Shota Haruyama, Takashi Otomo, Hiroaki Hirama, Takahito Sakuraba, Zentaro Honda, Koji Higuchi, Akira Kitajima, Akihiro Oshima, Shigehiko Hasegawa, and Hiroyuki Awano: Japanese Journal of Applied Physics, 54 (2015) 013001-1-013001-11.

International Conferences

[1]Single-shot readout electron spins in a quantum dot coupled to quantum Hall edge states (poster), H. Kiyama, A. Oiwa, and S. Tarucha: 8th International Conference on Quantum Dots (QD 2014), Italy May 11-16, 2014.

[2]Angular momentum conversion from single photons to single electron spins in a lateral double quantum dot (invited), A. Oiwa, T. Fujita, K. Morimoto, H. Kiyama, G. Allison, M. Larsson, A. Ludwig, A.D. Wieck and S. Tarucha: Solid State Devices and Materials (SSDM2014), Japan,September 11th, 2014.

[3]Conversion from a single photon to a single electron spin using electrically controlled quantum dots (invited), A. Oiwa, T. Fujita, K. Morimoto, M. Larsson, G. Allison, H. Kiyama, A. Ludwig, A. D. Wieck, and S. Tarucha: Fujihara Seminar: Real-time Dynamics of Physical Phenomena and Manipulation by External Fields, Japan, September 23-27, 2014,.

[4]Unique Behavior of Photoluminescence from Small Size Nanowires (poster), M. Almokuhtar, S. Emura, and A. Oiwa: The 18th SANKEN International Symposium, Japan, December 10-11, 2014.

[5]Photon-spin coupling using electron spins in quantum dots (poster), A. Oiwa, T. Fujita, K. Morimoto, M. Larsson, G. Allison, H. Kiyama, A. Ludwig, A. D. Wieck, and S. Tarucha: The 18th SANKEN International Symposium, Japan, December 10-11, 2014.

[6]Single-shot readout of electron spin states in a quantum dot coupled to quantum Hall edge states (poster), H. Kiyama, A. Oiwa, and S. Tarucha: The 18th SANKEN International Symposium, Japan,December 10-11, 2014.

[7]Fabrication and transport properties of InAs self-assembled quantum dots contacted with nanogap electrodes (poster), H. Kiyama, T. Hirayama, R. Shikishima, S. Baba, N. Nagai, K. Hirakawa, S. Tarucha, and A. Oiwa: 1st International Workshop on Topological Electronics (Topotronics2015), Japan, March 9-11, 2015,.

[8]Growth and Characterization of Fe Nitride on GaN(0001) (oral), higehiko Hasegawa, Shota Yamauchi, Masaru Yoneoka, Hiroaki Yamaguchi: 5th International Symposium on Growth of III-Nitrides.

[9]Structural and Mechanical Characterization of BN Films Grown on Si(001) by Magnetically-Enhanced Plasma Ion Plating (poster), S. Hasegawa, M. Noma, M. Yamashita, and K. Eriguchi: 5th International Symposium on Growth of III-Nitrides.

[10]Non-local Detection of Spin Injection through a Co/GaN Schottky Barrier (poster), Shigehiko Hasegawa and Hiroaki Yamaguchi: The 7th International Symposium on Surface Science.

[11]A Novel Reactive Plasma-Assisted Coating Technique (RePAC) for Thin BN/Crystalline-Si Structures and their Mechanical and Electrical Properties (oral), K. Eriguchi, M. Noma, S. Hasegawa, M. Yamashita, and K. Ono: AVS 61st International Symposium & Exhibition.

[12]Effects of ion energy on surface and mechanical properties of BN films formed by a reactive plasma-assisted coating method (oral), M. Noma, K. Eriguchi, S. Hasegawa, M. Yamashita, and K. Ono: 36th International Symposium on Dry Process.

[13]Environment Identification of Nitrogen Vacancy in GaN:Gd by X-ray Spectroscopy (oral), S. Emura, A. Koike, K. Shirai, K. Niki, and T. Fujikawa, 28th International Conference on Defects in Semiconductors, Espoo, Finland, July 27 – 31, 2015.

[14]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, Espoo, Finland, July 27 – 31, 2015.

[15]Vacancy identification in GaN doped with rare earth element by XANES (poster), A. Koide, K. Niki, T. Fujikawa, and S. Emura, 16th International X-ray Absorption Fine Structure Conference (XAFS16), August 23 – 28, Karlsruhe, Germany.

Patents

[1]K20140010 Magnetic semiconductor elements, 2014-244212

[2]K20140011 Magnetic semiconductor devices, 2014-244209

Contributions to International Conferences and Journals

A. Oiwa The 21st International Conference on Electronic Properties of Two-Dimensional Systems (Program Committee)

A. Oiwa	The 9th International Conference on Physics and Applications of Spin-related Phenomena in Solids (Organizing Committee (Chair))			
S. HASEGAWA	The 7th International Symposium on Surface Science (Local Arrangement Vice-Chair)			
A. Oiwa	The 1st International Works	hop on Topological Electronics (Sterring c	ommittee)	
A. Oiwa	2015nternational Conference	e on Solid State Devices and Materials (Pr	ogram	
	committee)	Ň	8	
Publications in Dor	nestic Meetings			
JPS 2014 Autumn M	leeting		3 papers	
JSP The 70th Annua	l Meeting		2 papers	
The 75th JSAP Autu	m meeting		3 papers	
Jthe 62nd SAP Sprin	ng Meeting 2015		6 papers	
The 38th Annual Co	nference on MAGNETICS ir	n Japan	1 paper	
Annual report meeting	ng of Innovative area "Nano	Spin conversion Science"	3 papers	
2014 8th Joint Resea	arch Meeting of MEXT Natio	onal Projects on Condensed-Matter	1 paper	
Science	-	-		
Academic Degrees				
Bachelor Degree for	Fabrication and evaluation	n of Fe4N/GaN(0001) interface grown by r	nolecular	
Engineering	beam epitaxy			
M. Kimura				
Bachelor Degree for	Fabrication and transport	measurement of single-electron transistors	using InAs	
Engineering	igineering self-assembled quantum dots			
R. Shikishima				
Doctor Degree for	Spin-dependent electron tr	ransport in a quantum dot coupled to quant	um Hall edge	
Engineering	states			
H. Kiyama				
Grant-in-Aid for Se	cientific Research			
A. Oiwa	Quantum state conversion from	om photons to spins using quantum	¥6,630,000	
	dots and generation of entang	glements		
A. Oiwa	Optical spin conversion		¥5,681,000	
A. Oiwa	Steering committee of Nano	Spin Conversion Science	¥1,300,000	
A. Oiwa	Novel solid state phyics via s	spatial controls of quantum pairs	¥4,901,000	
S. Hasegawa	A design of spin polarization analyzer and its application to ¥260,000 quasi-exclusive OR gate			
Entrusted Research	1			
A. Oiwa	Ministry of Internal	Development quantum interface	¥455,000	
	Affairs and	consisting of integratable electrically		
	Communications	controlled spin quantum bits		

Department of Semiconductor Electronics Original Papers

[1]Characterization of reduced graphene oxide field-effect transistor and its application to biosensor, Masaki Hasegawa, Yuki Hirayama, Yasuhide Ohno, Kenzo Maehash2 and Kazuhiko Matsumoto: Japanese Journal of Applied Physics, 53 (5S1) (2014) 05FD05-1-4.

[2]Raman spectral mapping of self-aligned carbon nanowalls, Toshio Kawahara, Satarou Yamaguchi, Yasuhide Ohno, Kenzo Maehashi, Kazuhiko Matsumoto, Kazumasa Okamoto, Risa Utsunomiya, Teruaki Matsuba, Yuki Matsuoka and Masamichi Yoshimura: Japanese Journal of Applied Physics, 53 (5S1) (2014) 05FD10-1-6.

[3]Carbon Nanowall Field Effect Transistors Using a Self-Aligned Growth Process, Toshio Kawahara, Satarou Yamaguchi, Yasuhide Ohno, Kenzo Maehashi, Kazuhiko Matsumoto, Kazumasa Okamoto, Risa Utsunomiya, Teruaki Matsuba: e-Journal of Surface Science and Nanotechnology, 12 (2014) 225-229.

[4]Direct graphene synthesis on a Si/SiO2 substrate by a simple annealing process, Takashi Ikuta, Kenta Gumi, Yasuhide Ohno, Kenzo Maehashi, Koichi Inoue and Kazuhiko Matsumoto: Materials Research Express, 1 (2) (2014) 025028-1-8.

[5]Effect of the inert Gas adsorption on the bilayer graphene to the localized electron magnetotransport, A Fukuda, D Terasawa, Y Ohno and K Matsumoto: Journal of Physics, 568 (2014) 052009-1-7.

[6]Top gating of epitaxial (Bi1-xSbx)2Te 3 topological insulator thin films, Fan Yang, A. A. Taskin, Satoshi Sasaki, Kouji Segawa, Yasuhide Ohno, Kazuhiko Matsumoto and Yoichi Ando: Journal of Physics, 104 (2014) 161614-1-4.

[7]Optical Observation of Deep Bulk Damage in Amorphous Perfluorocarbon Films Produced by UV Photons Emitted from Low-Pressure Argon Plasma, Takao Ono, Ryo Iizuka, Takanori Akagi, Takashi Funatsu and Takanori Ichiki: Journal of Photopolymer Science and Technology, 27 (3) (2014) 393-398.

International Conferences

[1]Direct Growth of Graphene on SiO2 Substrate by Thermal & Laser CVDs (oral), Kazuhiko Matsumoto: Workshop on Compuond Semiconductor Devices and Integrated Circuits & Expert Evaluation and Control of Compound Semiconductor Materials and Technologies.

[2]Carbon Nanotube Quantum Nano Memory with Ultra-Low Programing Bias (oral), Kazuhiko Matsumoto: The 6th IEEE International Nanoelectronics Conference.

[3]Graphene Synthesis by Laser-Annealing Technique Using Co Catalyst (oral), : 2014 International Conference on Solid State Devices and Materials.

[4]Graphene Synthesis by Laser-Annealing Technique and Device Aplications (oral), Yusuke Ishibashi, Keisuke Koshida, Yasushi Kanai, Yasuhide Ohno, Kenzo Maehashi, Koichi Inoue, and Kazuhiko Matsumoto: The 6th International Conference on Recent Progress in Graphene Research.

[5]pH Detection Based on Direct Graphene Growth on Si/SiO2 Substrate (oral), Takashi Ikuta, Yasushi Kanai, Yasuhide Ohno, Kenzo Maehashi, Koichi Inoue, and Kazuhiko Matsumoto: The 6th International Conference on Recent Progress in Graphene Research.

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Contribution to I	Research				
K.Matsumoto	AIXTRO	N SE	¥100,000		
Cooperative Res	earch				
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	committee secretary)
T. SEKITANI	Printed Memory and Circuits at SPIE Optics+Photonics 201 5 (Program
	committee)
T. SEKITANI	International Conference on Microelectronic Test Structure (Program committee)

T. SEKITANI	2015 Material	Research Society Spring Meeting (Session organizer)	
Publications in Do	mestic Meeting	s	
LSI and Systems W	orkshop		1 paper
ICD Young Scientist Workshop			
Soft-Error Worksho	р		1 paper
The 95th Annual M	eeting 2015 of C	CSJ	1 paper
ECSJ 81st Spring M	leeting		1 paper
The 62nd JSAP Spr	ing Meeting, 20	15	1 paper
The Japan Society of	of Mechanical E	ngineers	1 paper
Grant-in-Aid for S	cientific Resear	rch	
T.Uemura	Development of	f high-speed operating organic transistors and	¥6,370,000
	fundamental ur	nderstanding for low contact resistance	
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T.Araki	Development of	f Stretchable Conductors with High robustness	¥900,000
T.Sekitani	Organic Analog	g Integrated Circuits for Big-data Ambient Sensors	¥130,000
Entrusted Researc	h		
T.Sekitani	JST	Manufacturing and Evaluation of Bio-harmonized Electronics	¥24,700,000
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Contribution to Re	esearch		
T. Uemura	Hitachi Metals	Materials Science Foundation	¥800,000
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Y. Yagi	The 2014 Int. Conf. on Informatics, Electronics & Vision (ICIEV 2014) (Advisory	
-	Board Member)	
Y. Yagi	2014 IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS 2014)	
-	(Associate Editor)	
Y. Yagi	The 13th European Conf. on Computer Vision (ECCV 2014) (Reviewer)	
Y. Yagi	The 12th Asian Conf. on Computer Vision Workshop (Program Committee)	
Y. Yagi	The 2015 Int. Conf. on Informatics, Electronics & Vision (ICIEV 2015) (Advisory	
-	Board Member)	
Y. Yagi	Information Security and Biometric Authentication 2015 (Program Committee)	
Y. Yagi	The 13th Asian Conf. on Computer Vision (ACCV 2016) (Steering Committee)	
Y. Yagi	2015 IEEE 8th International Workshop on Computational Intelligence and	
-	Applications (IWCIA 2015) (Program Committee)	
Y. Yagi	The 8th IAPR Int. Conf. on Biometrics (ICB 2015) (Program Committee)	
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Y. Yagi	IEEE Int. Conf. on Information and Automation 2015 (Program Committee)		
Y. Yagi	The 7th IEEE Int. Conf. on Biometrics, Applications, and Systems (Program		
	Committee)		
Y. Yagı	2015 IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS 2015)		
X7 X7 ·	(Associate Editor)		
Y. Yagi	The 15th Int. Conf. on Computer Vision (ICCV 2015) (Reviewer)	2014)	
Y. Makihara	The 2/th IEEE Conf. on Computer Vision and Pattern Recognition (CVPR	2014)	
V Malrihana	(Program Commutee Member) The 12th European Conf. on Commuter Vision (ECCV 2014) (Devisioner)		
I. Makillara	The 15th European Colli. on Computer Vision (ECCV 2014) (Reviewer) The 22 nd Int. Conf. on Dettern Pagegration (ICDP 2014) (Technical Program	~	
1. Makillara	Committee Member)	11	
Y. Makihara	The 2nd IEEE/IAPR Int. Joint. Conf. on Biometrics (IJCB 2014) (Reviewe	r)	
Y. Makihara	The 12th Asian Conf. on Computer Vision (ACCV 2014) (Program Commi	ittee	
	Member)		
Y. Makihara	The 12th Asian Conf. on Computer Vision Workshop (Program Co-chair)		
Y. Makihara	The 2014 Pacific-Rim Conf. on Multimedia (PCM 2014) (Program Commi	ttee	
** > * 1 ''	Member)	(017710	
Y. Makihara	2014) (Program Committee Member)	ns (SITIS	
Y. Makihara	The 11th IEEE Conf. on Automatic Face and Gesture Recognition (FG 201	5)	
	(Program Committee Member)	,	
Y. Makihara	The 3rd IAPR Asian Conf. on Pattern Recognition (ACPR 2015) (Program		
	Committee Member)		
Y. Makihara	3D Vision 2014 (3DV 2014) (Reviewer)		
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 Con	nmittee	
	Member)		
Y. Makihara	The 26th British Machine Vision Conf. (BMVC 2015) (Reviewer)		
Y. Makihara	IEICE Trans. on Information and Systems (Associate Editor)		
I. Mitsugami	The 12th Asian Conf. on Computer Vision (ACCV 2014) (Program Commin	ittee	
I Mitangami	The 10th Int. Conf. on Signal Image Technology and Internet based System		
1. Wittsugann	2014) (Program Committee Member)	18 (51115)	
I Mitsugami	The 3rd IAPR Asian Conf. on Pattern Recognition (ACPR 2015) (Program		
1. Wittsugann	Committee Member)		
Publications in Dor	nestic Meetings		
The 17th Meeting or	n Image Recognition and Understanding (MIRU 2014)	12 papers	
IPSJ SIG CVIM: Co	mputer Vision and Image Media	6 papers	
The 4th Symposium	on Biometrics, Recognition and Authentication	3 papers	
IEICE Technical Con	mmittee on Biometrics	2 papers	
The 19th Symposium	n on Sensing via Image Information	1 paper	
The 14th Meeting of	the Japan Society for Precision Engineering Technical Committee on	1 paper	
3D Scanning, Recog	nition, and Modeling of Large Scale Environments		
Symposium on High	resolutoin Terrain Information	1 paper	
Academic Degrees			
PhD Degree for	Shape from Scattering: Shape Estimation Based on Light Transport Anal	ysis in	
Information Science	Translucent Objects		
C. Inoshita		-	
Master Degree for	Disease Detection using Co-occurrence Information in Disease Local Str	ucture of	
Information Science	Capsule Endoscopy Image		
r. Imura			

Master Degree for Information Science T. Okada	Analysis of Gait Motion Changes Derived from Gaze Direction Changes		
Master Degree for	Pedestrian Region Extrac	tion by Matching with Standard Gait M	odels for Gait
Information Science	ce Recognition	, ,	
T. Tanoue	C		
Master Degree for	Estimating Depth of Lay	ered Struture based on Spekle Correlation	on using Blurred
Information Science	ce Images		
T. Matsumura			
Grant-in-Aid for	Scientific Research		
Y. Makihara	High-accuracy gait recogn	nition by fluctuation analysis	¥2,990,000
Y. Makihara	Proposal of Cross-modal	Biometrics	¥1,300,000
Entrusted Resear	ch		
Y. Yagi	Japan Science and Technology Agency	Behavior Understanding based on Intention-Gait Model	¥54,538,000
Y. Yagi	Ministry of Education, Culture, Sports, Science	Human sensing system for criminal investigation	¥6,587,000
	and Technology		
Y. Yagi	Ministry of Education, Culture, Sports, Science	Human sensing system for criminal investigation	¥9,293,000
	and Technology		
Contribution to F	lesearch		
Y. Yagi	Fujitsu Laboratory Ltd., Med	dia Processing Systems Laboratories,	¥500,000
	Director, Shoji Suzuki		
Cooperative Rese	arch		
Y. Yagi	Olympus Co, Ltd., NAIST		¥1,000,000
Y. Yagi	Osaka Prefecture University, Corporation	Wakayama University, Toshiba	¥0,000
Y. Yagi	NICT		¥0,000

Department of Reasoning for Intelligence Original Papers

[1]Bayesian estimation of causal direction in acyclic structural equation models with individual-specific confounder variables and non-Gaussian distributions, S. Shimizu, K. Bollen: Journal of Machine Learning Research, 15 (-) (2014) 2629-2652.

[2]A novel approach to predict toxicity from toxicogenomic data based on class association rule mining, K. Nagata, T. Washio, Y. Kawahara and A. Unami: Toxicology Reports, 1 (-) (2014) 1133-1142.

[3]Application of continuous and structural ARMA modeling for noise analysis of a BWR coupled core and plant instability event, M. Demeshko, A. Dokhane, T. Washio, H. Ferroukhi, Y. Kawahara and C. Aguirre: Annals of Nuclear Energy, 75 (-) (2015) 645-657.

[4]Scatterplot layout for high-dimensional data visulaization, Y. Zheng, H. Suematsu, T. Itoh, R. Fujimaki, S. Morinaga and Y. Kawahara: Journal of Visualization, 18 (1) (2015) 111-119.

[5]An Analysis on Smoothing Effect of PV Distribution by using Measurement Data of Sakai Solar Power Plant, K. Yasunami, T. Washio: IEEJ Transactions on Power and Energy, 134 (10) (2014) 856-865.

[6]Toxicity prediction from toxicogenomic data based on class association rule mining, K. Nagata, T. Washio, Y. Kawahara and A. Unamia: Toxicology Reports, 1 (-) (2014) 1133–1142.

International Conferences

[1]Multi-Task Feature Selection on Multiple Networks via Maximum Flows, M. Sugiyama, C.-A.

Azencott, D. Grimm, Y. Kawahara and K. M. Borgwardt: Proceedings of the 2014 SIAM International Conference on Data Mining, (2014) 199–207.

[2]Efficient Generalized Fused Lasso with Application to the Diagnosis of Alzheimer's Disease, B. Xin, Y. Kawahara, Y. Wang and W. Gao: Proc. of the 28th AAAI Conf. on Artificial Intelligence (AAAI'14), (2014) 2163-2169.

[3]Improving iForest with relative mass, S. Aryal, K. M. Ting, J. Wells and T. Washio: Proc. of PAKDD2014: 18th Pacific-Asia Conference on Knowledge Discovery and Data Mining, Advances in Knowledge Discovery and Data Mining, Lecture Notes in Computer Science, 8444 (2014) 510-521.

[4]mp-dissimilarity: A data dependent dissimilarity measure, S. Aryal, K. M. Ting, G. Haffari and T. Washio: Proc. of ICDM2014:IEEE International Conference on Data Mining 2014, 1 (2014) DM570.

[5]A non-Gaussian approach for estimating possible causal direction in the presence of latent confounders (invited), S. Shimizu: Conference on Statistics and Causality 2014.

[6]Estimation of causal direction in the presence of latent confounders and linear non-Gaussian structural equation models (invited), S. Shimizu: Causal Modeling and Machine Learning.

[7]A performance comparison of generative and discriminative models in causal and anticausal problems (poster), P. Blöbaum, S. Shimizu and T. Washio: 17th International Conference on Artificial Intelligence and Statistics.

[8]On approximate non-submodular minimization via tree-structured supermodularity (poster), Y. Kawahara, R. Iyer and J. Bilmes: Proc. of NIPS 2014 Workshop on Discrete and Combinatoria.

[9]Outliers on Concept Lattices (oral), M. Sugiyama: Workshop on Data Discretization and Segmentation for Knowledge Discovery.

[10]Detecting Anomalous Subgraphs on Attributed Graphs via Parametric Flow (oral), M. Sugiyama, K. Otaki: Workshop on Graph-based Algorithms for Big Data and its Applications.

[11]Multiple Testing Correction in Graph Mining (invited), M. Sugiyama: Tokyo Workshop on Statistically Sound Data Mining.

Review Papers

Anomaly Detection of Informatical Quantum States by Using Machine Learning, K. Fukui, Artificial Intelligence, The Japanese Society for Artificial Intelligence, 30 (2015), 217-223.

Patents

[1]K20110229 Discrimanative-model learning device, discriminative-model learning method, and discriminative-model learning program, K20110229

[2]K20110230 Optimal-query generation device, optimal-query extraction method, and discriminative-model learning method, K20110230

[3]K20110251 Device, method, and program for visualization of multi-dimensional data, K20110251

M. SUGIYAMA	The 25th European Conference on Machine Learning and 18th Principles and		
	Practice of Knowledge Discovery in Databases (Program Committee)		
M. SUGIYAMA	The 6th Asian Conference on Machine Learning (Program Committee)		
T. WASHIO	Neural Information Processing Systems Foundation 2014 (NIPS 2014) (Program		

	Committee)	
T. WASHIO	The European Conference on Machine Learning and Principles and Practice	of
	Knowledge Discovery in Databases (ECML/PKDD 2015) (Journal Track Gu	iest
TWACINO	Editor)	(The in)
T. WASHIO	The 10th Desifie Asia Conference on Knowledge Discovery and Deta Mining	Chair)
I. WASHIO	(DA KDD2015) (Dublicity Choir)	lg 2013
T WASHIO	ACM SIG-KDD'15: The 21st ACM SIGKDD Conference on Knowledge Di	scovery
I. WASHIO	and Data Mining (Program Committee)	scovery
T. WASHIO	The 19th Pacific-Asia Conference on Knowledge Discovery and Data Minin	Ig
	(PAKDD2014) (Senior Program Committee Member)	0
T. WASHIO	The 2015 SIAM Data Mining Conference (SDM 2015) (Program Committee	e)
T. WASHIO	IEEE International Conference on Data Mining 2015 (ICDM2015) (Program	1
	Committee)	
T. WASHIO	Society for Industrial and Applied Mathematics, Division of Data Mining an	d
	Analytics, Society for Industrial and Applied Mathematics (Program Director	or)
T. WASHIO	DS-2014: the Seventeenth International Conference on Discovery Science (I	Program
	Committee)	
T. WASHIO	JSAI International Symposia on AI(JSAI-isAI 2014) (Advisory Board Mem	oer)
T. WASHIO	ACM SIGKDD'14: The 20th ACM SIGKDD Conference on Knowledge Dis	scovery
TWACHIO	and Data Mining (Program Committee)	
I. WASHIO	ECML/PKDD 2014: The European Conference on Machine Learning and P	rincipies
TWASHIO	The Second IEEE ICDM (IEEE International Conference on Data Mining)	.ee)
I. WASHIO	Workshop on Causal Discovery (CD 2014) (Organizing Committee Member	•)
T WASHIO	Editorial Board of Artificial Intelligence Encyclopedia Japanese Society of)
1. WASHIO	Artificial Intelligence (Editorial Board Member)	
T. WASHIO	Annual Conference of the Japanese Society for Artificial Intelligence (Progr	am
	Chair)	
Y. KAWAHARA	Workshop on Graph-based Algorithms for Big Data and its Applications (Pro	ogram
	Co-Chair)	U
Y. KAWAHARA	The 6th Asian Conference on Machine Learning (Program Committee)	
Y. KAWAHARA	The 17th International Conference on Artificial Intelligence and Statistics (P	rogram
	Committee)	
Y. KAWAHARA	The 23rd International World Wide Web Conference (Program Committee)	
Y. KAWAHARA	2014 SIAM International Conference on Data Mining (Program Committee)	1
Publications in Don	nestic Meetings	_
The 28th Annual Con	interence of the Japanese Society for Artificial Intelligence	5 papers
The 95th Workshop	of Special Interest Group on Fundamental Problems of Artificial	I paper
Intelligence	of Special Interest Crown on Eurodemontal Drahlams of Artificial	1
Intelligence	or special interest Group on Fundamental Problems of Artificial	i paper
Workshop of the Coo	peration with Mathematics Program on Probabilistic Graphical	1 nanor
Models	peration with Matternatics (Togram on Trobabilistic Graphical	i papei
The 28th Annual Co	aference of the Japan Society of Artificial Intelligence	3 papers
Devision Meeting of	Electric Power and Energy. The Institute of Electric Engineers	1 papers
of Japan	Zierane i over and Ziergy, ine institute of Zierane Zinghieris	r puper
18th Academic Meet	ing of The Japanese Heart Failure Society	1 paper
Academic Degrees		1 1
Master Degree for	A Bayesian estimation approach to analyze non-Gaussian data-generating	
Engineering	processes with latent classes	
N. Tanaka		
Bacheler Degree for	Portfolio selection based on change-point detection and sparse estimation	
Engineering		

A. Oka Bacheler Degree fo Engineering Y. Baba	r Fast frequent itemset mit	ning using sampling	
Grant-in-Aid for S	Scientific Research		
T. Washio	Development and Applicati	on of Statistical Estimation/Simulation	¥13,520,000
	Principle for Super High Di	imensional Data Space	
T. Washio	Model Mining: Study on Se	earch and Enumeration of Local	¥2,080,000
	Models from Super High D	imensional Large Data	
S. Shimizu	Causal structure learning fr	om multiple high-dimensional datasets	¥650,000
	and its application to life sc	tiences	
Y. Kawahara	Combinatorial approach to	sparse modeling and optimization	¥2,210,000
Y. Kawahara	Hardware-friendly machine	e learning by integer-parameter	¥1,430,000
	regularized learning based	on discrete convexity	
Y. Kawahara	Machine learning based on	discrete convex analysis and its	¥4,810,000
	applications		
M. Sugiyama	Development of methods to	o find statistically significant	¥1,300,000
	substructures from graph da	ata	
Entrusted Researc	ch .		
T. Washio	Fujitsu Laboratories	Study on Technical Basis for Data Analysis	¥2,000,000
T. Washio	National Cerebral and	Clinical study using multiple	¥50,000
	Cardiovascular Center	institutes on mathematical	
		formulation	
T. Washio	National Cerebral and	Development of a prediction model	¥500,000
	Cardiovascular Center	of heart failure rehospitalization	
		for chronic heart failure patients and	
		the standardization of their therapy	
M. Sugiyama	Japan Science and	Scalable Technologies for Finding	¥4,875,000
	Technology Agency	Significant Patterns	
Cooperative Resea	arch	-	
T. Washio	Japan Science and Techno	ology Agency	¥1,032,000
Y. Kawahara	Honda R&D Co.,Ltd		¥2,000,000
Y. Kawahara	Mizuno Corporation Univ	versity of Tsukuba	¥300,000
Y. Kawahara	Nippon Telegraph and Te	lephone Corporation	¥0,000

Department of Knowledge Science Original Papers

[1]An ontological modeling approach for abnormal states and its application in the medical domain, Y. Yamagata, K. Kozaki, T. Imai, K. Ohe and R.Mizoguchi: J. of Biomed Sem, 5 (1) (2014) 14pages.

[2]Publishing Linked Open Data from a Disease Ontology toward a Knowledge Infrastructure, K. Kozaki, Y. Yamagata, T. Imai, K. Ohe and R.Mizoguchi: Transactions of the Japanese Society for Artificial Intelligence, 29 (4) (2014) 396-405.

[3]A Surface-Similarity-Based Solver of Comprehension Questions Referring to Underlined Passages in Contemporary Japanese of the National Center Test, S. Satou, H. Kanou, S. Nishimura and K. Komatani: Journal of Natural Language Processing, 21 (3) (2014) 465-483.

[4]Surface-Similarity Based Textual Entailment Recognition for Japanese Text, S. Hatori, S. Satou and K. Komatani: Transactions of the Japanese Society for Artificial Intelligence, 29 (4) (2014) 416-426.

[5]Development of Abnormality Ontology in Diseases, Y. Yamagata, K. Kozaki, T. Imai, K. Ohe and R.Mizoguchi: Japan Journal of Medical Informatics, 34 (3) (2014) 101-117.

[6]Technical Artifacts: An Integrated Perspective, S. Borgo, M. Franssen, P. Garbacz, Y. Kitamura, R. Mizoguchi and P. E. Vermaas: J. of Applied Ontology, 9 (3-4) (2014) 217-235.

[7]Development of CHARM Pad: a Multi-viewpoint Knowledge Browsing System Towards Goal-oriented Learning of Nursing Actions and its Practical Use in Training of Novice Nurses, S. Nishimura, M. Sasajima, Y. Kitamura, A. Nakamura, H. Takahashi, A. Hirao, K. Hatori and R. Mizogushi: Transactions of the Japanese Society for Artificial Intelligence, 30 (1) (2015) 22-36.

International Conferences

[1]Systematic Description of Nursing Actions Based on Goal Realization Model, S. Nishimura, Y. Kitamura (oral), M. Sasajima and R. Mizoguchi: Proc. of 15th European Conf. on Knowledge Management (ECKM 2014), (2014) 730-739.

[2]Detecting Incorrectly-Segmented Utterances for Posteriori Restoration of Turn-Taking and ASR Results (oral), N. Hotta, K. Komatani, S. Sato, M. Nakano: Proc. of 15th Annual Conference of the International Speech Communication Association (Interspeech 2014), (2014) 313-317.

[3]Towards the Integration of Abnormality in Diseases (oral), Y. Yamagata, K. Kozaki and R. Mizoguchi: Proc. of 5th International Conference on Biomedical Ontology (ICBO 2014), (2014) 7-12.

[4]An Intelligent SPARQL Query Builder for Exploration of Various Life-science Databases (oral), A. Yamaguchi, K. Kozaki, K. Lenz, H. Wu and N. Kobayashi: Proc. of 3rd Intelligent Exploration of Semantic Data (IESD2014), (2014) 12pages.

[5]A Keyword Exploration for Retrieval from Biomimetics Databases (oral), K. Kozaki and R. Mizoguchi: Proc. of 4th Joint International Semantic Technology (JIST2014), (2014) 361-377.

[6]Choosing Related Concepts for Intelligent Exploration (oral), K. Kozaki: Proc. of 4th Joint International Semantic Technology (JIST2014), (2014) 378-386.

[7]An Information Literacy Ontology and its Use for Guidance Plan Design -An Example on Problem Solving- (oral), K. Kozaki, H. Kanoh, T. Hishida and M. Hasegawa: Proc. of 4th Joint International Semantic Technology (JIST2014), (2014) 469-472.

[8]Boundary Contraction Training for Acoustic Models based on Discrete Deep Neural Networks (poster), R. Takeda, N. Kanda and N. Nukaga: Proc. of 15th Annual Conference of the International Speech Communication Association (Interspeech 2014), (2014) 1063-1067.

[9]An Ontology Explorer for Biomimetics Database (poster), K. Kozaki, R.Mizoguchi: Poster and Demo Notes of 13th International Semantic Web Conference (ISWC2014), (2014).

[10]Ontology Building and its Application using Hozo (invited), K. Kozaki: 4th Joint International Semantic Technology (JIST2014), (2014).

Books

[1]Dialogue Systems (M. Okumura Ed.) M.Nakano, K.Komatani, K.Funakoshi and Y.Nakano, , CORONA PUBLISHING CO.,LTD., (296 pages) 2015 .

V VOMATANI	Special Interest Group on Discourse and Dialogue (SIGdial) (Scientific Advisory
K. KUMAIAM	Committee (Board) member)
V VOMATANI	The 15th Annual SIGdial Meeting on Discourse and Dialogue (SIGDIAL 2014) (PC
K. KOMATANI	member)

K. KOMATANI	15th Annual Conference of the International Speech Communication Association (Interspeech 2014) (Scientific Review Committee member)		
K. KOMATANI	AAAI Workshop on Machine Learning for Interactive Systems (MLIS'14) member)	(PC	
K. KOMATANI	6th International Workshop on Spoken Dialog Systems, IWSDS' 2015 (PC 2015 Conference of the North American Chapter of the Association for	member)	
K. KOMATANI	Computational Linguistics - Human Language Technologies (NAACL H (PC member)	LT 2015)	
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 IJCNLP 2015) (PC mem	lber)	
Y. KITAMURA	International Journal of Advanced Engineering Informatics (Editorial board member)	1	
Y. KITAMURA	The 6th International Conference on Design Computing and Cognition (Ac Board member)	lvisory	
Y. KITAMURA	The 4th Joint International Semantic Technology Conference (JIST2014) member)	(PC	
Y. KITAMURA	The 10th International Symposium on Tools and Methods of Competitive Engineering (TMCE 2014) (International Review Panel Member)		
K. KOZAKI	member)	PC	
K. KOZAKI	The International Workshop on Intelligent Exploration of Semantic Data (IESD2014) (Organaizing Committee)		
K. KOZAKI	Journal of Information Processing (Editorial board)		
Publications in Dor	nestic Meetings		
The Japanese Societ	y for Artificial Intelligence	13 papers	
Information Process	ing Society of Japan	6 papers	
The Association for	Natural Language Processing	1 paper	
Academic Degrees			
Bachelor Degree	A Consideration about a Development of Biomimetic Ontology Focus	sed on	
for Engineering T. Torimura	Ways for Function Achievement with its Guideline		
Bachelor Degree for Engineering R. Nakano	Question Generation based on Inter-Word Similarities for Information Acquisition about Unknown Words	on	
Bachelor Degree for Engineering S. Iwamoto	A Development of Dialogic Voice Search System for Public Informatic Local Governments based on a Consideration about	on by	
Master Degree for Engineering T. Masuda	A Development of an Ontology Contents Refinement System based o Consistencies of Concept Definitions among Is-a Hierarchies which a Referring Each Other	n re	
Master Degree for Engineering Y. Kobayashi	An Investigation on Systematized Definition of Vocabulary about Act Information Processing/Emotion and Modeling of their Achievement	ion for Ways	
Doctor Degree for Engineering S. Nishimura	Goal-oriented Action Knowledge Management Framework and its Pra Application in Medical Front	actical	
Grant-in-Aid for Se	cientific Research		
K. Kozaki	Intelligent Exploration of Semantic Data through Domains based on Multi-dimension Viewpoint Management of Ontologies	4,290,000	
M. Sasajima	Hierarchical modeling of the nursing care manual and development ¥ of its browser	3,250,000	
Y. Kitamura	Development of a common modeling framework for functional whole and an integrated modeling tool	3,770,000	

K. Kozaki	Formalizations of Probability, Causality and Risk in Applied		
	Ontology		
Y. Kitamura	Development of a biomimet	ic database	¥1,000,000
K. Kozaki	Development of a biomimet	ic database	¥4,400,000
Y. Kitamura	Development of the next-ge ontological engineering	neration knowledge systems using	¥1,200,000
K. Kozaki	Development of the next-ge ontological engineering	neration knowledge systems using	¥400,000
K. Kozaki	Development of an ontology classification of goals based	of information literacy and on international comparison	¥350,000
T.Sugiyama	Development of Spoken Dialogue System for Robots Considering Social Norms		¥900,000
Entrusted Research	h		
K. Kozaki	The University of Tokyo	Research on Development of a Medical Knowledge Database for Medical Information Systems; Design of a Semantic Relational Model	¥6,500,000
Contribution to Re	esearch		
K.Komatani	Casio Science Promotion Foundation		¥1,000,000
K.Komatani	Honda Research Institute USA, Inc. President Hiroshi Kawagishi		¥3,035,000
Cooperative Resea	rch		
K.Komatani	Honda Research Institute Ja	pan Co., Ltd.	¥2,580,000

Department of Architecture for Intelligence Original Papers

[1]Effects of Individual Health Topic Familiarity on the Activity Pattern during Health Information Searches, I. Puspitasari, K. Moriyama, K. Fukui and M. Numao: JMIR Medical Informatics, 3 (1) (2015) e16.

[2]An Intelligent Fighting Videogame Opponent Adapting to Behavior Patterns of the User, K. Moriyama, S. E. O. Branco, M. Matsumoto, K. Fukui, S. Kurihara and M. Numao: IEICE Transactions on Information and Systems, E97-D (4) (2014) 842-851.

[3]An Analysis of Player Affect Transitions in Survival Horror Games, V. Vachiratamporn and R. Legaspi and K. Moriyama and K. Fukui and M. Numao: Journal on Multimodal User Interfaces, 9 (1) (2015) 43-54.

[4]SIR-Extended Information Diffusion Model of False Rumor and its Prevention Strategy for Twitter, Y. Okada, K. Ikeda, K. Shinoda, F. Toriumi, T. Sakaki, K. Kazama, M. Numao, I. Noda and S. Kurihara: Journal of Advanced Computational Intelligence and Intelligent Informatics, 18 (4) (2014) 598-607.

[5]Discovering Seismic Interactions after the 2011 Tohoku Earthquake by Co-occurring Cluster Mining, K. Fukui, D. Inaba and M. Numao: Transactions of Japanese Society for Artificial Intelligence, 29 (6) (2014) 493-502.

[6]Sidekick: A Tool for Helping Students Manage Behavior in Self-initiated Learning Scenarios, P. S. Inventado, R. Legaspi, K. Moriyama, K. Fukui and M. Numao: International Journal of Distance Education Technologies, 12 (4) (2014) 32-54.

[7]Predicting Research Trends Identified by Research Histories via Breakthrough Researches, N. Yamashita, M. Numao and R. Ichise: IEICE Transactions on Information and Systems, E98-D (2) (2015) 355-362.

International Conferences

[1]Cooperation-Eliciting Prisoner's Dilemma Payoffs for Reinforcement Learning Agents, K. Moriyama, S. Kurihara and M. Numao: Proc. The 13th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2014), (2014) 1619-1620.

[2]Discovery of Damage Patterns in Fuel Cell and Earthquake Occurrence Patterns by Co-occurring Cluster Mining, K. Fukui, D. Inaba and M. Numao: Proc. The 2014 AAAI Workshop for Discovery Informatics, (2014) 19-26.

[3]An Implementation of Affective Adaptation in Survival Horror Games, V. Vachiratamporn, K. Moriyama, K. Fukui and M. Numao: Proc. the 2014 IEEE Conference on Computational Intelligence and Games (CIG 2014), (2014) 263-270.

[4]A First-Order Logic Representation Based Distance Function, N. Khamsemanan, C. Nattee and M. Numao: Proc. 24th International Conference on Inductive Logic Programming, (2014).

[5] Visualizations of First-Order Logic Representation Based Dataset, N. Khamsemanan, C. Nattee and M. Numao: Proc. 24th International Conference on Inductive Logic Programming, (2014).

[6]Fighter or Explorer? – Classifying Player Types in a Japanese-Style Role-Playing Game from Game Metrics, K. Fischer, K. Moriyama, K. Fukui and M. Numao: Proc. Workshop on Computation: Theory and Practice (WCTP-2014), (2014) 55-66.

[7]Learning better strategies with a combination of complementary reinforcement learning algorithms, W. Fujita, K. Moriyama, K. Fukui and M. Numao: Proc. Workshop on Computation: Theory and Practice (WCTP-2014), (2014) 43-54.

[8]Dynamic and Individual Emotion Recognition Based on EEG during Music Listening, N. Thammasan, K. Fukui, K. Moriyama and M. Numao: Proc. Workshop on Computation: Theory and Practice (WCTP-2014), (2014) 87-98.

[9]Predicting Consumer Familiarity with Health Topics by Query formulation and Search Result Interaction, I. Puspitasari, K. Fukui, K. Moriyama and M. Numao: Lecture Notes in Artificial Intelligence, 8862 (2014) 1016-1022.

[10]Symbiotic Evolution to Generate Chord Progression Consisting of Four Parts for a Music Composition System, N. Otani, S. Shirakawa and M. Numao: Lecture Notes in Artificial Intelligence, 8862 (2014) 849-855.

[11]Item-Based Learning for Music Emotion Prediction Using EEG Data, P. Vateekul, N. Thammasan, K. Moriyama, K. Fukui and M. Numao: Proc. 5th International Workshop on Empathic Computing (IWEC'14), (2014).

[12]Design of Populations in Symbiotic Evolution to Generate Chord Progression in Consideration of the Entire Music Structure, N. Otani, S. Shirakawa and M. Numao: Proc. 5th International Workshop on Empathic Computing (IWEC'14), (2014).

[13]Emotion detection from several physiological sensors and its application to music and games (invited), M. Numao: The 2nd International Workshop on Emotional Materials and Components, Seoul, Korea, Sep. 26, 2014.

[14]Detection of Concept Drift on an Adaptive Monitoring System (oral), Y. Sakamoto, K. Fukui, D. Nicklas, K. Moriyama and M. Numao: Workshop on Computation: Theory and Practice (WCTP-2014), Manila, Philippines, Oct. 6-7, 2014.

Review Papers

Mining Co-occurrences from Event Sequence Data -Extracting Damage Pattern in Fuel Cell and Occurrence Patternin Earthquakes-, K. Fukui and M. Numao, Journal of the Japanese Society for Artificial Intelligence, The Japanese Society for Artificial Intelligence, 30[2] (2014), 238-246.

Books

[1]Predictability Analysis of Aperiodic and Periodic Model for Long-Term Human Mobility Using Ambient Sensors(M. Atzmueller, A. Chin, C. Scholz, and C. Trattner) D. Sodkomkham, R. Legaspi, K. Fukui, K. Moriyama, S. Kurihara and M. Numao, "Mining, Modeling, and Recommending 'Things' in Social Media (LNCS)", Springer, 8940 (131-149) 2015.

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-Ch	nair)	
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 (Internat	ional	
	Editorial Review Board Member)		
K. MORIYAMA	IEEE Computational Intelligence Society, the Adaptive Dynamic Programm	ning and	
	Reinforcement Learning Technical Committee (ADPRLTC) (Member)	-	
K. FUKUI	IPSJ Journal of Information Processing (Editorial Member)		
K. FUKUI	I Workshop on Computation: Theory and Practice (WCTP-2014) (Program		
	Committee Member)		
Publications in Do	mestic Meetings		
Annual Conference	of the Japan Society of Artificial Intelligence	6 papers	
SIG Mathmatical M	odeling and Problem Solving, Information Processing Society of	2 papers	
Japan			
SIG Knowledge-Ba	se Ssytem, the Japan Society of Artificial Intelligence	1 paper	
Intelligent System S	symposium, The Society of Instrument and Control Engineers	1 paper	
Academic Degrees			
Master Degree	Cluster Sequence Mining:Sequential Pattern Mining for Numerical Event Security	equence	
for Information			
Science			
Y. Okada			
Master Degree	A Validation of Data-Distribution-Independent Concept Drift Detection Met	hod	
for Information	Under Unsupervised Learning		
Science			
Y. Sakamoto			
Master Degree	Dynamic and Individual Emotion Recognition Based on EEG during Music		
for Information	Listening		
Science			
N. Thammasan			
Grant-in-Aid for S	cientific Research		

Cooperative Re	search	
K. Fukui	Co-occurring Cluster Mining and its Environmental Contribution	¥1,300,000
	and Its Application to Sensor Network	
M. Numao	Distributed Inference to Support Inter-Subjective Formalization	¥1,300,000

Department of Quantum Functional Materials Original Papers

[1]Robust protection from backscattering in the topological insulator Bi_{1.5}Sb_{0.5}Te_{1.7}Se_{1.3}, Sunghun Kim, Shunsuke Yoshizawa, Yukiaki Ishida, Kazuma Eto, Kouji Segawa, Yoichi Ando, Shik Shin, and Fumio Komori: Phys. Rev. Lett., 112 (13) (2014) 136802/1-5.

[2]Top gating of epitaxial $(Bi_{1-x}Sb_x)_2Te_3$ Topological insulator thin films, Fan Yang, A. A. Taskin, Satoshi Sasaki, Kouji Segawa, Yasuhide Ohno, Kazuhiko Matsumoto, and Yoichi Ando: Appl. Phys. Lett., 104 (16) (2014) 161614/1-5.

[3]Infrared pseudogap in cuprate and pnictide high-temperature superconductors, S. J. Moon, Y. S. Lee, A. A. Schafgans, A. V. Chubukov, S. Kasahara, T. Shibauchi, T. Terashima, Y. Matsuda, M. A. Tanatar, R. Prozorov, A. Thaler, P. C. Canfield, S. L. Bud'ko, A. S. Sefat, D. Mandrus, K. Segawa, Y. Ando, and D. N. Basov: Phys. Rev. B, 90 (1) (2014) 014503/1-16.

[4]Doping-dependent charge dynamics in Cu_xBi₂Se₃, Luke J. Sandilands, Anjan A. Reijnders, Markus Kriener, Kouji Segawa, Satoshi Sasaki, Yoichi Ando, and Kenneth S. Burch: Phys. Rev. B, 90 (9) (2014) 094503/1-6.

[5]Pb₅Bi₂₄Se₄₁: A New Member of the Homologous Series Forming Topological Insulator Heterostructures, Kouji Segawa, A. A. Taskin, and Yoichi Ando: J. Solid State Chem., 221 (2014) 196-201.

[6]Electrical Detection of the Spin Polarization Due to Charge Flow in the Surface State of the Topological Insulator Bi_{1.5}Sb_{0.5}Te_{1.7}Se_{1.3}, Yuichiro Ando, Takahiro Hamasaki, Takayuki Kurokawa, Kouki Ichiba, Fan Yang, Mario Novak, Satoshi Sasaki, Kouji Segawa, Yoichi Ando, and Masashi Shiraishi: Nano Lett., 14 (11) (2014) 6226-6230.

[7]Spin-Electricity Conversion Induced by Spin Injection into Topological Insulators, Y. Shiomi, K. Nomura, Y. Kajiwara, K. Eto, M. Novak, Kouji Segawa, Yoichi Ando, and E. Saitoh: Phys. Rev. Lett., 113 (19) (2014) 196601/1-5.

[8]Superconductor derived from a topological insulator heterostructure, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Phys. Rev. B, 90 (22) (2014) 220504(R)/1-5.

[9]Scanning tunneling spectroscopy study of quasiparticle interference on the dual topological insulator Bi_{1-x}Sb_x, Shunsuke Yoshizawa, Fumitaka Nakamura, Alexey A. Taskin, Takushi Iimori, Kan Nakatsuji, Iwao Matsuda, Yoichi Ando, and Fumio Komori: Phys. Rev. B, 91 (4) (2015) 045423/1-6.

[10]Large linear magnetoresistance in the Dirac semimetal TlBiSSe, Mario Novak, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Phys. Rev. B, 91 (4) (2015) 041203(R)/1-4.

[11]Topological Crystalline Insulators and Topological Superconductors: From Concepts to Materials, Yoichi Ando and Liang Fu: Annu. Rev. Condens. Matter Phys., 6 (2015) 361-381.

[12]Ultrafast carrier relaxation through Auger recombination in the topological insulator Bi_{1.5}Sb_{0.5}Te_{1.7}Se_{1.3}, Yoshito Onishi, Zhi Ren, Kouji Segawa, Wawrzyniec Kaszub, Macieg Lorenc, Yoichi Ando, and Koichiro Tanaka: Phys. Rev. B, 91 (8) (2015) 085306/1-12.

[13]Topological proximity effect in a topological insulator hybrid, T. Shoman, A. Takayama, T. Sato, S. Souma, T. Takahashi, T. Oguchi, Kouji Segawa, and Yoichi Ando: Nature Communications, 6 (2015) 6547/1-6.

International Conferences

[1]Topological Insulators and Superconductors (invited), Y. Ando: OIST International Workshop on Novel Quantum Materials and Phases (NQMP2014).

[2]Topological Insulators and Superconductors (invited), Y. Ando: New Trends in Topological Inslators (NTTI) 2014.

[3]Progress toward Topological Insulator Devices (invited), Y. Ando: 32nd International Conference on the Physics of Semiconductors (ICPS 2014).

[4]Topological Insulators and Superconductors (invited), Y. Ando: Workshop on Novel Quantum States in Condensed Matter (NQS2014).

[5]Topological Superconductivity Based on Topological Insulators (invited), Y. Ando: International Conference on Topological Quantum Phenomena (TQP2014).

[6]Experimental Research on Topological Insulators (invited), K. Segawa: International Conference on Topological Quantum Phenomena (TQP2014).

[7]Superconducting $Sn_{1-x}In_x$ Te Nanoplates (poster), S. Sasaki and Y. Ando: International Conference on Topological Quantum Phenomena (TQP2014).

[8]Highly Gate-tunable Topological-Inslator Devices (poster), F. Yang, A. A. Taskin, S. Sasaki, K. Segawa, Y. Ohno, K. Matsumoto, Y. Ando: International Conference on Topological Quantum Phenomena (TQP2014).

[9]Electrical injection and extraction of spin polarized current through a ferromagnetic metal / topological insulator interface (poster), Y. Ando, T. Hamasaki, F. Yang, M. Novak, S. Sasaki, K. Segawa, Y. Ando, M. Shiraishi: International Conference on Topological Quantum Phenomena (TQP2014).

[10]Manipulation of topological states in a topological-insulator heterostructure (poster), T. Sato, K. Nakayama, Y. Tanaka, S. Souma, T. Takahashi, K. Eto, S. Sasaki, K. Segawa, and Y. Ando: International Conference on Topological Quantum Phenomena (TQP2014).

[11]Efficient Dual-Gate Tuning of Fermi Level in Thin-Film Topological Insulator (oral), A. Taskin, Fan Yang, Satoshi Sasaki, Kouji Segawa, Yasuhide Ohno, Kazuhiko Matsumoto, Yoichi Ando: APS March Meeting 2015.

[12]Manipulation of topological states in a topological-insulator heterostructure (oral), Yusuke Tanaka, Kosuke Nakayama, Takafumi Sato, Seigo Souma, Takashi Takahashi, Kazuma Eto, Satoshi Sasaki, Kouji Segawa, Yoichi Ando: APS March Meeting 2015.

Review Papers

Topological Superconductors, Yoichi Ando, Parity, Maruzen, 30 (2015), 16-17.

Books

[1]Introduction to Topological Insulators Yoichi Ando, "Introduction to Topological Insulators", Kodansha, (1-236) 2014.

Y. Ando	International Conference on Topological Quantum Phenomena (TQP2014)	
	(Organizing Committee)	
Publications in	Domestic Meetings	
Fall Meeting of	the Physical Society of Japan 2014	9 papers
The 70th Annua	al Meeting of the Physical Society of Japan	3 papers

Academic Degre	es		
Master Degree	Growth and characterizations of high-quality single crystals of chalcogenide		
for Science	topological materials		
Ryota Sato			
Master Degree	Growth of Topological Crystalline Insulator SnTe by Molecular B	eam Epitaxy	
for Science			
Sei Rai			
Grant-in-Aid for	r Scientific Research		
Y.Ando	Explorations of Novel Quantum Phenomena in Topological	¥25,740,000	
	Insulators and Superconductors		
K.Segawa	Precise Control of Physical Properties of Topological	¥1,040,000	
	Insulators/Superconductors with Electrochemical Technique		
Contribution to	Research		
S.Sasaki	The Murata Science Foundation	¥1,238,000	

Department of Semiconductor Materials and Processes Original Papers

[1]FT IR spectroscopy of nitric acid oxidation of silicon with hafnium oxide very thin layer, M. Kopani, M. Mikula, E. Pinčík, H. Kobayashi, M. Takahashi: Appl. Surf. Sci., 301 (2014) 24-27.

[2]Properties of HfO2/ultrathin SiO2/Si structures and their comparison with Si MOS structures passivated in KCN solution, E. Pinčík, H. Kobayashi, T. Matsumoto, M. Takahashi, M. Milan, R. Brunner: Appl. Surf. Sci., 301 (2014) 34-39.

[3]Multifractal analysis of textured silicon surfaces, S. Jurecka, H. Angermann, H. Kobayashi, M. Takahashi, E. Pinčík: Appl. Surf. Sci., 301 (2014) 46-50.

[4]Improvement of minority carrier lifetime and Si solar cell characteristics by nitric acid oxidation method, F. Shibata, D. Ishibashi, S. Ogawara, T. Matsumoto, C.-H. Kim, H. Kobayashi: ECS J. Solid State Sci. Technol., 3 (2014) Q137-Q141.

[5]Hydrogen effect on nanostructural features of nanocrystalline silicon thin films deposited at 200°C by PECVD, D. Yano, M. Murayama, H. Kobayashi, K. Yamanaka: Solid State Phenom., 219 (2014) 221-224.

[6]Nitric acid oxidation of Si method for improvement of crystalline Si solar cell characteristics by surface passivation effect, M. Maeda, K. Imamura, T. Matsumoto, H. Kobayashi: Appl. Surf. Sci., 312 (2014) 39-42.

[7]Si nanoparticles fabricated from Si swarf by photochemical method, T. Matsumoto, R. Hirose, F. Shibata, D. Ishibashi, S. Ogawara, H. Kobayashi: Sol. Energ. Mat. Sol. C., 134 (2015) 298-304.

[8]Ultra-low power poly-Si TFTs with 10 nm stacked gate oxide fabricated by nitric acid oxidation of silicon (NAOS) method, T. Matsumoto, H. Tsuji, S. Terakawa, H. Kobayashi: ECS J. Solid State Sci. Technol., 4 (2015) N36-N40.

International Conferences

[1]Improvement in conversion efficiencies of crystalline Si solar cells by surface technologies (invited), H. Kobayashi: European Conference on Surface Science (ECOSS) 30.

[2]Fabrication of Si nanoparticles from Si swarf and the application to hydrogen generation source (poster), T. Matsumoto, M. Maeda, T. Akai, S. Imai, H. Kobayashi: International Symposium on Small Particles and Inorganic Clusters (ISPIC) XVII.

[3]Photoluminescence properties of Si nanoparticles fabricated from Si swarf: fluorescence enhancement by organic molecules (poster), H. Kobayashi: International Symposium on Small Particles and Inorganic Clusters (ISPIC) XVII.

[4]Surface modification technologies for improvement of crystalline Si solar cell efficiencies (invited), H. Kobayashi, T. Matsumoto, K. Imamura: 7th Vacuum and Surface Sciences Conference of Asia and Australia.

[5]Developments of crystalline Si solar cells using chemical methods (invited), H. Kobayashi: Tunisia-Japan symposium, R&D on Energy and Materials Sciences for Sustainable Society.

[6]Fabrication of luminescent Si nanoparticles from Si swarf and fluorescence enhancement of adsorbed molecules (poster), M. Maeda, T. Matsumoto, H. Kobayashi: KANSAI Nanoscience and Nanotechnology, Handai Nanoscience and Nanotechnology International Symposium.

[7]Hydrogen generation from Si nanoparticles fabricated from Si swarf (poster), K. Kimura, M. Takahashi, T. Matsumoto, Y. Kanatani, T. Higo, H. Kobayashi: KANSAI Nanoscience and Nanotechnology, Handai Nanoscience and Nanotechnology International Symposium.

[8]Ultralow reflectivity surfaces by formation of nanocrystalline Si layer for crystalline Si solar cells and achievement of high efficiency (poster), M. Maeda, T. Matsumoto, H. Kobayashi: KANSAI Nanoscience and Nanotechnology, Handai Nanoscience and Nanotechnology International Symposium.

[9]High aspect ratio Si micro-holes formed by wet etching using Pt needles (poster), T. Akai, K. Imamura, H. Kobayashi: KANSAI Nanoscience and Nanotechnology, Handai Nanoscience and Nanotechnology International Symposium.

[10]New chemical methods for improvement of conversion efficiency of crystalline Si solar cells (invited), H. Kobayashi: The 16th international symposium on eco-materials processing and design.

[11]New chemical methods to form Si nanocrystals for applications to Si Solar cells, Light emitting materials, and... (poster), K. Imamura, T. Matsumoto, H. Kobayashi: Opto Osaka.

Patents

[1]K20140097 Solar cells and their manufacturing method of same, and manufacturing apparatus of same, JP2014-173616

[2]K20140096 Semiconductor wafers, semiconductor appartus and manufacturing appatus, and manufacturing method of same, JP2014-173617

[3]K20140098 Si wafers, solar cells and their manufacturing method of same, JP2014-173618

[4]K20140184 Anode materials for lithium ion batteries, lithium ion batteries, manufacturing method and apparatus of aanode or anode materials for lithium ion batteries, JP2014-207397

[5]K20140222 Silicon wafers, solar cells, manufacturing method of solarcells, and manufacturing apparatus of same, JP2015-029211

[6]K2014o304 Silicon carbide wafer, method of manufacturing flattened silicon carbide wafers, and apparatus of same, JP2015-033475

[7]K20140303 Semiconductor wafers, solar cells, manufacturing method of same, and manufacturing apparatus of same, JP2015-033506

[8]K20140318 Silicon wafers, solar cells and manufacturing method of same, JP2015-033564

[9]K20140319 Hydrogen water, production method of same, and manufacturing apparatus of same, JP2015-033643

[10]K20140003 Anode materials for lithium ion batteries, manufacturing method of same, manufacturing apparatus, and lithium ion batteries, PCT/JP2014/65432

[11]K20130041/K20130324 Hydrogen production apparatus, manufacturing method of same, and manufacturing method of silicon nanoparticles for hydrogen production, PCT/JP2014/72219/WO2015/033815

[12]K20090325 Solar cells and their manufacturing method of same, and manufacturing apparatus, JP-5717743-B2

[13]K20090344 Solar cells and their manufacturing method of same, and manufacturing apparatus, JP-5666552-B2

[14]K20080448 Processing method of semiconductor wafers, manufacturing method of semiconductor apparatus, JP-5633838-B2

[15]K20090325 Semiconductor apparatus, manufacturing method of same, and transfer memberane, JP-5698684-B2

[16]K20100081 Manufacturing apparatus and method of semiconductor appatus, JP-5620996-B2

[17]K20090216 S emiconductor apparatus and manufacturing method of same, US8728941 B2

H. Kobayashi	Applied Surface Scienc	e (Editor)	
H. Kobayashi	European Conference on Surface Science (ECOSS) 30 (International Advisory		
	Committee)		
Publications in Do	mestic Meetings		
Japan Applied Surface Science Meeting		11 papers	
Japan Physics Meeting			2 papers
Academic Degrees			
Master Degree	Application of surface passivation by the nitric acid oxidation of silicon method and		
for Science	back surface fied with a	liminum to crytalline silicon solar cells	
H. Nakajima			
Master Degree	High efficiency and thin single crystalline silicon solar cells with surfaces having		
for Science	ultra-low reflectivity achieved by the surface structure chemical transfer method and		
T. Nonaka	light trapping structures		
Master Degree	Water splitting and rpoduction of hydrogen water with silicon nanoparticles		
for Science			
S. Matsuda			
Grant-in-Aid for S	cientific Research		
H. Kobayashi	Fabrication of Si nanoparticles to silicon	articles from Si swarf and application of Si solar cells	¥650,000
T. Matsumoto	Surface science of highly-doped Si surface for devices in the next ¥1,30 generation		¥1,300,000
K. Imamura	Fabrication of ultrathin poly Si solar cells with high light trapping¥2,340,000effect using the surface strcture chemical transfer method		
Entrusted Researc	h		
H. Kobayashi	Japan Science and	Fabrication of silicon surface with	¥72,501,000

1	Fechnology Agency	ultra-low reflectivity with the interface control method and development of crystalline silicon solar cells with ultra-high efficiency	
Cooperative Researc	ch		
H. Kobayashi	IDEC Corp.		¥1,928,000
H. kobayashi	Nisshin Kasei Co. Ltd.		¥0,000

Department of Metallic Materials Process

Original Papers

[1]Diffusion of oxygen in amorphous Al₂O₃, Ta₂O₅, and Nb₂O₅, R. Nakamura, T. Toda, S. Tsukui, M. Tane, M. Ishimaru, T. Suzuki, H. Nakajima: J. Appl. Phys., 116 (2014) 033504.

[2]Effect of Crystallographic Texture on Mechanical Properties in Porous Magnesium with Oriented Cylindrical Pores, M. Tane, T. Mayama, A. Oda, H. Nakajima: Acta Mater., 84 (2015) 80–94.

[3]Crystallographic nature of deformation bands shown in Zn and Mg-based long-period stacking ordered (LPSO) phase, K. Hagihara, M. Yamasaki, M. Honnami, H. Izuno, M. Tane, T. Nakano, Y. Kawamura: Philos. Mag., 95 (2015) 132–157.

[4]Effect of Porphyromonas gingivalis lipopolysaccharide on bone marrow mesenchymal stem cell osteogenesis on a titanium nanosurface, H. Xing, Y. Taguchi, S. Komasa, I. Yamawaki, T. Sekino, M. Umeda, and J. Okazaki: J. Periodontol., 86 (34) (2015) 448-455.

[5]Er3+ loaded barium molybdate nanoparticles: IR to visible spectral upconversion, R. Adhikari, B. Joshi, R. Narro-García, E. De La Rosa, T. Sekino, and S.W. Lee: Mater. Lett., 142 (2015) 7-10.

[6]Application of Titanium Dioxide Nanotubes to Tooth Whitening, Obito Komatsu, Hisataka Nishida, Tohru Sekino, and Kazuyo Yamamoto: Nano Biomed., 6 (2) (2014) 63-72.

[7]Creation and Multifunction of Low-dimensional Nanostructured Titania via Solution Chemical Reaction Field Control, T. Sekino, S.-I. Tanaka: Materia Japan, 53 (11) (2014) 546-549.

[8]EDTA mediated microwave hydrothermal synthesis of WO3 hierarchical structure and its photoactivity under simulated solar light, R. Adhikari, G. Gyawali, T.H. Kim, T. Sekino, and S.W. Lee: J. Environ. Chem. Eng., 2 (3) (2014) 1365-1370.

[9]Understanding the infrared to visible upconversion luminescence properties of Er3+/Yb3+ co-doped BaMoO4 nanocrystals, R. Adhikari, J. Choi, R. Narro-García, E. De La Rosa, T. Sekino, and S.W. Lee: J. Sol. State Chem., 216 (2014) 36-41.

[10]Electrospray deposition and characterization of Cu2O thin films with ring-shaped 2-D network structure, H. Itoh, Y. Suzuki, T. Sekino, J.-C. Valmalette, and S. Tohno: J. Ceram. Soc. Japan, 122 (1425) (2014) 361-366.

[11]Effect of Nanosheet Surface Structure of Titanium Alloys on Cell Differentiation, Satoshi Komasa, Tetsuji Kusumoto, Yoichiro Taguchi, Hiroshi Nishizaki, Tohru Sekino, Makoto Umeda, Joji Okazaki, and Takayoshi Kawazoe: J. Nanomater., 2014 (2014) Article ID 642527 (11 pages).

[12]Osteogenic activity of titanium surfaces with nanonetwork structures, Helin Xing, Satoshi Komasa, Yoichiro Taguchi, Tohru Sekino, and Joji Okazaki: Int. J. Nanomed., 9 (2014) 1741-1755.

[13]Shear bond strength of veneering porcelain to porous zirconia, T. Nakamura, T. Sugano, H. Usami, K. Wakabayashi, H. Ohnishi, T. Sekino, and H. Yatani: Dental Materials Journal, 33 (2) (2014) 220-225.

[14]Effects of trace elements in fish bones on crystal characteristics of hydroxyapatite obtained by calcination, T. Goto, K. Sasaki: Ceram. Int., 40 (2014) 10777-10785.

[15]Immobilization of Sr2+ on naturally derived hydroxyapatite by calcination of different species of fish bones and influence of calcination on ion-exchange efficiency, K. Sasaki, T. Goto: Ceram. Int., 40 (2014) 11649-11656.

[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 (2) (2015) 257-262.

International Conferences

[1]Elastic properties of Mg-Zn-Y alloys with a long-period stacking ordered structure (oral), M. Tane, Y. Nagai, H. Kimizuka, K. Hagihara, Y. Kawamura: International Symposium on Long-Period Stacking Ordered Structure and Its Related Materials 2014.

[2]Deformation behavior of the synchronized LPSO phases accompanied by the formation of deformation bands (oral), K. Hagihara, M. Honnami, T. Okamoto, M. Yamasaki, H. Izuno, M. Tane, T. Nakano, Y. Kawamura: International Symposium on Long-Period Stacking Ordered Structure and Its Related Materials 2014.

[3]Effect of enrichment of Zn and Y atoms on elastic properties of a Mg–Zn–Y alloy: analyses by inverse Voigt-Reuss-Hill approximation and micromechanics modeling (poster), M. Tane, Y. Nagai, H. Kimizuka, K. Hagihara, Y. Kawamura: The 18th SANKEN International Symposium 2014.

[4]Structure Tuning of Titania Nanotubes for Physical-photochemical Multi-functionalization (invited), T. Sekino: TMS2015 144th Annual Meeting & Exhibition, Orlando, FL, USA, March 15-19, 2015.

[5]Materials Tuning of Titania Nanotubes and their Energy Applications (invited), T. Sekino: Materials Challenges in Alternative & Renewable Energy (MCARE 2015), Jeju, Korea, February 24-27, 2015.

[6]Enhanced Spinodal Phase Separation of SnO2-TiO2 Ceramics by Iron Doping and their Electrical Properties (invited), T. Sekino, T. Kusunose, and S.-I. Tanaka: The 39th Intl. Conf. on Adv. Ceram. and Exposition (ICACC'15), Daytona Beach, FL, USA, January 25-30 2015.

[7]Synthesis of Electrical Conductive Organic and Organic/Inorganic Nanoparticles and Their Application to Nanohybrid Pressure Sensors (oral), Tohru Sekino, and Youn-Gyu Han: The 16th International Symposium on Eco-materials Processing and Design (ISEPD2015), Kathmandu, Nepal, January 12-15, 2015.

[8]Structure Tuning of Titania Nanotubes for Solar Energy Conversion (invited), T. Sekino: International Conference on Sustainable Energy Technology, Coimbatore, India, December 11-13, 2014.

[9]Structure Tuning of Titania Nanotubes for Physical-photochemical Multi-functionalization (oral), T. Sekino: Nanomaterials Workshop in IGCAR, December 12-13, 2014, Kalpakkam, India.

[10]Modification of Titania Nanotubes by Metal-doping and their Physico- and Photo-chemical Functions (poster), Hisataka Nishida, Hiroaki Sugiyama, Shun-Ichiro Tanaka, and Tohru Sekino: The 18th SANKEN International Symposium, Osaka, Japan, December 10-11, 2014.

[11]Nanoscale Hybridization of Oxide Nanotubes for Multi-functionalization (plenary), T. Sekino: The3rd International Symposium on Hybrid Materials and Processing, Busan, Korea, November 10-13, 2014.[12]Photophysical-chemial Multifunctionalization of Low-dimensional Oxides Nanostructures via

Advanced Fusional Structure Control (poster), T. Sekino, H. Nishida, and K. Kuremoto: The 2nd International Symposium on Fusion Materials, November 2 – 4, 2014, Takeda Hall, University of Tokyo, JAPAN.

[13]Hetero-structure Formation and Properties of SnO2-TiO2 Ceramic Composites via Spinodal Phase Separation (invited), T. Sekino, S.-I. Tanaka, and T. Kusunose: The 3rd International Conference on Competitive Materials and Technology Processes (IC-CMTP3), Miskolc, Hungary, October 6-11, 2014.

[14]Modofication of Titania Nanotubes by Ru-doping and Their Optical and Physico-chemical Properties (oral), H. Sugiyama, and T. Sekino: The 3rd International Conference on Competitive Materials and Technology Processes (IC-CMTP3), Miskolc, Hungary, October 6-11, 2014.

[15]Direct Formation of Porous Nano-architectures on Ti-based Metal Surfaces by Solution Chemical Processing and Their Biocompatible Functions (invited), Tohru Sekino, Koki Kaga, Hisataka Nishida, Koh-Ichi Kuremoto, and Shun-Ichiro Tanaka: The 15th IUMRS-International Conference in Asia (IUMRS-ICA 2014), Fukuoka, Japan, August 24-30, 2014.

[16]Physico-photochemical and Biocompatible Functions of Low-dimensional Titania-based Nanostructures (oral), T. Sekino: CJK2014 Lanzhou-China Conference, Lanzhou University, Lanzhou, China, August 21-25, 2014.

[17]Materials Tuning of Titania Nanotubes and their Physico-photochemical Multifunctions (plenary), T. Sekino: The 5th International Congress on Ceramics (ICC5), Beijing, China, August 17-21, 2014.

[18]Materials Tuning of Titania Nanotubes for Physicochemical and Photochemical Multifunctionalization (invited), Tohru Sekino, Hiroki Tsukamoto, Hiroaki Sugiyama, Tae-Ho Kim, Soo Wohn Lee, and Shun-Ichiro Tanaka: The 6th International Symposium on Functional Materials (ISFM2014), Singapore, August 4-7, 2014.

[19]Development of Multifunctional Titania Nanotubes for Energy and Environmental Applications (invited), T. Sekino: Energy Material Nanotechnology (EMN) Summer Meeting 2014, Westin Resort & Spa, Cancun, Mexico, June 9-12, 2014.

[20]Monitoring of breath gas using thermoelectric gas sensor (poster), W. Shin, T. Nakashima, T. Goto, T. Itoh, T. Kondo, K. Sato: 8th International Conference on Breath Research & Cancer Diagnosis (Breath'2014).

Books

[1]Low Young's modulus in Ti-Nb-Ta-Zr-O alloys(T. Narushima, T. Nakano) M. Tane, "The Advanced Research of Biomaterials", The Japan Institute of Metals and Materials, (19-20) 2014.

[2]Elastic properties of Ti-Nb-Ta-Zr-O alloy single crystals(T. Narushima, T. Nakano) M. Tane, "The Advanced Research of Biomaterials", The Japan Institute of Metals and Materials, (27-28) 2014.

Patents

[1]K20040225、KP2007023 TITANIUM OXIDE NANOTUBE AND PROCESS FOR PRODUCING THE SAME, JP4868366

[2]K20050461 Zinc Oxide Sintered Material Containing Aluminum and Producing the Same, JP4900569

- T. Sekino International Journal of Applied Ceramic Technology (Associate Editor)
- T. Sekino Journal of the Ceramic Society of Japan (Editorial Board)
- T. Sekino Materials Transactions (Editorial Committee)

T. Sekino	The 6th International Symposium on Functional Materials (ISFM2014) (International Advisory Committee)		
T Sekino	The International Symposium on Advanced Functional Materials (ISAFM	2014)	
1. Dekilo	(International Advisory Committee)	2014)	
T Sekino	The 5th International Congress on Ceramics (ICC5) Symposium: Novel P	rocessing	
1. Senno	Technology (Co-organizer)	rocessing	
T Sekino	CIK2014 Lanzhou-China Conference (Organizing Committee)		
T. Sekino	The 15th IUMRS ICA Symposium C A (Co chair)		
T. Sekino	The 3rd International Conference on Competitive Materials and Technology		
1. SCKIIIO	Processes (IC-CMTP3) (The Organizers)	39	
T Sekino	The 3rd International Symposium on Hybrid Materials and Processing (Hy	vMaP	
1. Sekillo	2014) (International Advisory Committee)	yiviai	
T Sekino	The Keree Japan International Seminar on Coromics (Organizing Committee)		
T. Sekino	The International Symposium on Eco Materials Processing and Design (ISEPD)		
1. SCKIIIO	(Academic Committee/Editorial Committee)	JLI D/	
T Sakina	(Academic Commute: Editorial Commute) Materials Challenges in Alternative and Penewable Energy 2015 (MCAP)	E2015)	
1. SEKIIIO	(International Advisory Committee)	62013)	
T Salino	(International Advisory Commutee))_	
1. Sekillo	Compositos (ICACC) (Sumposium Colorgenizar)	۷	
T Salino	The 11th International Conference on Coronic Materials and Components	for Enormy	
1. Sekillo	and Environmental Applications (11th CMCEE) (Symposium Organizar)	for Energy	
T Calcino	International Conference on Characterization and Control of Interfaces for	ILich	
1. Sekillo	Ovality Advanced Meterials (ICCCI) (Organizing Committee)	nign	
T Calcino	The 14th International Union of Materials Descent Societies International	1	
1. Sekino	The 14th International Union of Materials Research Societies-International		
	Conference on Advanced Materials (IUMRS-ICAM) (Program/Publicatio	n	
T. C. L'	Committee)		
1. Sekino	Advanced Ceramics and Technologies for Sustainable Energy Application	s toward a	
Dublications in De	Low Carbon Society (ACISEA) (International Advisory Committee)		
Publications in Do	The Jonen Institute of Matels and Materials	2	
2014 Fall Meeting, 2015 Spring Mastir	The Japan Institute of Metals and Materials	2 papers	
Z015 Spring Meetin	Ig, The Japan Institute of Metals and Materials	2 papers	
The Japan Society	of Machanical Engineers, M&M 2014	1 paper	
The Japan Society of Mot	origina Science, Japan	1 paper	
The Society of Mat	enais Science, Japan	2 papers	
The Commission Symposiu	in on Basic Science of Ceramics	2 papers	
The Ceramic Societ	ty of Japan 2/th Fall Meeting (2014)	3 papers	
The Japan Society of	S reveal and Powder Metallurgy 2014 Fall Meeting	1 paper	
Ceramics Research	Symposium 2014	1 paper	
The Ceramic Societ	ty of Japan 2015 Annual Meeting	3 papers	
The 23th Materials	Engineering Conference	1 paper	
The Japan Society of	of Powder and Powder Metallurgy 2014 Spring Meeting	1 paper	
Japan Association of	of Chemical Sensors, The 58th Chemical Sensor Symposium	1 paper	
The 6th Annual Con	ngress: Japan Society of Medical Application of Stable Isotope and	3 papers	
Biogas		4	
The Ceramic Societ	ty of Japan, Academic Forum on Ceramics Research in Tokai, 2014	1 paper	
The 55th Symposiu	m for Mg alloys	1 paper	
Academic Degrees			
Master Degree	Elastic properties of 18R- and 10H-type LPSO phases in Mg-Zn-Y alloys		
for Engineering			
S. Suzuki	leientifie Dessent		
Grant-in-Aid for S	Detentific Research	V2 000 000	
1. Sekino	Fusion of Advanced Structure and Multifunctions in	₹2,990,000	
М. Тоно	Low-dimensional Oxides Nanostructured Materials	V4 600 000	
wi. Tane	Development of original method for the determination of	1 4,080,000	
	single-crystalline elastic properties		
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M. Tane	Elastic properties and thermal expansion coefficient of LPSO phases	¥13,910,000	
Contribution to R	esearch		
T. Sekino	Inaba Rubber Co. Ltd.	¥1,500,000	
T. Sekino	Nikkato Corp.	¥500,000	
M. Tane	The Light Metal Educational Foundation, Inc.	¥150,000	
M. Tane	The Japan Titanium Society	¥400,000	
Cooperative Resea	urch		
T.Sekino	DENSO Corp.	¥1,000,000	
T.Sekino	Rotus Alloy Co. Ltd.	¥864,000	
T.Sekino	Sun Moon University	¥6,923,000	
M.Tane	Toray Industries, Inc.	¥800,000	

Department of Advanced Interconnection Materials Original Papers

[1]Pressureless wafer bonding by turning hillocks into abnormal grain growths in Ag films, C. Oh, S. Nagao, T. Kunimune, K. Suganuma: Appl. Phys. Letters, 104 (2014) 161603.

[2]Enhanced reliability of Sn-Ag-Bi-In joint under electric current stress by adding Co/Ni elements, Y. Kim, S. Nagao, T. Sugahara, K. Suganuma, M. Ueshima, H.-J. Albrecht, K. Wilke: J. Mater. Sci.: Mater. Electron, 25 (7) (2014) 3090–3095.

[3]Hillock growth dynamics for Ag stress migration bonding, C. Oh, S. Nagao, T. Sugahara, K. Suganuma: Materials Letters, 137 (2014) 170-173.

[4]Refinement of the microstructure of Sn-Ag-Bi-In solder, by addition of SiC nanoparticles, to reduce electromigration damage under high electric current, Y. Kim, S. Nagao, T. Sugahara, K. Suganuma, M. Ueshima, H.-J. Albrecht, K. Wilke: J. Electron. Mater., 43 (12) (2014) 4428-4434.

[5]Using Ozawa method to study the curing kinetics of electrically conductive adhesives, H.-W. Cui J.-T. Jiu, S. Nagao, T. Sugahara, K. Suganuma, H. Uchida: J. Thermal Analysis and Calorimetry, 117 (3) (2014) 1365-1373.

[6]Photonic sintering of thin film prepared by dodecylamine capped $CuIn_xGa_1 - _xSe_2$ nanoparticles for printed photovoltaics, M. Singh, J.-T. Jiu, T. Sugahara, K. Suganuma: Thin Solid Films, 565 (2014) 11-18.

[7] Thin Film CIGS Solar Cell Based on Low Temperature and All Printing Process, M. Singh, J.-T. Jiu, T. Sugahara, K. Suganuma: ACS Appl. Mater. Interfaces, (2014) 16297-16303.

[8]Sol–Gel-Derived High-Performance Stacked Transparent Conductive Oxide Thin Films, T. Sugahara, Y. Hirose, S. Cong, H. Koga, J. Jiu, M. Nogi, S. Nagao, K. Suganuma: J. Am. Ceram. Soc., 97 (10) (2014) 3238-3243.

[9]Pressureless Bonding Using Sputtered Ag Thin Films, C. Oh, S. Nagao, K. Suganuma: J. Electron. Mater., 43 (12) (2014) 4406-4412/26.

[10] 'Chrysanthemum petal' arrangements of silver nano wires, H.-W. Cui, J.-T. Jiu, T. Sugahara1, S. Nagao, K. Suganuma, H. Uchida: Nanotechnology, 25 (48) (2014) 485705.

[11]Silver Nanowire Electrodes: Conductivity Improvement Without Post-treatment and Application in Capacitive Pressure Sensors, J. Wang, J.-T. Jiu, T. Araki, M. Nogi, T. Sugahara, S. Nagao, H. Koga, P. He, K. Suganuma: Nano-Micro Letters, 7 (1) (2015) 51-58.

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[15]The effect of light and humidity on the stability of silver nanowire transparent electrodes, J.-T. Jiu, J. Wang, T. Sugahara, S. Nagao, M. Nogi, H. Koga, K. Suganuma, M. Hara, E. Nakazawa, H. Uchida: RSC Advances, 5 (2015) 27657-27664.

International Conferences

[1]Silver sinter joining and new thin film bonding for WBG die-attach (invited), K. Suganuma, S. Nagao, T. Sugahara, C. Oh, H. Zhang, S. Koga, S. Park: 2nd International Conference on Nanojoining and Microjoining, Emmetten, Switzerland, Dec. 7-10, 2014.

[2]Towards high reliability interconnections for advanced electronic (invited), K. Suganuma, S. Nagao, T. Sugahara: 67th IIW Annual Assembly & International Conference (IIW2014), Seoul, July 17-18, 2014.

[3]Interconnection materials for high-temperature electronics applications (oral), K. Suganuma: International Conference on Electronic Materials 2014 (IUMRS), Taipei, June 10-14, 2014.

[4]From lead-free soldering to new interconnections for advanced electronics (oral), K. Suganuma: International Conference on Brazing, Soldering and Special Joining Technology, Chinese Welding Society, Beijing, June 9-13, 2014.

[5]Microimpact testing for miniaturized electronic component packaging (oral), S. Nagao, Y.-S. Kim, T. Sugahara, Y. Onishi, K. Suganuma: 20th European conference of fracture (ECF20), Trondheim, Norway | June 30- July 4.

[6]Low-pressure sintering bonding with Cu and CuO flake paste for power devices (oral), S.W. Park, R. Uwataki, S. Nagao, T. Sugahara, Y. Katoh, H.Ishino, K. Sugiura, K. Tsuruta, K. Suganuma: The 64th IEEE Electronic Components and Technology Conference (ECTC2014), Lake Buena Vista, FL, USA, May 27-30 (2014).

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[9]Sol-Gel-Derived Amorphous Semiconductor TFT Fabrication (invited), Tohru Sugahara, Takuro Matsuo, Yukiko Hirose, Jinting Jiu, Shijo Nagao, and Katsuaki Suganuma: EMN Ceramics Meeting 2015.

[10]Photoelectrical and microphysical properties of Sol-Gel derived IGZO thin films for printed TFTs (poster), T. Matsuo, T. Sugahara, Y. Hirose, J. Jiu, S. Nagao, K. Suganuma, Jianying He, Zhiliang Zhang: ESTC 2014.

[11]Ultrasonic bonding of Cu/Al clad ribbon interconnections in power electronic modules (oral), Semin Park 1, Shijo Nagao 1, Tohru Sugahara 1, Emi Yokoi 1, Osami Iizuka 2, and Katsuaki Suganuma: 67th IIW Annual Assembly & International Conference.

[12]Nano-SiC added Ag paste sintering die-attach for SiC power devices (oral), Hao Zhang, Shijo Nagao, Sungwon Park, Shunsuke Koga, Tohru Sugahara, and Katsuaki Suganuma: 5th Electronics System-Integration Technology Conference.

[13]SiC die-attch on DBA substrate with ceramic nano-particles added hybrid Ag particle paste (oral), Hao Zhang, Shijo Nagao, Katsuaki Suganuma: Materials Science & Technology 2014.

[14]High-Dielectric Paper Composite Consisting of Cellulose Nanofiber and Silver Nanowire (oral), Tetsuji Inui, Hirotaka Koga, Masaya Nogi, Natsuki Komoda, Katsuaki Suganuma: 14th International Conference on Nanotechnology (IEEE NANO 2014).

[15]Synthesis and application of silver nanowires (oral), J. Jiu1, T. Araki1, J. Wang1, M. Nogi1, T. Sugahara1, S. Nagao1, H. Koga1, K. Suganuma1, E. Nakazawa2, M. Hara2, H. Uchida2: 1st International Conference on Polyol Mediated Synthesis (IC-PMS), Paris, France | June 22-25.

[16]Sol-Gel-Derived Amorphous Semiconductor TFT Fabrication and its Performance (invited), Tohru Sugahara, Takuro Matsuo, Yukiko Hirose, Jinting Jiu, Shijo Nagao, and Katsuaki Suganuma: EMN Ceramics Meeting 2015.

Review Papers

Trend in printed electronics, K.Suganuma, Plastics Age, Plastics Age Co., Ltd., 1月号 (2015), 82-87.

Electrically conductive adhessives technology, K.Suganuma, Materials Science and Engineering, SHOKABO. Co., Ltd., 51[2] (2014), 42-47.

Advanced packaging applications from Pb-free solder bonding, K.Suganuma, Robot, Japan Robot Association, 221 (2014), 1-8.

Fabrication of Flexible Thermoelectric Module on Middle Temperature for the Applying of Curved Surface, T.Sugahara, The journal of the Thermoelectrics Society of Japan, The Thermoelectrics Society of Japan, Vol. 11 No.2:ISSN 1349-4279 (2014), 9-11.

Books

[1]Electronic Packaging and reliability on SiC/GaN power devices K.Suganuma, NIKKAN KOGYO SHIMBUN,LTD., 2014.

[2]Introduction to electrically conductive adhessives K.Suganuma, Kagaku Gijyutsu Shuppan, 2014.

[3]Performance and evaluation technology for Advanced materials K.Suganuma, Industrial Technology Service Center, (514-557) 2014.

[4]Improving interconnection reliability of electronic packagings for motor vehicles K.Suganuma, CMC Publishing Co.,Ltd., (125-137) 2014.

[5] History of device failures due to Sn whiskers K.Suganuma, CMC Publishing Co., Ltd., (133-142) 2014.

Patents

[1]K20130290 Method of producing conductive fibers, method of producing a sheet electrode, the conductive fibers, and the sheet electrode, 2014-106142

[2]K20130376 Synthesize method of Ag particle, the synthesized Ag particles, method of producing conductive paste, and produced conductive paste, 2014-123394

[3]K20140145 Electrically conductive fiber aggregates, 2014-232872

[4]K20140175 Joint structure, and the fabrication method of the joint structure, 2014-248918

[5]K20140208 Joint structure, and the fabrication method of the joint structure, 2015-041268

[6]K20140257 Method of producing semiconductor films, 2015-056004

[7]K20140315 Formation process of electrically conductive transparent films, the transparent conductive films, and transparent conductive substrate, 2015-030821

[8]K20140324 Fabrication method of circuit substrate, circuit substrate, and plasma equipment, 2015-043856

[9]K20140364 Method of producing Cu particles, Cu particles, and Cu pastes, 2015-043640

[10]K20140383 Semiconductor device, 2015-067438

[11]G20130122US Insulator material, passive element, circuit board, and fabrication method of insulator sheet, 14/311546

[12]G20140005WO Method of producing a patterned nanowires network, PCT/NL2014/050218

[13]G20140006WO Method of producing metal nanowires, and the metal nanowires, PCT/JP2014/063851

[14]G20140020WO Fabrication method, PCT/JP2014/069197

[15]G20140087WO Method of producing chalcopyrite particles, PCT/JP2015/052999

[16]K20090142 Thermoelectric converter module, and fabrication method of the thermoelectric converter module, 2009-244350

[17]K20090391 Production facility of conductive wires, the method of producing conductive wires, and the method of circuit board, 2010-163455

[18]KP2013033 Method of producing electrically conductive transparent patterns, 2014-503564

[19]KP2013040 Electrically conductive transparent ink, and method of forming an electrically conductive transparent pattern, 2014-512709

[20]G20060044US Surface treatment method to mitigate whisker growth, 12/089,025

[21]K20080084 Method of producing solder material, and soldered joint, K20080084

[22]K20080371 Method of conductive material production, produced conductive material, and electric devices, luminous, K20080371

[23]K20090402 Stretchable wires involving polyurethane and substrate material, K20090402

Contributions to I	nternational Conferences and Journals		
K. Suganuma	Electronics System-Integration Technology Conference (ESTC 2014)	Organaizing	
	Committee)		
K. Suganuma	The 65th Electronic Components and Technology Conference (ECTC) (Program		
	Committee)		
Publications in Do	mestic Meetings		
The Japan Institute	e of Electronics Packaging	3 papers	
The Ceramic socie	ty of Japan	3 papers	
The Japan Society	of Applied Physics	1 paper	
Academic Degrees			
Master of	Development of sol-gel precursor ink and fabrication of TFT structure		
Engineering			
M.Matuso			
Master of	Paper-based Electrode for Flexible Supercapacitor Prepared by Papern	naking and	
Engineering	Flash-Reduction		
H.Tonomura			
Doctor of	Electromigration and mechanical reliability improvement of Pb-free S.	ABI solder	
Engineering	joint with refined microstructure		
Y. Kim	•		
Doctor of	Solid-state bonding by stress migration in Ag thin films		
Engineering			
C.Oh			
Doctor of	Pressure-less Ag die-bonding methods for LED packaging		
Engineering			
T.Kunimune			
Doctor of	Development of conductive wiring techniques for stretchable electr	onics	
Engineering	C I		
T. Araki			
Grant-in-Aid for S	Scientific Research		
K.Suganuma	Hetero phase interface science of power semiconductors for extreme environments	¥32,500,000	
T.Sugahara	Development of stretchable thermoelectric devices by printing method	¥1,635,000	
Entrusted Researc	h		
K Suganuma	IAPERA	¥3 479 000	
K Suganuma	COL	¥7 692 000	
K Suganuma	SIP	¥13 700 000	
Contribution to Re	esearch	112,700,000	
K.Suganuma	Daicel Corporation	¥455.000	
K.Suganuma	CEMEDINE Co., ltd.	¥455.000	
K.Suganuma	SHOWA DENKO K.K.	¥910.000	
K.Suganuma	E-Thermogentech	¥364.000	
K.Suganuma	C.Uvemura & Co., Ltd.	¥910.000	
K Suganuma	FUIITSU LABORATORIES LTD	¥455,000	
K Suganuma	NIPPON STEEL & SUMIKIN CHEMICAL CO. LTD	¥455,000	
Cooperative Resea	nrch	1155,000	
K Suganuma	FUIITSU TEN LIMITED	¥823.000	
K Suganuma	SHOWA DENKO K K	¥13 200 000	
K Suganuma	Kishu Giken Kogyo Co Ltd	¥4 940 000	
K Suganuma	PI-CRYSTAL INC	¥353 000	
K Suganuma	C Uvemura & Co. I td	¥432 000	
K Suganuma	TOPPAN FORMS CO. LTD	¥2 625 000	
K Suganuma	DENSO CORPORATION	¥4 166 000	
K Suganuma	SHARP CORPORATION	¥35 345 000	
K Suganuma	NIPPON SHOKUBALCO ITD	¥3 588 000	

K.Suganuma	Senju Metal Industry Co., Ltd.	¥0,000
S.Nagao	Senju Metal Industry Co., Ltd.	¥80,000
K.Suganuma	CEMEDINE Co., ltd.	¥420,000

Department of Excited Solid-State Dynamics Original Papers

[1]Crucial roles of holes in electronic bond rupture on semiconductor surfaces, J. Tsuruta, E. Inami, J. Kanasaki and K. Tanimura: Surf. Sci., 626 (2014) 49-52.

[2]State-resolved ultrafast dynamics of impact ionization in InSb, H. Tanimura, J. Kanasaki and K. Tanimura: Scientific Reports, 4 (2014) 06849-1-4.

[3]Imaging energy-, momentum-, time-resolved distributions of photoinjected hot electrons in GaAs, J. Kanasaki, H. Tanimura and K. Tanimura: Phy. Rev. Lett., 113 (23) (2014) 237401-1-4.

[4]Ultrafast scattering processes of hot electrons in InSb studied by time- and angle-resolved photoemission spectroscopy, H. Tanimura, J. Kanasaki and K. Tanimura: Phys. Rev. B, 91 (4) (2015) 045201-1-16.

[5]What Does the Angle-Integrated Photoelectron Spectrum Show? :A Comparison between First-Principles Calculation and Experiments for Graphite, Shin-ichiro Tanaka, Yusaku Takano, Makoto Okusawa, and Kazuhiko Mase: J. Phys.Soc. Jpn, 83 (8) (2014) 084705-1-4.

International Conferences

[1]Ultrafast electron dynamics in photo-excited semiconductors studied by time- and angle-resolved two-photon photoelectron spectroscopy (invited), J. Kanasaki: Conference on Lasers and Electro-Optics (CLEO-2014).

[2]Dynamics of the Secondary Electron Emission from the Graphite Surface Excited by the Soft-X ray: Investigation by the Electron-Electron Coincidence Spectroscop (oral), S. Tanaka and Kazuhiko Mase: The 7th International Symposium on Surface Science.

[3]Electron-Phonon Scattering between Unoccupied Electronic States of Graphite Probed by Angle-Resolved Photoelectron and Electron Energy Loss Spectroscopies (oral), S. Tanaka, M. Matsunami, S. Kimura, M. Arita, K.Shimada, S.Shimizu, K. Mukai and J. Yoshinobu: The 7th International Symposium on Surface Science.

[4]State-resolved ultrafast dynamics of impact ionization in InSb (poster), H. Tanimura, J. Kanasaki, K. Tanimura: The 18th SANKEN International symposium.

Review Papers

Ultrafast crystalline-structural dynamics by time-resolved MeV-electron diffraction, N. Naruse, Yvlin Giret, J. Yang, K. Tanimura, The Review of Laser Engineering, The Laser Society of Japan, 43[3] (2015), 114-.

Contributions to International Conferences and Journals

S. TANAKA	Scientific Reports (Editorial Board Member)
J. KANASAKI	The 9th International Sympopsium on Ultrafast Surface Dynamics (Local
	Committee)
K. TANIMURA	The 9th International Sympopsium on Ultrafast Surface Dynamics (Co-Chair)

Publications in Domestic Meetings

Annual meeting of physical society of Japan IMS symposium

9 papers 1 paper

Meeting of SR Surfa Japan	ace Science Research Division in Surface Science Society of	1 paper
The Fullerenes, Nar	notubes and Graphene General Symposium	2 papers
Synchrotron Radiati	ion Research Symposium	2 papers
IMSS Science Festa	L Contraction of the second	2 papers
Annual meeting of e	excitation-controlled nano-processes	2 papers
Academic Degrees		
Doctor Degree	Ultrafast relaxation processes of excited electrons in semiconductors st	udied by
for Engineering	femto-second time-resolved two-photon photoemission spectroscopy	
H. Tanimura		
Grant-in-Aid for S	cientific Research	
K.Tanimura	Innovation of structural materials science: Femtosecond	¥7,800,000
	time-resolved atomic imaging	
S.Tanaka	Elemental processes of the electron-phonon coupling in carbon nanomaterials	¥1,430,000
N.Naruse	Reconsideration of atomic scattering factor in ultrfast electron	¥3,120,000
	diffraction	
Contribution to Re	esearch	
J. Kanasaki	Ultrafast carrier dynamics in semiconductors studied by	¥300,000
	femtosecond two photon photoelectron spectroscopy	

Department of Accelerator Science Original Papers

[1]Grid pulser for an electron gun with a thermionic cathode for the high-power operation of a terahertz free-electron laser, S.Suemine, K.Kawase, N.Sugimoto, S.Kashiwagi, K.Furuakwa, R.Kato, A.Irizawa, M.Fujimoto, H.Ohsumi, M.Yaguchi, S.Funakoshi, R.Tsutsumi, K.Kubo, A.Tokuchi, G.Isoyama: Nuclear Instruments and Methods in Physics Research A, 773 (2015) 97-103.

[2]Excitation of giant monopole resonance in 208Pb and 116Sn using inelastic deuteron scattering, D. Patel, U. Garg, M. Itoh, H. Akimune, G.P.A. Berg, M. Fujiwara, M.N. Harakeh, C. Iwamoto, T. Kawabata, K. Kawase, J.T. Matta, T. Murakami, A. Okamoto, T. Sako, K.W. Schlax, F. Takahashi, M. White, M. Yosoi: Physics Letters B, 735 (2014) 386-390.

[3]Development of a high-power solid-state switch using static inductio nthyristors for a klystron modulator, A.Tokuchi, F.Kamitsukasa, K.Furukawa, K.Kawase, R.Kato, A.Irizawa, M.Fujimoto, H.Osumi, S.Funakoshi, R.Tsutsumi, S.Suemine, Y.Honda, G.Isoyama: Nuclear Instruments and Methods in Physics Research A, 769 (2015) 72-78.

[4]Spin-Polarized Angle-Resolved Photoelectron Spectroscopy of the So-Predicted Kondo Topological Insulator SmB6, S.Suga, K.Sakamoto, T.Okuda, K.Miyamoto, K.Kuroda, A.Sekiyama, J.Yamaguchi, H.Fujiwara, A.Irizawa, T.Ito, S.Kimura, T. Balashov, W. Wulfhekel, S. Yeo, F.Iga, S.Imada: Journal of the Physical Society of Japan, 83 (2014) 014705 1-6.

[5]Bulk nature of layered perovskite iridates beyond the Mott scenario: An approach from a bulk-sensitive photoemission study, A. Yamasaki, S. Tachibana, H. Fujiwara, A. Higashiya, A. Irizawa, O. Kirilmaz, F. Pfaff, P. Scheiderer, J. Gabel, M. Sing, T. Muro, M. Yabashi, K. Tamasaku, H. Sato, H. Namatame, M. Taniguchi, A. Hloskovskyy, H. Yoshida, H. Okabe, M. Isobe, J. Akimitsu, W. Drube, R. Claessen, T. Ishikawa, S. Imada, A. Sekiyama, and S. Suga: Physical Review B, 89 (2014) 121111 1-5.

International Conferences

[1]SOLID-STATE SWITCH FOR A KLYSTRON MODULATOR FOR STABLE OPERATION OF A THZ-FEL (poster), G. Isoyama, M. Fujimoto, S. Funakoshi, K. Furukawa, A. Irizawa, R. Kato, K. Kawase, K. Miyazaki, A. Tokuchi, R. Tsutsumi, M. Yaguchi: FEL2014, Basel, Switzerland.

[2]Ablation of organic crystals using picosecond THz free electron laser pulses. (oral), M. Nagai, E. Matsubara, M. Ashida, K. Kawase, A. Irizawa, R. Kato and G. Isoyama: Infrared, Millimeter, and Terahertz waves (IRMMW-THz), 2014 39th International Conference.

[3]HIGH POWER OPERATION OF THE THZ FEL AT ISIR, OSAKA UNIVERSITY. (poster), K. Kawase, S. Suemine, R. Kato, A. Irizawa, M. Fujimoto, M. Yaguchi, S. Funakoshi, R. Tsutsumi, K. Miyazaki, K. Furukawa, K. Kubo, A. Tokuchi, G. Isoyama: FEL2014, Basel, Switzerland.

Books

[1] Synchrotron light and free electron lasers actively used in a wide range of fields (Photon Pioneers

Center in Osaka University) H. Ajiki, K. Inoue, G. Isoyama, T. Jitsuno, N. Miyanaga, H. Asahi, M.

Matsumoto, T. Harada, M. Matsumura, T. Mori, T. Hirai, S. Urabe, M. Yoshimura, Y. Takaya, S. Ito, H.

Miyasaka, M. Ashida, S. Tajima, "Optical Science World", Asakura Publishing Co., Ltd., (15-30).

Patents

[1] Imaging system and imaging method, US20140232931 A1

Grant-in-Aid for Scientific Research

G.Isoyama Development of new operating region of the free electron laser ¥2,8

¥2,860,000

Department of Beam Materials Science Original Papers

[1]Theoretical relationship between quencher diffusion constant and effective reaction radius for neutralization in contact hole imaging using chemically amplified extreme ultraviolet resists, Takahiro Kozawa, Taku Hirayama: Japanese Journal of Applied Physics, 53 (2014) 066502.

[2]Theoretical study on stochastic defect generation in chemically amplified resist process for extreme ultraviolet lithography, Takahiro Kozawa, Julius Joseph Santillan, Toshiro Itani: Japanese Journal of Applied Physics, 53 (2014) 066504.

[3]Relationship between stochasticity and wavelength of exposure source in lithography, Takahiro Kozawa: Japanese Journal of Applied Physics, 53 (2014) 066505.

[4]Effect of photodecomposable quencher on latent image quality in extreme ultraviolet lithography, Takahiro Kozawa: Japanese Journal of Applied Physics, 53 (2014) 066508.

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[13]Feasibility study of sub-10-nm-half-pitch fabrication by chemically amplified resist processes of extreme ultraviolet lithography: II. Stochastic effects, Takahiro Kozawa, Julius Joseph Santillan, and Toshiro Itani: Japanese Journal of Applied Physics, 54 (2015) 036507.

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[2]Theoretical Study on Stochastic Effects in Chemically Amplified Resist Process for Extreme Ultraviolet Lithography (invited), Takahiro Kozawa, Julius Joseph Santillan, Toshiro Itani: 2014

International Workshop on EUV Lithography.

[3]Relationships between Stochastic Phenomena and Optical Contrast in Chemically Amplified Resist Process of Extreme Ultraviolet Lithography (invited), Takahiro Kozawa, Julius Joseph Santillan and Toshiro Itani: 31st International Conference of Photopolymer Science and Technology (ICPST-31).

[4] Position Control of Metal Nano Particle by Self Assembly (oral), Hiroki Yamanoto, Akira Onuma, Fumiaki Otani and Takahiro Kozawa: 31st International Conference of Photopolymer Science and Technology (ICPST-31).

[5]A Picosecond Pulse Radiolysis Study of Methanol and Ethanol at Extreme Conditions up to Supercritical State (poster), Yusa MUROYA, Daisuke HATOMOTO, Testuro YOSHIDA, Shinichi YAMASHITA, Yosuke KATSUMURA, and Takahiro KOZAWA: The 5th Asia Pacific Symposium on Radiation Chemistry.

[6]A Picosecond Pulse Radiolysis Study of Water at Extreme Conditions up to Supercritical State (oral), Yusa MUROYA, Daisuke HATOMOTO, Testuro YOSHIDA, Shinichi YAMASHITA, Mingzhang LIN, Yosuke KATSUMURA, and Takahiro KOZAWA: The 5th Asia Pacific Symposium on Radiation Chemistry.

[7]Reactivity of Hydrated Electron Formed by Radiolysis of Water at High Temprature (poster), Daisuke HATOMOTO, Yusa MUROYA, Yosuke KATSUMURA, Shinichi YAMASHITA, and Takahiro KOZAWA: The 5th Asia Pacific Symposium on Radiation Chemistry.

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[9]Radiation-induced Synthesis of Metal Nanoparticles in Ethers THF and PGMEA (poster), Hiroki YAMAMOTO, Takahiro KOZAWA, Seiichi TAGAWA, Muneyuki NAITO, Jean-Louis MARIGNIER, Mehran MOSTAFAVI, and Jacqueline BELLONI: The 5th Asia Pacific Symposium on Radiation Chemistry.

[10]Theoretical study on stochastic effects in chemically amplified resist process for extreme ultraviolet lithography (oral), Takahiro Kozawa, J.J. Santillan, T. Itani: 12th FRAUNHOFER IISB LITHOGRAPHY SIMULATION WORKSHOP.

[11]High Aspect Ratio Patterning by Using ClF3-Ar Neutral Cluster Etching (poster), H. Yamamoto, T. Seki, J. Matsuo, K. Koike, T. Kozawa: The 40th International Conference on Micro and Nano Engineering.

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[14]Study on Dissolution Behavior of Chemically Amplified Resists for Extreme Ultraviolet Lithography (oral), M. Mitsuyasu, H. Yamamoto and T. Kozawa: 27 t h International Microprocesses and Nanotechnology Conference.

[15]Effect of Molecular Weight on Dissolution Behavior of Poly(methyl methacrylate) (poster), A. Konda, H. Yamamoto, M.Mitsuyasu, T. Kozawa, S. Yoshitake: 27 t h International Microprocesses and

Nanotechnology Conference.

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[2]Radiation chemistry of water and dilute aqueous solutions(Y. Muroya) M. Lin, Y. Muroya, "Dictionary of nuclear, quantum, and fusion science", MARUZEN, (104-105) 2014.

[3]Material–Coolant Interactions(Y. Oka and H. Mori) Yosuke Katsumura and Yusa Muroya, "Supercritical-Pressure Light Water Cooled Reactors", Springer Japan, (347-375) 2014.

Patents

[1]K20080228 Supporting film materials and method for the measurement of extreme ultraviolet absorption coefficient of thin films, K20080228

Contributions to International Conferences and Journals

Takahiro Kozawa	2014 International Symposium on Extreme Ultraviolet Lithography (Program		
	Steering Committee)	-	
Takahiro Kozawa	27th International Microprocesses and Nanotechnology Conference (O	rganaizing	
	Committee)		
Takahiro Kozawa	28 th International Microprocesses and Nanotechnology Conference (Organaizing	
	Committee)		
Y.MUROYA	The 5th Asia Pacific Symposium on Radiation Chemistry (Steering Co	ommittee)	
H. Yamamoto	28 th International Microprocesses and Nanotechnology Conference (Program		
	Committee)	-	
Publications in Do	mestic Meetings		
The 41st Symposium	n on Biomolecular Science	1 paper	
The 51th Japan Rad	ioisotope Association Meeting	2 papers	
The 75st JSAP Autu	mn Meeting 2014	4 papers	
The 87th Annual Me	eeting of the Japanese Biochemical Society	2 papers	
The 12th RF-gun me	eeting	1 paper	

The 12th RF-gun meeting The 62nd JSAP Spring Meeting 2015 The 95th Japan Chemical Society Meeting Academic Degrees

Master Degree Study on molecular hydrogen formation reaction originating from hydrated electrons in radiolysis of water at high temperature condition

D. HatomotoMaster Degree for EngineeringStudy on Dissolution Behavior of Resist Films Using Quartz Crystal MicrobalanceMethod

Doctor Degree Mechanistic Study on Oxidative Stress Sensor Protein Containing Iron-sulfur Cluster for Engineering

1 paper

1 paper

M. FujikawaDoctor Degree for EngineeringStudy on Extreme Ultraviolet Sensitization Mechanism of Resist Polymers HavingOnium Salt as Side Chain

Y. Komuro

M. Mitsuyasu

Grant-in-Aid for Scientific Research

T. Kozawa	Study on nano chemistry induce in nanofabrication materials		¥8,060,000
	using combination of quantu		
Y. Muroya	Reaction mechanism of a bin electrons in water	nolecular self reaction of hydrated	¥780,000
H. Yamamoto	Creation and Control of Met of Top-down and Bottom-up	al Nano-structure Using Combination	¥1,300,000
H. Yamamoto	Creation of Nanofabrication using organic-inorganice hyl	process for extreme quantum beam orid nanoparticles	¥15,730,000
Entrusted Researc	h	-	
Y. Muroya	Central Research Institute of Electric Power Industry	Study on radiolysis of poly acryl acid at PWR water chemistry condition	¥562,000
Y. Muroya	Central Research Institute of Electric Power Industry	Evaluation of absorbed dose and temperature change of coating plates under electron beam irradiation	¥143,000
Contribution to Re	esearch		
T. Kozawa	Daihach Kogyo Co., Ltd.		¥200,000
H. Yamamoto	Frontierkouki Inc.		¥1,000,000
Cooperative Resea	rch		
T. Kozawa	NISSAN CHEMICAL INI	DUSTRIES, LTD.	¥0,000
T. Kozawa	Taiwan Semiconductor Ma	nufacturing Conductor (TSMC)	¥2,816,000
T. Kozawa	Tokyo Ohka Kogyo.Co.,Lt	d	¥417,000
T. Kozawa	MITSUBISHI GAS CHEN	IICAL COMPANY, INC.	¥416,000
T. Kozawa	NuFlare Technology, Inc.		¥0,000
T. Kozawa	TOSHIBA CORPORATIO	N	¥2,083,000

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[1]Single-Particle Study of Pt-Modified Au Nanorods for Plasmon-Enhanced Hydrogen Generation in Visible to Near Infrared Region, Z. Zheng, T.Tachikawa, and T. Majima: J. Am. Chem. Soc., 136 (19) (2014) 6870-6873.

[2]Far-Red Fluorescence Probe for Monitoring Singlet Oxygen during Photodynamic Therapy, S. Kim, T. Tachikawa, M. Fujitsuka, and T. Majima: J. Am. Chem. Soc., 136 (33) (2014) 11707-11715.

[3]Photocurrent generation enhanced by charge delocalization over stacked perylenediimide chromophores inside DNA, T. Takada, A. Ashida, M. Nakamura, M. Fujitsuka, T. Majima, K. Yamana: J. Am. Chem. Soc., 136 (19) (2014) 6814-6817.

[4]Radical Ions of Cycloparaphenylenes: Size-Dependence Contrary to the Neutral Molecules, M. Fujitsuka, S. Tojo, T. Iwamoto, E. Kayahara, S. Yamago, and T. Majima: J. Phys. Chem. Lett, 5 (13) (2014) 2302-2305.

[5]Solvent Dynamics Regulated Electron Transfer in S2-Excited Sb- and Ge Tetraphenylporphyrins with an Electron Donor Substituent at Meso-Position, M.Fujitsuka, T. Shiragami, D. W. Cho, S. Tojo, M. Yasuda, and T. Majima: J.Phys. Chem. A, 118 (22) (2014) 3926-3933.

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[16]Structural Study on Biphenyl with Various Substituents and Its Radical Anions Based on the Time-resolved Resonance Raman Spectroscopy Combined with Pulse Radiolysis, J. Choi, D. W. Cho, S. Tojo, M. Fujitsuka, and T. Majima: J. Phys. Chem. A, 119 (5) (2015) 851-856.

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[3]Photoinduced Electron Transfer Processes in Supramolecular Donor Acceptor Dyads using Porphyrin

Isomers (invited), M. Fujitsuka, H. Shimakoshi, Y. Hisaeda, and T. Majima: Korea Japan Symposium on Frontier Photoscience, Seoul, Korea, June 21-23, 2014.

[4]Size-Dependent Fluorescence Properties of [n]Cycloparaphenylenes (n = 8 - 13), Hoop-Shaped π -Conjugated Molecules (poster), M. Fujitsuka, D. W. Cho, T. Iwamoto, S. Yamago, and T. Majima: Korea Japan Symposium on Frontier Photoscience, Seoul, Korea, June 21-23, 2014.

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[6]Superstructure of TiO₂ crystalline nanoparticles with effective charge transfer pathway (invited), T. Majima: Urumqi Symposium on Recent Advances and Applications in Nanoengineering and Nanosystems, Urumqi, Xinjian Autonomous Region, Xinjian, China, June 27-30, 2014.

[7]Photocatalytic Reactions using Superstructure TiO₂ Crystalline Nanoparticles with Effective Charge Transfer Pathways (oral), T. Majima: 25th IUPAC symposium on Photochemistry, Bordeaux, France, July13-18, 2014.

[8]Nanoscale Visualization of TiO₂ Photocatalytic Reactions (plenary), T. Majima: 14th National Conference on Solar Energy Photochemistry and Photocatalysis (SEPP14), Harbin, China, July 27-31, 2014.

[9]Superstructure of TiO₂ crystalline nanoparticles with effective charge transfer pathways (invited), T. Majima: UNIST (Ulsan National Institute of Science and Technology) Annual international conference on energy materials, Ulsan, Korea, August 19-22, 2014.

[10]Recent Approach in Radiation Chemistry toward Material and Biological Science (invited), T. Majima: 2014APSRC (Asian Pacific Symposium on Radiation Chemistry), Tokyo, Japan, September 8-11, 2014.

[11]Time-resolved Raman Spectroscopic Measurement during Pulse Radiolysis of Supramolecules and Biomolecules (oral), M. Fujitsuka, J. Choi, and T. Majima: 2014APSRC (Asian Pacific Symposium on Radiation Chemistry), Tokyo, Japan, September 8-11, 2014.

[12]Metal oxide mesocrystals with efficient charge transport properties (invited), T. Majima: Fall E-MRS Conference, Warsaw University of Technology, Warsaw, Poland, September14-25,2014.

[13]Metal oxide mesocrystals with effective charge transfer pathways (plenary), T. Majima: 4th TKU-ECUST-OPU-KIST Joint Symposium on Advanced Materials and their Applications, Taipei, Taiwan, September 24-26, 2014.

[14]Solvent accessibility of the fluorescent molecule monitored by fluorescence blinking (oral), K. Kawai, T. Koshimo, A. Maruyama, T. Majima: 41st International Symposium on Nucleic Acids Chemistry (ISNAC2014), Fukuoka, Japan, November 5-7, 2014.

[15]Single-Particle Study of Pt-Modified Au Nanorods for Plasmon-Enhanced Hydrogen Generation in Visible to Near Infrared Region (poster), Z. Zheng, T. Tachikawa, and T. Majima: SANKEN International Symposium, Osaka, Japan, December 10-11, 2014.

[16]Development of n ew photocatalysts (plenary), T. Majima: International Workshop on Resource Chemistry in Shanghai Normal University, Shanghai, China, December 23, 2014.

[17]Pulse radiolysis (oral), T. Majima: 2015 1st Workshop of Collaboration Laboratory between

SANKEN, Osaka, Japan, January 26, 2015.

[18]Pulse radiolysis of nanomaterials (oral), M. Fujitsuka and T. Majima: 2015 1st Workshop of Collaboration Laboratory between SANKEN, Osaka, Japan, January 26, 2015.

[19]Introduction of SANKEN and Quantum Beam Laboratory (oral), T. Majima: 2015 Japan-Korea Bilateral Symposium on Quantum Beam Science, Osaka, Japan, February 25, 2015.

[20]Radiation Chemistry of Nanomaterials (oral), M. Fujitsuka and T. Majima: 2015 Japan-Korea Bilateral Symposium on Quantum Beam Science, Osaka, Japan, February 25, 2015.

[21]Electron transfer from excited radical ions in functionalized organic molecular systems (invited), M. Fujitsuka and T. Majima: Kobe mini-symposium on functionalized organic molecules, Kobe, Japan, November 10, 2014.

Review Papers

Developing a new fluorescence probe of singlet oxygen during photodynamic therapy, S. Kim, M. Fujitsuka, and T. Majima, EPA Newslett., 86 (2014), 92-95.

Infrared photochemistry, T.Majima, Photochemistry dictionary, Asakura Publishing Co., Ltd., N (2014), 74-75.

Transfer, transport, and diffusion of excited energy, M.Fujitsuka, Photochemistry dictionary, Asakura Publishing Co., Ltd., (2014), 46-47.

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Books

[1]Single-molecule reactive oxygen species detection in photocatalytic reactions(Alexander Greer and Joel F. Liebman) T. Majima, "The Chemistry of Peroxides", John Wiley & Sons, (421-436) 2014.

[2]Fundamental reaction mechanisms in radiation chemistry and recent examples" in "Applications of EPR in Radiation Research(Anders Lund and Masaru Shiotani) M. Fujitsuka and T. Majima,
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Patents

[1]K20140028 Fluorescence probe, singlet oxygen detection reagent, or singlet oxygen detection method, 2014-124543

[2]PCT/JP2015/67522. Fluorescence probe, singlet oxygen detection reagent, or singlet oxygen detection method, PCT Int. Appl. PCT/JP2015/67522.

Contributions to International Conferences and Journals

T. Majima	Korean Japan Symosium on Photoscinece (Chair person)
T. Majima	Asian Pacific Symposium on Radiation Chemistry (Chair person)

T. Majima	25th IUPAC Symposium on	Photochemistry, (Chair person)	
T. Majima	Urumqi Symposium on Recent Advances and Applications in Nanoengineering and		
-	Nanosystems (Chair person)		
T. Majima	Langmuir, American Chemic	cal Society (Senior Editor)	
T. Majima	ACS Applied Materials & In	terfaces, American Chemical Society (Edi	torial
5	Advisory Board)	•	
T. Majima	ChemPlusChem, union of 16	European Chemical Societies, Wiley VH	C (Editorial
·	Board)	-	
T. Majima	Rapid Communication in Ph	otoscienece, Korean Society of Photoscier	nce
-	(International Editorial Boar	d)	
T. Majima	Photochemistry and Photobio	ology, Wiley VHC (Associate Editor)	
Publications in Do	mestic Meetings		
The 35th Japan Pho	tomedicine and Photobiology	Meeting	2 papers
Japan Photochemist	try Meeting 2013		3 papers
The 94th Japan Che	emical Society Meeting		4 papers
Academic Degrees			
Master Degree	Studies on intramolecular el	ectron transfer of fullerene derivative rad	dical anion in
for Engineering	the excited state		
T. Ohsaka			
Master Degree	Study on intramolecular elec	ctron transfer using perylenediimide radi	cal anion in
for Engineering	the excited state as electron	donor	
S. Ano			
Master Degree	Synthesis of Carbon Quantu	m Dots From Hydrothermal Reaction of	Aromatic
for Engineering	Compounds		
K. nakao			
Doctor Degree	Studies on Single-Molecule Analysis and Visualization of Biological Phenomena		
for Engineering	Using Fluorescence Probes		
S. Kim			
Grant-in-Aid for S	Scientific Research		
T. Majima	Single molecule chemistry o exchange system	f nanocatalysts for light-energy	¥44,850,000
M. Fujitsuka	Dynamics of excited state re- and polymers	active intermediatesof supramolecules	¥4,030,000
K. Kawai	Development of single-mole	cule level analysis techniques for	¥4,290.000
	RNA editing and chemical m	nodifications	,_, .,
T. Maiima	Study on the structural chara	cteristics of titanium oxide	¥1.100.000
j ti	photocatalyst by time- and si	pacial-resolved spectroscopy	, - ,
Y. Osakada	Imaging of small number of	nucleic acids in iPS cells at single	¥1,300,000
	molecule level	6	, ,
Entrusted Researc	h		
T. Majima	Japan Science and	Study on unstable reactive species of	¥10,719,000
5	technology Agency	CPP	, ,
K. Kawai	Japan Science and	Development of molecule	¥7,579,000
	technology Agency	technology based on fluorescence	, ,
		blinking	
Contribution to R	esearch	C	
Y. Osakada	ATI Foundation advanced te	chnology institute	¥500,000
			-
D () 00			

Department of Synthetic Organic Chemistry

Original Papers

[1]Enantioselective Organocatalyzed Formal [4+2] Cycloaddition of Ketimines with Allenoates: Easy Access to a Tetrahydropyridine Framework with a Chiral Tetrasubstituted Stereogenic Carbon Center, S. Takizawa, F. A. Arteaga, Y. Yoshida, M. Suzuki, H. Sasai: Asian J. Org. Chem., 3 (2014) 412-415.

[2]Palladium Enolate Umpolung: Cyclative Diacetoxylation of Alkynyl Cyclohexadienones Promoted by a Pd/SPRIX Catalyst, K. Takenaka, S. C. Mohanta, H. Sasai: Angew. Chem. Int. Ed., 53 (2014) 4675-4679.

[3]C3-Symmetric Chiral Trisimidazoline-Catalyzed Friedel-Crafts (FC)-Type Reaction, S. Takizawa, S. Hirata, K. Murai, H. Fujioka, H. Sasai: Org. Biomol. Chem., 12 (2014) 5827-5830.

[4]Facile Regio- and Stereo-Selective Metal-Free Synthesis of All-Carbon Tetrasubstituted Alkenes Bearing a C(sp3)-F Unit via Dehydroxyfluorination of Morita-Baylis-Hillman (MBH) Adducts, S. Takizawa, F. A. Arteaga, K. Kishi, S. Hirata, H. Sasai: Org. Lett., 16 (2014) 4162-4165.

[5]Enantioselective Construction of C2-Symmetric Spiro Skeleton through Intramolecular Copper-Catalyzed N-Arylation, K. Takenaka, M. Sako, S. Takatani, H. Sasai: ARKIVOC, 2015 (2014) 52-63.

[6]Alkylamines-Intercalated α-Zirconium Phosphate as Latent Thermal Anionic Initiators, O. Shimomura, K. Maeno, A. Ohtaka, S. Yamaguchi, J. Ichihara, K. Sakamoto, R. Nomura: Journal of Polymer Science, Part A: Polymer Chemistry, 52 (2014) 1854-1861.

International Conferences

[1]Enantioselective Synthesis of α -Methylidene- γ -Butyrolactones and γ -Butyrolactams: Intramolecular Rauhut-Currier Reaction Promoted by Bifunctional Organocatalysts (poster), S. Takizawa, T. M.-N. Nguyen, K. Kishi, F. A. Arteaga, M. Suzuki, H. Sasai: 15th Tetrahedron Symposium, London, UK, June 24-27, 2014.

[2]Enantioselective Organocatalyzed Formal [n+2] Cycloaddition Using Allenoates (poster), S. Takizawa, F. A. Arteaga, Y. Yoshida, M. Suzuki, T. M.-N. Nguyen, H. Sasai: 15th Tetrahedron Symposium, London, UK, June 24-27, 2014.

[3]Ir Catalyzed Asymmetric Tandem Reaction of meso-Diols and Aldehydes (poster), T. Suzuki, Y. Ishizaka, K. Ghozati, D.-Y. Zhou, K. Asano, H. Sasai: 2nd International Symposium on C-H Activation, Rennes, France, June 30 – July 3, 2014.

[4]Catalytic Enantioselective Pd(II)/Pd(IV) Reactions Using SPRIX Ligand (oral), H. Sasai: 20th International Conference on Organic Synthesis, Budapest, Hungary, June 29-July 4, 2014.

[5]Ir Catalyzed Asymmetric Tandem Reaction of meso-Diols and Aldehydes (oral), T. Suzuki, Y. Ishizaka, K. Ghozati, D.-Y. Zhou, K. Asano, H. Sasai: The 26th International Conference on Organometallic Chemistry (ICOMC2014), Sapporo, Japan, July 13-18, 2014.

[6]Recent Progress in Enantioselective Reactions Catalyzed by Pd-SPRIX: Pd Enolate Umpolung and Pd(II)/Pd(IV) Catalysis (oral), K. Takenaka, S. C. Mohanta, Y. D. Dhage, H. Sasai: The 26th International Conference on Organometallic Chemistry (ICOMC2014), Sapporo, Japan, July 13-18, 2014.

[7]Enantioselective Synthesis of Chiral Spiro Compounds and Their Applications to Organocatalysis (poster), Y. Takeuchi, L. Fan, S. Takizawa, H. Sasai: The 26th International Conference on Organometallic Chemistry (ICOMC2014), Sapporo, Japan, July 13-18, 2014.

[8]Recent Progress in Enantioselective Reactions Catalyzed by Pd-SPRIX: Pd Enolate Umpolung and Pd(II)/Pd(IV) Catalysis (invited), K. Takenaka: ICOMC 2014 Post-Symposium in Osaka: New Aspects of Reactive Organometallic Complexes of Transition Metals, Osaka, Japan, July 19, 2014.

[9]Development of Novel Chiral Spiro Ligands Bearing Imidazoles Coordination Sites (poster), S. Takatani, K. Sawada, K. Takenaka, H. Sasai: ICOMC 2014 Post-Symposium in Osaka: New Aspects of

Reactive Organometallic Complexes of Transition Metals, Osaka, Japan, July 19, 2014. [10]Enantioselective C-C Bond Forming Reactions Catalyzed by Vanadium(V) Complex (poster), M. Sako, S. Takizawa, Y. Yoshida, J. Kodera, T. Doi, H. Sasai: ICOMC 2014 Post-Symposium in Osaka: New Aspects of Reactive Organometallic Complexes of Transition Metals, Osaka, Japan, July 19, 2014.

[11]Palladium-Catalyzed Direct C–H Arylation of Isoxazoles at Their 5-Position (poster), M. Shigenobu, K. Takenaka, H. Sasai: ICOMC 2014 Post-Symposium in Osaka: New Aspects of Reactive Organometallic Complexes of Transition Metals, Osaka, Japan, July 19, 2014.

[12]Recent Progress of Enantioselective Catalysis Promoted by Pd-SPRIX (poster), S. C. Mohanta, Y. D. Dhage, K. Takenaka, H. Sasai: 248th ACS National Meeting & Exposition, San Francisco, USA, August 10-14, 2014.

[13]Enantioselective Organocatalyzed Domino Process Based on aza-Morita-Baylis-Hillman-Type (aza-MBH) Reaction (poster), S. Hirata, S. Takizawa, N. Inoue, F. A. Arteaga, Y. Yoshida, M. Suzuki, H. Sasai: 248th ACS National Meeting & Exposition, San Francisco, USA, August 10-14, 2014.

[14]Enantioselective Palladium(II) Catalyzed Cyclization-Cycloaddition Cascade Reactions of Alkenyl Oximes (poster), M. A. Abozeid, S. Takizawa, H. Sasai: 248th ACS National Meeting & Exposition, San Francisco, USA, August 10-14, 2014.

[15]Organocatalyzed Enantioselective Reactions of Ketimines with Allenoates (oral), S. Takizawa, F. A. Arteaga, Y. Yoshida, M. Suzuki, H. Sasai: Aachen-Osaka Joint Symposium, Aachen, Germany, September 3-5, 2014.

[16]Palladium-Catalyzed Direct C–H Arylation of Isoxazoles at Their 5-Position (oral), M. Shigenobu, K. Takenaka, H. Sasai: Aachen-Osaka Joint Symposium, Aachen, Germany, September 3-5, 2014.

[17]Enantioselective C–C Bond Forming Reactions Catalyzed by Vanadium(V) Complex (oral), M. Sako, S. Takizawa, Y. Yoshida, J. Kodera, H. Sasai: Aachen-Osaka Joint Symposium, Aachen, Germany, September 3-5, 2014.

[18]Recent Progress of Enantioselective Catalysis Promoted by Pd-SPRIX (poster), S. C. Mohanta, X. Lin, K. Takenaka, H. Sasai: ETH Zürich-Osaka Univ. Joint Symposium, Osaka, Japan, October 9-10, 2014.

[19]Enantioselective C–C Bond Forming Reactions Catalyzed by Vanadium(V) Complex (poster), M. Sako, S. Takizawa, T. Tsujihara, Y. Yoshida, J. Kodera, T. Kawano, H. Sasai: ETH Zürich-Osaka Univ. Joint Symposium, Osaka, Japan, October 9-10, 2014.

[20]Recent Progress in Enantioselective Reactions Catalyzed by Pd-SPRIX: Pd Enolate Umpolung and Pd(II)/Pd(IV) Catalysis (poster), S. C. Mohanta, Y. D. Dhage, K. Takenaka, H. Sasai: The 2nd International Conference on Organometallics and Catalysis, Nara, Japan, October 26-29, 2014.

[21]Development of Novel Chiral Spiro Ligands Bearing Imidazole Coordination Sites (poster), K. Sawada, S. Takatani, K. Takenaka, H. Sasai: The 2nd International Conference on Organometallics and Catalysis, Nara, Japan, October 26-29, 2014.

[22]Palladium-Catalyzed Direct C–H Arylation of Isoxazoles at Their 5-Position (poster), M. Shigenobu, K. Takenaka, H. Sasai: The 2nd International Conference on Organometallics and Catalysis, Nara, Japan, October 26-29, 2014.

[23]Novel Enantioselective Reactions Promoted by Pd-SPRIX; Pd(II)/Pd(IV) Catalyses and Umpolung of Pd-Enolates (invited), H. Sasai: Molecular Chirality Asia 2014, Beijing, China, October 29-31, 2014.

[24]Enantioselective Palladium(II) Catalyzed Cyclization-Cycloaddition Cascade Reactions of Alkenyl Oximes (poster), M. A. Abozeid, S. Takizawa, H. Sasai: Molecular Chirality Asia 2014, Beijing, China, October 29-31, 2014.

[25]Development of New SPRIX Ligands Having an effective Asymmetric Environment (poster), X. Lin, K. Takenaka, H. Sasai: Molecular Chirality Asia 2014, Beijing, China, October 29-31, 2014.

[26]Enantioselective C–C Bond Forming Reactions Catalyzed by Vanadium(V) Complex (poster), S. Takizawa, Y. Yoshida, M. Sako, J. Kodera, T. Sakai, H. Sasai: Molecular Chirality Asia 2014, Beijing, China, October 29-31, 2014.

[27]Enantioselective Organocatalyzed Formal [n+2] Cycloaddition Using Allenoates (poster), S. Takizawa, F. A. Arteaga, Y. Yoshida, M. Suzuki, K. Kishi, T. M.-N. Nguyen, H, Sasai: Molecular Chirality Asia 2014, Beijing, China, October 29-31, 2014.

[28]Enantio- and Diastereoselective Rauhut-Currier Reaction: Facile Synthesis of α-Methylidene-γ-Butyrolactones and γ-Butyrolactams (poster), S. Takizawa, K. Kishi, T. M.-N Nguyen, S. A. Arteaga, M. Suzuki, H. Sasai: Advanced Molecular Transformations by Organocatalysts 2nd International Conference & 7th Symposium on Organocatalysis, Tokyo, Japan, November 21-22, 2014.

[29]Ir Catalyzed Asymmetric Tandem Reaction of meso-Diols and Aldehydes (poster), T. Suzuki, Ismiyarto, Y. Ishizaka, K. Ghozati, D.-Y. Zhou, K. Asano, H. Sasai: The 18th SANKEN and The 13th SANKEN Nanotechnology Symposium, Osaka, Japan, December 10-11, 2014.

[30]Carbon Nanotubes(CNTs)-Supported Vanadium(V) Catalyst (poster), M. Sako, S. Takizawa, T. Tsujihara, Y. Yoshida, J. Kodera, T. Kawano, H. Sasai: The 18th SANKEN and The 13th SANKEN Nanotechnology Symposium, Osaka, Japan, December 10-11, 2014.

[31]Palladium-Catalyzed Direct C5 Arylation of Isoxazoles: Mechanistic Study and Application (oral), M. Shigenobu, K. Takenaka, H. Sasai: Biotechnology and Chemistry for Green Growth (Aachen-Osaka Joint Symposium), Osaka, Japan, March 10-11, 2015.

Review Papers

Enantioselective Acid-Base Organocatalyzed Domino Reactions Based on aza-Morita-Baylis-Hillman Process, S. Takizawa, H. Sasai, J. Synth. Org. Chem. Jpn., The Society of Synthetic Organic Chemistry, Japan, 72[7] (2014), 781-796.

A Dual Relationship without a Duel: Enantioselective Synthesis via Cooperative Catalysis, K. Takenaka, H. Sasai, Chemistry, Kagakudojin, 69[10] (2014), 66-67.

Books

[1]The Henry (Nitroaldol) Reaction(P. Knochel, G. A. Molander) H. Sasai, "Comprehensive Organic Syntheses, Second Edition", Elsevier, 2[2-13] (543-570) 2014.

[2]Addition Reactions with Formation of Carbon–Oxygen Bonds: (iv) The Wacker Oxidation and Related Reactions(P. Knochel, G. A. Molander) K. Takenaka, H. Sasai, "Comprehensive Organic Syntheses, Second Edition", Elsevier, 7[7-17] (431-491) 2014. **Patents**

[1]G20140061WO, PCT/JP2014/080375

[2]K20080301, 2009-115073

[3]K20080099, K20080099

[4]K20080100, K20080100 [5]K20080101, K20080101

[6]K20090300, K20090300

Contributions to International Conferences and Journals

H. Sasai	The 26th International Conference on Organometallic Chemistry (ICOMC2014)			
	(Organaizing Committee)			
K. Takenaka The 26th International Conference on Organometallic Chemistry (ICOMC				
	(Organaizing Committee)			
H. Sasai	ICOMC 2014 Post-Sympo	sium in Osaka: New Aspects of Reactive Or	ganometallic	
	Complexes of Transition N	Aetals (Organaizing Committee)	0	
Publications in Do	mestic Meetings			
Symposium on Mol	ecular Chirality 2014		1 paper	
Joint Symposium of	n "Advanced Molecular Tra	nsformations by Organocatalysts" and	1 paper	
"Molecular Activati	on Directed toward Straight	tforward Synthesis"	1.1.1	
2014 Summer Sym	posium on Process Chemist	rv	1 paper	
34th Synthetic Orga	nic Chemistry Seminar for	Young Scientists	3 papers	
44th Congress of He	eterocyclic Chemistry		1 naner	
61st Symposium on	Organometallic Chemistry	Japan	1 paper	
22nd Synthetic Org	anic Chemistry Seminar	Jupun	1 paper	
40th Symposium on	Progress in Organic Reacti	ions and Syntheses Symposium	2 napers	
The 135th Annual N	Jeeting of PSI	ions and Syntheses Symposium	2 papers	
The 95th CSI Annu	al Meeting		10 papers	
Academic Degrees			10 papers	
Doctor Degree of	Organocatalyzed Enantios	elective Raubut-Currier Reaction and Forma	1 [3+2]	
Chemistry	Cycloaddition: Their appli	estion to the Synthesis of a Alkylidene y bu	tyrolactones	
T M N Nauvon	and Banzofuranonas	eation to the synthesis of u-Aikyndene-y-ou	tyrolactones	
Doctor Dograd of	Enontiosoloctivo Organoos	atalyzad aza Marita Raylis Hillman and For	mal[n+2]	
Chemistry	Enantioselective Organocatalyzed aza-Monta-Bayits-Hillman and Formal [n+2]			
	Cycloaddition Reactions o	a Kethinines		
F. A. Alleaga	Development of Nevel Ch	iral Liganda Dagad an Spirahilaatan		
Chamistery	Development of Novel Ch	irai Ligands Based on Spirobhactani		
Chemistry C. Talaatani				
S. Takatam				
Doctor Degree of	Development of Chiral He	licenes and Chiral Spiro-type Ionic liquids b	earing	
Chemistry	functionalized 1,2,3-triazo	les		
Y. Yoshida				
Master Degree of	Development of Catalytic and Enantioselective Synthesis of Oxa[9]helicenes and			
Chemistry	Spiro[4.4]nonanones			
Y. Takeuchi				
Master Degree of	Construction of Chiral Qua	aternary Carbon Center via Inter and Intra-m	olecular	
Chemistry	Cyclization Reactions			
K. Kishi				
Grant-in-Aid for S	cientific Research			
S. Takizawa	Development of Multifunc	tional Organocatalysts and their	¥3,510,000	
	Applications to Enantiosel	ective Domino Reactions		
S. Takizawa	Development of Chiral Spiro-type Catalysts and their Applications ¥1,430,000			
	to Green Reactions			
J. Ichihara	Reaction mechanism of the	e halogen-free epoxidation reaction by the	¥1,300,000	
	environmentally friendly p	owder reaction		
Entrusted Researc	h			
H. Sasai	Japan Science and	Control of Chirality by Immobilized	¥10,920,000	
	Technology Agency	Ligands Based on Metal-bridging Polymer		
H. Sasai	Japan Science and	Practical Transformation Based on	¥7,800,000	

	Technology Agency	Catalytic Asymmetric Domino	
		Reactions	
Contribution to	o Research		
H. Sasai	Nagase ChemteX Corpor	ation	¥1,200,000
H. Sasai	Nissan Chemical Industri	les, Ltd.	¥400,000
Cooperative R	esearch		
J. Ichihara	OKAWARA MFG. Co., L	td.	¥864,000
J. Ichihara	OKAWARA MFG. Co., L	td.	¥0,000
Other Research	h Fund		
H. Sasai	National Institute of Natu	ral Sciences, Institute for Molecular	¥3,000,000
	Science		

Department of Regulatory Bioorganic Chemistry

Original Papers

[1]Formation of Ligand-Assisted Complex of Two RNA Hairpin Loops, C. Hong, T. Otabe, S. Matsumoto, C. Dohno, A. Murata, M. Hagihara, K. Nakatani: Chem. Eur. J., 20 (2014) 5244-5252.

[2]Modulation of binding properties of amphiphilic DNA containing multiple dodecyl phosphotriester linkages to lipid bilayer membrane, S. Makishi, T. Shibata, M. Okazaki, C. Dohno, K. Nakatani: Bioorg. Med. Chem. Lett., 24 (2014) 3578-3581.

[3]Synthesis of 8-substituted adenine and adenosine libraries and the binding to pre-miR-29a, T. Fukuzumi, H. Aikawa, Y. Harada, A. Sugai, A. Murata, K. Nakatani: Bull. Chem. Soc. Jpn., 87 (2014) 1013-1015.

[4]Cytosine-bulge dependent fluorescence quenching for real-time hairpin primer PCR, F. Takei, C. Chen, G. Yu, T. Shibata, C. Dohno, K. Nakatani: Chem. Commun., 50 (2014) 15195-15198.

[5]Recognition of Chelerythrine to Human Telomeric DNA and RNA G-quadruplexes, L. Bai, M. Hagihara, K. Nakatani, Z. H. Jiang: Sci. Rep., 4 (2014) 6767.

[6]2-Aminophenanthroline dimer stabilized the C-C mismatched duplex DNA, J. Li, J. Matsumoto, K. Otabe, C. Dohno, K. Nakatani: Bioorg. Med. Chem., 23 (2015) 753-758.

International Conferences

[1]Synthesis and Evaluation of 8-substituted Adenine Derivatives as RNA Binding Molecules (poster), H. Aikawa, T. Fukuzumi, A. Murata, Y. Harada, K. Nakatani: RNA 2014 The 19th Annual Meeting of the RNA Society.

[2]Synthesis and design of RNA binding molecules in enthalpy-driven manner (poster), N. Natsuhara, Y. Di, T. Tsuda, S. Mukherjee, K. Nakatani: RNA 2014 The 19th Annual Meeting of the RNA Society.

[3]Regulation of DNA/RNA structure and function by small molecules (invited), K. Nakatani: JSPS UK-Japan Meeting: From Duplexes to Quadruplexes –Understanding DNA Structure and Function.

[4]Synthetic DNA that works in lipid membrane system (oral), C. Dohno, K. Nakatani: Next Generation Sensor Devices for a Healthier, Safer Society International Networking Workshop.

[5]Regulation of –1ribosomal frameshifting by ligand-induced RNA pseudoknot formation (poster), K. Nakatani: XXI Round Table on Nucleosides, Nucleotides and Nucleic acids.

[6]Novel PCR Monitoring System Using Hairpin Primer Having Cytosine-Bulge and Covalent Binding Fluorescence Molecule (poster), F. Takei, C. Chen, G. Yu, C. Dohno, K. Nakatani: XXI Round Table on Nucleosides, Nucleotides and Nucleic acids.

[7]Development of Novel PCR Primers for Facile Gene Detection (invited), K. Nakatani: A3RONA 2014 China.

[8]Synthetic RNA switches controlled by a photoresponsive ligand (poster), C. Dohno, M. Kimura, I. Kohyama, K. Nakatani: ISNAC2014.

[9]Synthesis of amphiphilic i-motif DNAs (poster), H. Yamaguchi, K. Matsuzaki, S. Makishi, T. Shibata, C. Dohno, K. Nakatani: ISNAC2014.

[10]In vitro selection of pre-miR-29a loop mutant library against the restrained naphthyridine dimer (poster), Y. Mori, Y. Di, A. Sugai, T. Otabe, J. Li, H. Aikawa, A. Murata, K. Nakatani: ISNAC2014.

[11]Targeting CUG trinucleotide repeats with synthetic ligands (poster), J. Li, J. Matsumoto, K. Nakatani: ISNAC2014.

[12]Suppression of miR-29a maturation by synthetic ligand (oral), T. Otabe, J. Li, A. Murata, K. Nakatani: ISNAC2014.

[13]Toward new FET devices detecting DNA (oral), R. K. Verma, A. Michikawa, N. Sabani, F. Takei, K. Nakatani: 3rd imec Handai International Symposium.

[14]Regulation of Structure and Function of Nucleic Acids by Small Molecules (oral), K. Nakatani: 2015 IMCE International Symposium.

Publications in D	omestic Meetings		
The 95rd CSJ Annual Meeting 2015			13 papers
The 135th Annual	The 135th Annual Meeting of the Pharmaceutical Society of Japan		
9th Annual Meetin	ng of Japanese Society for Ch	nemical Biology	3 papers
The 76th JSAP Sp	ring Meeting		1 paper
Academic Degree	es		
Master Degree	Synthesis of naphthyridine	e-amino sugar conjugates for DNA and RN	NA binder
for Science			
Y. Okada			
Master Degree	Design and synthesis of en	nthalpy driven RNA binding ligands	
for Science			
N. Natsuhara			
Doctoral Degree	Studies on DNA nanostruc	ctures modified with hydrophobic moieties	s and their
for Science	interaction with lipid mem	ibranes	
S. Makishi			
Grant-in-Aid for	Scientific Research		
K. Nakatani	Chemical Biology Studies	on Trinucleotide Reat Disease using	¥123,760,000
	Repat-Binding Molecules		
F. Takei	The high sensitive virus detection system using hairpin primer ¥6,500,000		
	PCR method		
A. Murata	Gene regulation by small r	nolecule-modulated miRNA pathway	¥1,950,000
H. Aikawa	Developments of new modification reactions of peptide and ¥1,950,000		
	development of new amide	e isosteres	
Entrusted Resear	rch		
K. Nakatani	National Institute of	Development of Research Basis for	¥48,000,000
	Biomedical Innovation	accelerating the Drug Discovery	
		targeting Functional ncRNA	
K. Nakatani	JST	Development of Digital Hairpin	¥9,185,000
		Primer OCR for Diagnosis of	

Hepatitis

Cooperative Re	search	
K. Nakatani	NITTO KASEI co., ltd.	¥864,000
K. Nakatani	FURUKAWA ELECTRIC ADVANCED ENGINEERING	¥0,000
	CO.,LTD.	

Department of Organic Fine Chemicals Original Papers

[1]RNA-Directed Amino Acid Coupling as a Model Reaction for Primitive Coded Translation, K. Harada, S. Aoyama, A. Matsugami, P. K. R. Kumar, M. Katahira, N. Kato, J. Ohkanda: ChemBioChem, 15 (6) (2014) 794-798.

[2]Virus purification and enrichment by hydroxyapatite chromatography on a chip, M Niimia, T. Masuda, K Kaihatsu, N. Kato, S. Nakamura, T. Nakaya, F. Arai: Sens. Actut. B, 201 (2014) 185-190.

[3]Alkylamines-intercalated α-zirconium phosphate as latent thermal anionic initiators, O. Shimomura, K. Maeno, A. Ohtaka, S. Yamaguchi, J. Ichihara, K. Sakamoto, R. Nomura: J. Polymer Sci., Part A: Polymer Chem., 52 (13) (2014) 1854-1861.

[4]Significant roles of the (pro)renin receptor in integrity of vascular smooth muscle cells., A. Kurauchi-Mito, A. Ichihara, K. Bokuda, M. Sakoda, K. Kinouchi, T. Yaguchi, T. Yamada, G. H. Sun-Wada, Y. Wada, H. Itoh: Hypertens Res., 37 (9) (2014) 830-835.

[5]Cotylenin A and arsenic trioxide cooperatively suppress cell proliferation and cell invasion activity in human breast cancer cells, T. Kasukabe, J. Okabe-Kado, N. Kato, Y. Honma, S. Kumakura: Int. J. Oncol., 46 (2) (2015) 841-848.

[6]An EGCG derivative effectively induces apoptosis via SHP-1-mediated suppression of BCR-ABL and STAT3 signalling in chronic myelogenous leukaemia., JH. Jung, M. Yun, EJ. Choo, SH. Kim, MS. Jeong, DB. Jung, H. Lee, EO. Kim, N. Kato, B. Kim, SK. Srivastava, K. Kaihatsu, SH. Kim.: Br. J. Pharmacol., in press (2015).

International Conferences

[1]Effect of Non-natural Amino Acids on the Functions of Peptide and Peptide Nucleic Acid (oral), K. Kaihatsu, N. Kato: BIT's 7th Annual World Protein & Peptide Conference.

[2]Diagnosis of influenza virus gene by peptide nucleic acid-immobilized device.Current problems and solutions. Microbiology & Infections Disease Asia Congress. (oral), K. Kaihatsu: BIT's Annual World Congress of Microbes 2014.

[3]Rapid identification of influenza A virus gene by peptide nucleic acid-chromatography (oral), K. Kaihatsu: 2nd Annual Microbiology & Infections Disease Asia Congress.

[4]Upregulation of Vacuolar-type ATPase G1 Subunit by a Genetic Loss of Subunit G2 in Neuron (poster), Nobuyuki Kawamura, 1 Ge-Hong Sun-Wada, and 2 Yoh Wada: 15th IUBMB International Conference.[5]Effect of terminal functional group of peptide nucleic acid on its sequence specificity (oral), K.Kaihatsu, N. Kato: the 41st International Symposium on Nucleic Acids Chemistry.

[6]Association behavior of tolane-modified peptide nucleic acid with ssDNA (poster), K. Kaihatsu, N. Kato: the 41st International Symposium on Nucleic Acids Chemistry.

[7]Effect of terminal tolane group of peptide nucleic acid on its sequence specificity (poster), K. Kaihatsu, T. Hayashi, M. Okazaki, K. Takagi, S. Sawada, N. Kato: The 18th SANKEN International Symposium.

[8]Structure function relationship of fusicoccin derivatives as protein-protein interaction stabilizers (poster), : The 19th SANKEN International Symposium.[9]Structure-based drug design of novel inhibitors of the bacterial multidrug efflux transporters (poster), : The 20th SANKEN International Symposium.

[10]Microautophagy, a unique membrane dynamics, in rodent visceral endoderm is involved in the regulation of canonical Wnt pathway and morphogenesis (poster), Yoh Wada, Minako Aoyama, Nobuyuki Kawamura, Ge-Hong Sun-Wada: Endoderm Lineages in Development and Disease, Keystone Symposium.

[11]Embryonic defect in ATP6Voc mutant mice lacking the vacuolar-type H+-ATPase c subunit (poster), Yoh Wada, Minako Aoyama, Nobuyuki Kawamura, Ge-Hong Sun-Wada: Endoderm Lineages in Development and Disease, Keystone Symposium.

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Patents

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[3]G20140061WO Method for producing epoxy compounds with solid catalysts, PCT/JP2014/080375

Contributions to International Conferences and Journals

Contributions to	o miter national Comercices and sour nuis	
K. Kaihatsu	Journal of Antivirals and Antiretrovirals (Editorial Board)
Publications in	Domestic Meetings	
The Chemical So	ociety of Japan	2 papers
Japanese Society	for Chemical Biology	3 papers
Japan Catechinol	logy	3 papers
Japanese Society	of Developmental Biologists	1 paper
The Society for A	Antibacterial and Antifungal agents, Japan	1 paper
The Society of P	olymer Science, Japan	1 paper
Biooptics		1 paper
Tea Academic Re	esearch Society	1 paper
Academic Degre	ees	
Master Degree	Single-base mismatch recognition by N-termal tolane-mo	odified peptide nucleic acid

for Science

K. Takagi Grant-in-Aid for Scientific Research

010010 101 1010 101 1		
Y. Wada	Microautophagy as a regulatory mechanism in early	¥6,500,000
	embryogenesis	
K. Kaihatsu	Single-base mismatch discrimination by chemically-modified	¥5,590,000
	peptide nucleic acid	
Y. Wada	A novel endocytic pathway, microautophagy	¥1,170,000
K. Kaihatsu	Development of Highly sensitive RNA detection system by	¥1,950,000
	artificial nucleoproteins	
K. Kaihatsu	Development of on-chip device for respiratory virus detection	¥1,300,000
	and its application	

K. Kaihatsu	Development of 3-way junction nucleic acid for the inhibition of influenza virus		¥260,000
Entrusted Researc	ch		
N. Kato	JST	Design and synthesis of universal inhibitors for bacterial efflux pumps	¥12,484,000
Contribution to R	esearch	I T	
K. Kaihatsu	Toyobo Co., Ltd.		¥1,200,000
K. Kaihatsu	Arkray, Ltd.		¥199,000
Y. Higuchi	Protein Research Fundation		¥800,000
Cooperative Resea	urch		
K. Kaihatsu	Protectea Co. Ltd.		¥108,000
K. Kaihatsu	Protectea Co. Ltd.		¥872,000
K. Kaihatsu	Rico Co. Ltd.		¥1,500,000

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[1]High-throughput de novo screening of receptor agonists with an automated single-cell analysis and isolation system, N. Yoshimoto, K. Tatematsu, M. Iijima, T. Niimi, A.D. Maturana, I. Fujii, A. Kondo, K. Tanizawa, and S. Kuroda: Sci. Rep., 4 (2014) 4242.

[2]Oligomerization-induced conformational change in the C-terminal region of Nel-like molecule 1 (NELL1) protein is necessary for the efficient mediation of murine MC3T3-E1 cell adhesion and spreading, Y. Nakamura, A. Hasebe, K. Takahashi, M. Iijima, N. Yoshimoto, A.D. Maturana, K. Ting, S. Kuroda, and T. Niimi: J. Biol. Chem., 289 (2014) 9781-9794.

[3]Enhanced OH radical generation by dual-frequency ultrasound with TiO2 nanoparticles: Its application to targeted sonodynamic therapy, K. Ninomiya, K. Noda, C. Ogino, S. Kuroda, and N. Shimizu: Ultrason. Sonochem., 21 (2014) 289-294.

[4]Specific delivery of microRNA93 into HBV-replicating hepatocytes downregulates protein expression of liver cancer susceptible gene MICA, M. Ohno, M. Otsuka, T. Kishikawa, C. Shibata, T. Yoshikawa, A. Takata, R. Muroyama, N. Kowatari, M. Sato, N. Kato, S. Kuroda, and K. Koike: Oncotarget, 5 (2014) 5581-5590.

[5]A cisplatin-incorporated liposome that targets the epidermal growth factor receptor enhances radiotherapeutic efficacy without nephrotoxicity, J. Jung, S.Y. Jeong, S.S. Park, S.H. Shin, E.J. Ju, J. Choi, J. Park, J.H. Lee, I. Kim, Y.A. Suh, J.J. Hwang, S. Kuroda, J.S. Lee, S.Y. Song, and E.K. Choi: Int. J. Oncology, 46 (2015) 1268-1274.

[6]Single-cell-based breeding: Rational strategy for the establishment of cell lines from a single cell with the most favorable properties, N. Yoshimoto, and S. Kuroda: J. Biotechnol. Bioeng., 117 (2014) 394-400.

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[8]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., 290 (2015) 11144-11166.

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surfaces (poster), M. Iijima, and S. Kuroda: Biosensors2014, Melbourne, Australia, May 27-31, 2014.

[2]Mechanical cell sorting using antibody-immobilized nanoneedle array (poster), M. Miyazaki, R. Kawamura, S.R. Rao, T. Kobayashi, M. Iijima, S. Kuroda, F. Iwata, and C. Nakamura: Biosensors2014, Melbourne, Australia, May 27-31, 2014.

[3]Enhancement of mass-detection sensitivity in wireless-electrodeless QCM biosensors by bio-nanocapsules (poster), K. Noi, H. Ogi, M. Iijima, S. Kuroda, and M. Hirao: Biosensors2014, Melbourne, Australia, May 27-31, 2014.

[4]Sub-atomic resolution structure of bacterial copper amine oxidase shows binding of O2-like diatomic molecules under atmospheric conditions (oral), T. Okajima, T. Murakawa, H. Hayashi, and K. Tanizawa: The 4th International conference on cofactor (ICC-04), Parma, Italy, August 25-28, 2014.

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The Bio–nanocapsule: Versatile Liposomes Armed with Virus–derived Functional Domains, S. Kuroda, Membrane, The Membrane Society of Japan, 39 (2014), 283-289.

Development of automated single cell analysis and isolation system, S. Kuroda, BB Chube, The Society for Biotechnology, Japan; Chubu Branch, 5 (2014), 15-20.

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[1]Bio-nanocapsules: Nanocarriers for drug delivery system functioning as a bioimaging tool(Technical Information Institute CO., LTD) N. Yoshimoto, S. Kuroda, "Preparation of micro / nano- capsules, sustained-release control and application case", Technical Information Institute Co., Ltd, (257-263) 2014.

[2]Development of An Automated Single-Cell Analysis and Isolation System for Realizing Single Cell-Based Breeding(T. Omasa) N. Yoshimoto, S. Kuroda, "Advanced cell culture process engineering for production of biologics. High technology informaion.", CMC Publishing Co.,Ltd., (56-66) 2015.

[3]Bio-nanocapsules: Nanocarriers Harboring Virus-Derived Transfection Machinery for Use as Pinpoint Drug Delivery Systems(A. Tsuda & P. Gehr) S. Kuroda, "Nanoparticles: Drug Inhalation Therapy – Events at Air-Blood Tissue Barrier", CRC, (235-246) 2014.

[4]Novel Bone Morphogenetic Protein NELL1 (Nagoya University Editorial Committee for Cutting-edge Medical Engineering) T. Niimi, S. Kuroda, "Cutting-edge Medical Engineering", ICHIRYUSHA, 2014.
[5]Bio-nanocapsules: Nanocarriers for In-Vivo Pinpoint Drug and Gene Delivery Systems (Nagoya University Editorial Committee for Cutting-edge Medical Engineering) N. Yoshimoto, S. Kuroda, "Cutting-edge Medical Engineering", ICHIRYUSHA, 2014.

Patents

[1] Drug Delivery System, ZL2008 8 012784.9

[2] LIPOSOME COMPLEX, PRODUCTION METHOD AND ITS USE, 5713311

[3] Neutral and Anionic Liposomes Containing Nucleic Acids and Their Manufacturing Method, 2014-170680

Contributions to International Conferences and Journals

- S. KURODA The Journal of Biochemistry (Tokyo) (Associate Editor)
- S. KURODA The Open Veterinary Science Journal (Editorial Board Member)
- S. KURODA The Open Nanomedicine Journal (Editorial Board Member)
- T. OKAJIMA The Journal of Biochemistry (Advisory Board)

Publications in Domestic Meetings

The 14th Annual Meeting of the Protein Science Society of Japan			2 papers
The 30th Annual Meeting of the Japan Society of Drug Delivery System			1 paper
The 157th meeting of the Japanese Society of Veterinary Science			1 paper
The 66th Annual N	leeting of the Society for E	Biotechnology, Japan	3 papers
The 8th Symposium	m of Division of Bifunction	nal Chemistry, The Chemical Society of	1 paper
Japan			
The 37th Annual N	leeting of the Molecular B	iology Society of Japan	3 papers
The 82th Meeting	of The Electrochemical So	ciety of Japan	1 paper
The 2015 Annual G	Conference of the Japan So	ciety for Bioscience, Biotechnology and	4 papers
Agrochemistry			
The 32th Symposit	um of Japanese Associatior	nfor Animal Cell Technology	1 paper
The 87th Annual M	leeting of the Japanese Bio	ochemical Society	4 papers
The 486th Kansai	Branch Meeting of Japan S	ociety for Bioscience, Biotechnology, and	1 paper
Agrochemistry			
Grant-in-Aid for	Scientific Research		
T. Okajima	Mechanism of FeS cluste	r-binding crosslink enzyme and production	¥1,040,000
	of novel cyclic peptide		
S. Kuroda	Development of Novel D	DS Carrier Harboring Virus-derived	¥14,560,000
	Functional Dpmains		
M. Iijima	Development of Oriented	I Immobilization Techniquess for	¥2,730,000
	Biosensing Molecules		
Entrusted Resear	ch		
K. Tatematsu	Nagoya University	Establishment of Methods for	¥2,670,000
		Preparation of Modified	
		Bionanocapsules and Their Mass	
		Production	
S. Kuroda	BRAIN	Development of Animal Vaccined	¥62,900,000
		Based on In Vivo Pinpoint DDS	
S. Kuroda	Ministry of Health,	Identification of HBV Receptors	¥11,000,000
	Labour and Welfare	by Using Bionanocapsule as a	
		Probe	
S. Kuroda	Maxis-Shinto, Inc.	Development of Degital	¥650,000
		Holography Microscope for	
		Water/Foods Examination	
Contribution to R	lesearch		
S. Kuroda	The Naito Foundation		¥3,000,000
S. Kuroda The Okawa Foundation for Information and		or Information and	¥1,000,000
	Telecommunications		
Cooperative Rese	arch		
T. Okajima	Okayama University, Kin	¥0,000	
	Chemistry, YuiMedic IN	С.	

Department of Cell Membrane Biology

Original Papers

[1]Effect of methylglyoxal on multidrug-resistant Pseudomonas aeruginosa, K. Hayashi, A. Fukushima, M. Hayashi-Nishino and K. Nishino: Front. Microbiol., 5 (2014) Airticle Number 180.

[2]Salmonella enterica serovar Typhimurium multidrug efflux pumps EmrAB and AcrEF support the major efflux system AcrAB in decreased susceptibility to triclosan, U. Rensch, K. Nishino, G. Klein and C. Kehrenberg: Int. J. Antimicrob. Agents, 44 (2) (2014) 179-180.

[3]Bile-mediated activation of the acrAB and tolC multidrug efflux genes occurs mainly through transcriptional derepression of ramA in Salmonella enterica serovar Typhimurium, S. Baucheron, K. Nishino, I. Monchaux, S. Canepa, M. C. Maurel, F. Coste, A. Roussel, A. Cloeckaert and E. Giraud: J. Antimicrob. Chemother., 69 (9) (2014) 2400-2406.

[4]AcrB, AcrD, and MdtABC multidrug efflux systems are involved in enterobactin export in Escherichia coli, T. Horiyama and K. Nishino: PLoS One, 9 (9) (2014) e108642.

International Conferences

[1]Structural basis for the inhibition of bacterial multidrug efflux pumps (oral), S. Yamasaki: ISIR and INRA International Joint Symposium.

[2]Structural Analysis of the AcrAB-TolC Multidrug Efflux System (oral), K. Hayashi: ISIR and INRA International Joint Symposium.

[3]Effects of Bile Acids and Toxic Compounds on Promoter Activities of the acrAB Operon and the ramA Gene (oral), K. Nishino: ISIR and INRA International Joint Symposium.

[4]Structural basis for the inhibition of bacterial multidrug efflux pumps (oral), S. Yamasaki: JSPS and DAAD International Joint Symposium.

[5]Structural Analysis of the AcrAB-TolC Multidrug Efflux System (oral), K. Hayashi: JSPS and DAAD International Joint Symposium.

[6]Rapid Detection of ESBL Producing Strains by the New Rapid Susceptibility Testing Method via Microscopy Using a Novel Microfluidic Device (poster), Y. Matsumoto, S. Sakakihara, R. Iino, A. Yan, K. Nishino: ICAAC2014.

[7]Regulation and Physiological Function of Bacterial Multidrug Efflux Pumps (invited), K. Nishino: The 52nd Annual Meeting of the Biophysical Society of Japan.

[8]Rapid Detection of ESBL in Enterobacteriaceae --- Application of the New Rapid Drug-Susceptibility Testing Method via Microscopy Using a Novel Microfluidic Device --- (poster), Y. Matsumoto, S. Sakakihara, R. Iino, A. Yan, A. Yamaguchi, K. Nishino: The 18th SANKEN International Symposium / The 3rd International Symposium of Nano-Macro Materials, Devices, and System Research Alliance Project.

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Functional roles of sphingosine-1-phosphate (S1P) transporter in mammals., T. Nishi, N. Kobayashi, Y. Hisano, A. Kawahara, A. Yamaguchi, Biochim. Biophys. Acta, Elsevier, 1841 (2014), 759-765.

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Patents

[1]G20100018CN, 201080033912.89999

Contributions to In	nternational Conferences an	nd Journals	
K. NISHINO	Frontiers in Micirobiology (Antimicrobials, Resistance and Chemothe	erapy)
V NICHINO	(Associate Editor)	mothemany (Ad Hee Deviewer)	
K. NISHINO	Journal of Antimianahial Che	emotherapy (Ad-Hoc Reviewer)	
K. NISHINO	Di a Cona (A di Lia a Daviano	eniouterapy (Ad-noc Reviewer)	
K. NISHINO	PLoS One (Ad-Hoc Review	er)	
K. NISHINO	Journal of Biochemistry (Ac	1-Hoc Reviewer)	
K. NISHINO	Institut Pasteur, Evaluation	of the Head of the Research Unit in Bateri	al Resistance
Publications in Do	to Antibiotics (Evaluation R mestic Meetings	eferee)	
Report Meeting of	ISPS Ikushi Prize		1 naner
88th Annual Meetin	of the Iapanese Society for	Bacteriology	2 napers
62nd Annual Meetin	ng of the Japanese Society of	Chemotherapy	2 papers
Deport Meeting of I	Nano Magro Materiala Dovio	as and System Descerab Alliance	1 papers
Labo Eastival ISID	Open to the Public	es and System Research Annance	1 paper
ICHO FESUIVAI - ISIK	Open to the Public		1 paper
DDE2014	in interpriex Japan		1 paper
PPF2014			1 paper
Annual Meeting of	Western Japan Branch of the	Japanese Society of Chemotherapy	l paper
Research Meeting of	of Society for Bacterial Drug I	Resistance	l paper
G3 Report Meeting	of Nano-Macro Materials, De	evices and System Research	1 paper
Alliance			
Report Meeting of I	Projects for Promoting Interna	ational Joint Research (Osaka	1 paper
University)			
5th Annual Meeing	of SENRI to Connect Acader	nia and Industry	1 paper
Annual Meeting of	Japanese Society for Clinical	Microbiology	3 papers
Annual Meeting of	Pseudomonas Aeruginosa Inf	ection Society	1 paper
Annual Meeting of	the Proein Science Society of	Japan	1 paper
The 96th CSJ Annu	al Meeting		1 paper
The 135th Annual M	Aeeting of the Pharmaceutical	l Society of Japan in Kobe	1 paper
Academic Degrees			
Doctoral Degree	Bacterial xenobiotic transpo	reters as a target of new drugs	
for			
Pharmaceutical			
Science			
S. Yamasaki			
Grant-in-Aid for S	cientific Research		
K. Nishino	Mechanism of bacterial hom	eostasis modulated by transportes and	¥12,220,000
	development of novel therap	eutics	
T. Nishi	Development of simple meth	¥1,560,000	
	using click chmistry		
M. Nishino	Regulation of bacterial virule	ence by ABC-type transporters	¥1,560,000
Entrusted Researc	h		
Y. Matsumoto	Japan Science and	Development of a quick method to	¥1,932,000
	Technology Agency	meaure antimicrobial susceptibilities	
		using a new device	
K. Nishino	Ministry of Education.	Mechanism of bacterial homeostasis	¥9.200.000
	Culture, Sports, Science	modulated by transportes and	- , ,
	and Technology	development of novel therapeutics	
K. Nishino	Ministry of Education	Mechanism of bacterial homeostasis	¥743 000
	Culture, Sports Science	modulated by transportes and	1, 10,000
	and Technology	development of novel therapeutics	
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Contribution to Research Y. Matsumoto Fukoku Co. Ltd. ¥3,000,000 **Cooperative Research** K. Nishino Shionogi & Co., Ltd. ¥304.000 Y. Matsumoto Fukoku Co. Ltd. ¥2,320,000 Keirex Technology Inc. ¥0,000 Y. Matsumoto K. Nishino Corinna Kehrenberg (Tierärztliche Hochschule Hannover) ¥0,000 Axel Cloeckaert (INRA, France) K. Nishino ¥0,000 Filip Van Immerseel (Ghent University) K. Nishino ¥0,000 Chikara Furusawa (RIKEN) K. Nishino ¥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 **Other Research Fund** K. Nishino Japan Society for the Promotion of Science ¥2,500,000

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[2]Optical control of the Ca2+ concentration in a live specimen with a genetically encoded Ca2+-releasing molecular tool., Fukuda N, Matsuda T, Nagai T.: ACS Chem Biol., 9 (2014) 1197-1203.

[3]In vivo visualization of subtle, transient and local activity of astrocytes using an ultrasensitive Ca2+ indicator., Kanemaru K, Sekiya H, Xu M, Satoh K, Kitajima N, Yoshida K, Okubo Y, Sasaki T, Moritoh S, Hasuwa H, Mimura M, Horikawa K, Matsui K, Nagai T, Iino M, Tanaka KF.: Cell Rep., 8 (2014) 311–318.

[4]Arl3 and LC8 regulate dissociation of dynactin from dynein., Jin M, Yamada M, Arai Y, Nagai T, Hirotsune S.: Nat Commun., 24 (2014) 5295.

[5]Ultrasensitive imaging of Ca2+ dynamics in pancreatic acinar cells of Yellow Cameleon-Nano transgenic mice., Oshima Y, Imamura T, Shintani A, Kajiura-Kobayashi H, Hibi T, Nagai T, Nonaka S, Nemoto T.: Int J Mol Sci., 15 (2014) 19971-19986.

[6]Nicotine exposure alters human vascular smooth muscle cell phenotype from a contractile to a synthetic type., Yoshiyama S, Chen Z, Okagaki T, Kohama K, Nasu-Kawaharada R, Izumi T, Ohshima N, Nagai T, Nakamura A.: Atherosclerosis., 237 (2014) 464-470.

[7]Dynamic transformations of self-assembled polymeric microspheres induced by AC voltage and shear flow., Morimoto, N., Wazawa, T., Inoue, Y., Suzuki, M.: RSC Adv., 5 (2015) 14851-14857.

[8]Redox sensor proteins for highly sensitive direct imaging of intracellular redox state., Sugiura K, Nagai T, Nakano M, Ichinose H, Nakabayashi T, Ohta N, Hisabori T.: Biochem Biophys Res Commun., 457 (2015) 242-248.

[9]Lever arm extension of myosin VI is unnecessary for the adjacent binding state., Ikezaki K, Komori T, Arai Y, Yanagida T.: BIOPHYSICS, 11 (2015) 47-53.

[10]Expanded palette of Nano-lantern for real-time muliti-color luminescence imaging., Takai A, Nakano M, Saito K, Haruno R, Watanabe TM, Ohyanagi T, Jin T, Okada Y, Nagai T.: Proc Natl Acad Sci U S A., 112 (2015) 4352-4356.

International Conferences

[1]Cellular individualty observed by cavity enhanced light absorption microscpy. (poster), Y. Arai, T. Yamamoto & T. Nagai: FOM2014(Forcus On Microscopy 2014).

[2]Genetically encoded photoactivatable Ca2+ indicator for hilighted imaging in arbitrary single cell. (oral), T. Matsuda & T. Nagai: FOM2014(Forcus On Microscopy 2014).

[3]A novel photoswitchable fluorescent protein for nanoscopy. (oral), D.K. Tiwari, Y. Arai, M. Yamanaka, K. Fujita & T. Nagai: FOM2014(Forcus On Microscopy 2014).

[4]Genetically-encoded tools to optically control and image calcium dynamics. (invited), T. Nagai: the 2014 FASEB SRC on Calcium and Cell Function.

[5]Genetically-encoded photosensitizer for light-dependent perturbation of biological function. (invited), T. Nagai: iCeMS International Symposium: "Light Control in Cell Biology".

[6]Genetically-encoded chemiluminescent voltage indicator applicable in conjunction with multiple optogenetic tools. (oral), S. Inagaki, T. Matsuda, Y. Arai, Y. Jinno, H. Tsutsui, Y. Okamura, T. Nagai: Next Generation Sensor Devices for a Healthier, Safer Society International Networking Workshop.

[7]Photochromic fluorescent protein with fast on-off switching for versatile nanoscopy. (oral), T. Nagai: IUPAB Congress 2014 (2014 International Biophysics Congress).

[8]Multi-modal superduper chemiluminescent proteins enabling multicolor functional imaging and manipulation. (poster), K. Suzuki, Y. Arai, T. Nagai: IMC 2014(The International Microscopy Congress 2014).

[9]Expanded palette of super-duper luminescent proteins for real-time multi-color long-term imaging. (oral), T. Nagai: Joint Meeting of the 1st Africa International Biotechnology & Biomedical Conference and the 8th International Workshop on Approaches to Single-Cell Analysis.

[10]Expanded palette of bright luminescent proteins for real-time multi-color luminescence imaging. (invited), T. Nagai: Janelia Conference: Fluorescent Proteins and Biological Sensors IV.

[11]Genetically-encoded chemiluminescent voltage indicator applicable in conjunction with multiple optogenetic tools. (poster), S. Inagaki, T. Matsuda, Y. Arai, Y. Jinno, H. Tsutsui, Y. Okamura, T. Nagai: Janelia Conference: Fluorescent Proteins and Biological Sensors IV.

[12]Genetically-encoded tools to optically control and image Ca2+ dynamics. (invited), T. Nagai: the 16th International Conference on Retinal Proteins (ICRP2014).

[13]Bioimaging by means of engineered fluorescent/chemiluminescent proteins. (invited), T. Nagai: Special Lecture.

[14]Luminescent Ca2+ imaging in Marchantia polymorpha. (oral), M. Iwano: Marchantia Workshop 2014.

[15]Basics of genetically-encoded fluorescent/chemiluminescentprobes. (invited), T. Nagai: 2nd AIST International Imaging Workshop.

[16]Flow Stimulation of Hela Cells Induces Transient [Mg2+]Cyt Increase as Reported by a Novel Genetically Encoded Mg2+ Indicator. (poster), V. P. Koldenkova, T. Matsuda, T. Nagai: The 18th SANKEN International Symposium.

[17]A fast positive photoswitching fluorescent protein for quantitative PALM and other live cell superresolution microscopy imaging. (poster), D. K. Tiwari, Y. Arai, M. Yamanaka, T. Dertinger, K. Fujita, T. Nagai: The 18th SANKEN International Symposium.

[18]Genetically-encoded chemiluminescent sensor for membrane voltage to monitor neuronal activity. (invited), T. Nagai: 2nd Conference of SANKEN Core to Core, 3rd imec Handai International Symposium (2nd Symposium of SANKEN BrainCirculation Program).

[19]Genetically-encoded tools to optically control and image Ca2+ dynamics. (invited), T. Nagai: International Symposium on Bio-imaging and Gene Targeting Sciences in Okayama.

[20]Toward long term single molecule imaging in live cells with luminescent probes. (invited), T. Nagai: The 15th International Membrane Research Forum.

[21]Genetically-encoded tools to optically control and image Ca2+ and Mg2+ dynamics. (invited), T. Nagai: The 2nd International Symposium on Plant Environmental Sensing.

[22]Monitoring temperature inside a single cell with a novel genetically encoded fluorescent temperature indicator. (poster), M. Nakano, Y. Arai, I. Kotera, T. Iwasaki, Y. Kamei & T. Nagai: Focus on Microscopy FOM 2015.

[23]Development of a ratiometric Mg2 indicator with expanded dynamic range. (poster), T. Nagai, S. Kawakami, T. Matsuda, M. Nakano & V.P. Koldenkova: Focus on Microscopy FOM 2015.

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Compatible use of fluorescence and chemiluminescence imaging with optogenetic stimulation during "dead-time" of CCD camera at real time., Y. Arai, T. Nagai, SEIKAGAKU, The Japanese Biochemical Society, 86[2] (2014), 167-173.

Analysis of cell individuality through photoswitchable functional probes, T. Matsuda, T. Nagai, SEITAI NO KAGAKU, Igaku-Shoin, 65[2] (2014), 101-106.

Development of a bright chemiluminescent protein, Nano-lantern, K. Saito, T. Nagai, KAGAKU TO SEIBUTSU, INTERNATIONAL ACADEMIC PUBLISHING, 52[10] (2014), 646-650.

Superresolution microscopy surpassing diffraction limit, T. Nagai, CHEMISTRY, KAGAKUDOJIN, 69 (2014), 21-26.

Genetically encoded Ca2+ indicators; expanded affinity range, color hue and compatibility with optogenetics., T. Nagai, K. Horikawa, K. Saito, T. Matsuda, Frontiers in Neuroscience, Frontiers, 7[90] (2014), 25.

Real-Time chemiluminescence imaging using Nano-Lantern probes., Y. Arai, T. Nagai, Current Protocols in Chemical Biology, John Wiley & Sons, 6[4] (2014), 221-236.

Quantitative measurement of intracellular protein dynamics using photobleaching or photoactivation of fluorescent proteins., T. Matsuda, T. Nagai, Microscopy, Oxford Journals, 63[6] (2014), 403-408.

Development of your own plugins of ImageJ., Y. Arai, SAIBOKOGAKU, Gakken Medical Shujunsha Co., Ltd., 33 (2014), 994-1001.

Real time imaging of biological phenomena with super-duper luminescent proteins., T. Nagai, CYTOLOGIA, The Japan Mendel Society, 80[1] (2015), 1-2.

Books

[1]Superresolution technology developed by fluorescence proteins(H. Noji) T. Nagai, T. Matsuda, "Single molecule nano bio measurement", KAGAKUDOJIN, (190-199) 2014.

[2]5) Brief introduction of image analysis by ImageJ(T. Kobayashi, K. Aoki) Y. Arai, "Biological Image Analysis", YODOSHA, (103-113) 2014.

[3] 6) Programming by ImageJ for Image Processing(T. Kobayashi, K. Aoki) Y. Arai, "Biological Image Analysis", YODOSHA, (114-126) 2014.

Patents

[1]G201431 Fluorescent protein, PCT/JP2014/074121

Contributions to I	nternational Conferences and Journals	
T. Nagai	BIOPHYSICS (Editorial Board)	
T. Nagai	Microscope (Editorial Board)	
Publications in Do	omestic Meetings	
The 70th Annual M	leeting of The Japanese Society of Microscopy	2 papers
Japanese Conference	ce for Laboratory Animal Science and Technology, Sapporo 2014	1 paper
The 14th Annual M	leeting of the Protein Science Society of Japan	1 paper
The 23th Annual M	leeting of the Bioimaging Society	2 papers
The 3th Fluoresce	ent Imaging Mini-symposium	1 paper
The 52nd Annual M	feeting of the Biophysical Society of Japan (BSJ2014)	7 papers
The 37th Annual M	leeting of the Molecular Biology Society of Japan	4 papers
The 9th NIBB Bioi	maging forum	1 paper
The 120th Annual M	Meeting of the Japanese Association of Anatomists The 92nd Annual	1 paper
Meeting of the Phy	siological Society of Japan	
The 87th Annual M	leeting of the biochemical society of Japan	1 paper
Academic Degrees	3	
Master Degree	Genetically-encoded chemiluminescent voltage indicator applicabl	e in conjunction
for Engineering	with multiple optogenetic tools	
S. Inagaki		
Master Degree	Development of high sesitive fluorescent Mg2+ sensor and visualize	zation of
for Engineering	intracellular Mg2+ dynamics	
S. Kawakami		
Bachelor Degree	Development of high senseitive ratiometric chemiluminescent Ca2	+ senseor for
for Engineering	quantitative measurement	
M. Ashitani		
Bachelor Degree	Gene cloning of luminescent protein from Mycena chlorophos	
for Engineering		
R. Seto		
Grant-in-Aid for S	Scientific Research	
T. Nagai	Spying minority in biological phenomena -Toward bridging	¥14,170,000
	dynamics between individual and ensemble processes-	
T. Nagai	Development of molecular probes and photonic tools for	¥54,340,000
	bio-manipulation	
T. Nagai	Innovation of chemiluminogenetics capable of noninvasive	¥22,880,000
	manipulation of biological functions deep inside body	
Y. Arai	Developlment of optical sectioning microscopy for	¥650,000
	chemiluminescent imaging	
T. Wazawa	Kinetic analysis of local visicosity of hydration layers around	¥650,000
	actomyosin by frequency-domain fluorescence polarization	
M. Iwano	Analysis of compatible-pollen reception system in Brassicaceae	¥1,690,000
Entrusted Researc	ch	

T. Nagai	Japan Science and Technology Agency (IST)	Development of multi-modal chemiluminescent imaging system	¥21,437,000
T. Matsuda	Japan Science and Technology Agency (JST)	Analysis of Dynamics of Drug Efflux Transporter and Drug	¥13,367,000
Contribution to Re	esearch	Enter multiporter and Drug	
T. Nagai	International Society Of Inter	rnal Medicine In Periodontics	¥100,000
Cooperative Resea	rch		
T. Nagai	OPTO-LINE, Inc.		¥5,896,000
T. Nagai	Nikon Instech Co.,Ltd.		¥0,000
T. Nagai	Nikon Co.,Ltd.		¥7,584,000
T. Nagai	Panasonic Corporation		¥800,000
T. Nagai	Japan Science and Technol	ogy Agency (JST)	¥9,932,000
T. Nagai	RIKEN		¥0,000
T. Nagai	RIKEN		¥0,000
T. Nagai	Hamamatsu Photonics K.K	r L.	¥0,000
Other Research Fund			
T. Nagai	JSPS		¥1,500,000

Laboratory of Microbiology and Infectious Diseases

Original Papers

[1]Effect of methylglyoxal on multidrug-resistant Pseudomonas aeruginosa, K. Hayashi, A. Fukushima, M. Hayashi-Nishino and K. Nishino: Front. Microbiol., 5 (2014) Airticle Number 180.

[2]Salmonella enterica serovar Typhimurium multidrug efflux pumps EmrAB and AcrEF support the major efflux system AcrAB in decreased susceptibility to triclosan, U. Rensch, K. Nishino, G. Klein and C. Kehrenberg: Int. J. Antimicrob. Agents, 44 (2) (2014) 179-180.

[3]Bile-mediated activation of the acrAB and tolC multidrug efflux genes occurs mainly through transcriptional derepression of ramA in Salmonella enterica serovar Typhimurium, S. Baucheron, K. Nishino, I. Monchaux, S. Canepa, M. C. Maurel, F. Coste, A. Roussel, A. Cloeckaert and E. Giraud: J. Antimicrob. Chemother., 69 (9) (2014) 2400-2406.

[4]AcrB, AcrD, and MdtABC multidrug efflux systems are involved in enterobactin export in Escherichia coli, T. Horiyama and K. Nishino: PLoS One, 9 (9) (2014) e108642.

International Conferences

[1]Structural basis for the inhibition of bacterial multidrug efflux pumps (oral), S. Yamasaki: ISIR and INRA International Joint Symposium.

[2]Structural Analysis of the AcrAB-TolC Multidrug Efflux System (oral), K. Hayashi: ISIR and INRA International Joint Symposium.

[3]Effects of Bile Acids and Toxic Compounds on Promoter Activities of the acrAB Operon and the ramA Gene (oral), K. Nishino: ISIR and INRA International Joint Symposium.[4]Structural basis for the inhibition of bacterial multidrug efflux pumps (oral), S. Yamasaki: JSPS and DAAD International Joint Symposium.

[5]Structural Analysis of the AcrAB-TolC Multidrug Efflux System (oral), K. Hayashi: JSPS and DAAD International Joint Symposium.

[6]Rapid Detection of ESBL Producing Strains by the New Rapid Susceptibility Testing Method via Microscopy Using a Novel Microfluidic Device (poster), Y. Matsumoto, S. Sakakihara, R. Iino, A. Yan, K. Nishino: ICAAC2014.

[7]Regulation and Physiological Function of Bacterial Multidrug Efflux Pumps (invited), K. Nishino: The 52nd Annual Meeting of the Biophysical Society of Japan.

[8]Rapid Detection of ESBL in Enterobacteriaceae --- Application of the New Rapid Drug-Susceptibility Testing Method via Microscopy Using a Novel Microfluidic Device --- (poster), Y. Matsumoto, S. Sakakihara, R. Iino, A. Yan, A. Yamaguchi, K. Nishino: The 18th SANKEN International Symposium / The 3rd International Symposium of Nano-Macro Materials, Devices, and System Research Alliance Project.

Review Papers

Mechanisms of antibiotic resistance, J. Lin, K. Nishino, M. C. Roberts, M. Tolmasky, R. I. Aminov and L. Zhang, Front. Microbiol., Frontiers Media S.A., 6 (2015), Article Number 34.

Molecular biology of multidrug efflux transporters, S. Yamasaki and K. Nishino, Antibiotics & Chemotherapy, Iyaku (Medicine and Drug) Journal Co., 31[3] (2015), 433-439.

Contributions to International Conferences and Journals

K. NISHINO	Frontiers in Micirobiology (Antimicrobials, Resistance and Chemotherapy)
	(Associate Editor)
K. NISHINO	Journal of Infection and Chemotherapy (Ad-Hoc Reviewer)
K. NISHINO	Journal of Antimicrobial Chemotherapy (Ad-Hoc Reviewer)
K. NISHINO	PLoS One (Ad-Hoc Reviewer)
K. NISHINO	Journal of Biochemistry (Ad-Hoc Reviewer)
K. NISHINO	Institut Pasteur, Evaluation of the Head of the Research Unit in Baterial Resistance
	to Antibiotics (Evaluation Referee)

Publications in Domestic Meetings

Report Meeting of JSPS Ikushi Prize	1 paper
88th Annual Meeting of the Japanese Society for Bacteriology	2 papers
62nd Annual Meeting of the Japanese Society of Chemotherapy	3 papers
Report Meeting of Nano-Macro Materials, Devices and System Research Alliance	1 paper
Icho Festival - ISIR Open to the Public	1 paper
ISIR Techno Salon in Interphex Japan	1 paper
PPF2014	1 paper
Annual Meeting of Western Japan Branch of the Japanese Society of Chemotherapy	1 paper
Research Meeting of Society for Bacterial Drug Resistance	1 paper
G3 Report Meeting of Nano-Macro Materials, Devices and System Research Alliance	1 paper
Report Meeting of Projects for Promoting International Joint Research (Osaka University)	1 paper
5th Annual Meeing of SENRI to Connect Academia and Industry	1 paper
Annual Meeting of Japanese Society for Clinical Microbiology	3 papers
Annual Meeting of Pseudomonas Aeruginosa Infection Society	1 paper
Annual Meeting of the Proein Science Society of Japan	1 paper

Academic Degrees

Doctoral Degree for	r Bacterial xenobiotic t	ransporeters as a target of new drugs	
Pharmaceutical			
Science			
S. Yamasaki			
Grant-in-Aid for S	cientific Research		
K. Nishino	Mechanism of bacterial h development of novel the	nomeostasis modulated by transportes and erapeutics	¥12,220,000
M. Nishino	Regulation of bacterial virulence by ABC-type transporters ¥1,560		¥1,560,000
Entrusted Researc	ch C		
Y. Matsumoto	Japan Science and Technology Agency	Development of a quick method to meaure antimicrobial susceptibilities using a new device	¥1,932,000
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
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K. Nishino	Ministry of Education, Culture, Sports, Science and Technology	Mechanism of bacterial homeostasis modulated by transportes and development of novel therapeutics	¥743,000
Contribution to Re	esearch		
Y. Matsumoto	Fukoku Co. Ltd.		¥3,000,000
Cooperative Resea	irch		
K. Nishino	Shionogi & Co., Ltd.		¥304,000
Y. Matsumoto	Fukoku Co. Ltd.		¥2,320,000
Y. Matsumoto	Keirex Technology Inc.		¥0,000
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	Chikara Furusawa (RIKEN)		¥100,000
K. Nishino	Ayano Satoh (Okayama Ur	niversity)	¥150,000
K. Nishino	Junichi Yamagishi (Nihon Pharmaceutical University)		¥150,000
K. Nishino	Yuji Morita (Aichi Gakuin	University)	¥100,000
Other Research Fu	ınd	-	
K. Nishino	Japan Society for the Promot	tion of Science	¥2,500,000

Laboratory of Atomic Scale Materials Processing

Original Papers

[1]A flux induced crystal phase transition in the vapor-liquid-solid growth of indium-tin oxide nanowires, G. Meng, T. Yanagida, H. Yoshida, K. Nagashima, M. Kanai, F. W. Zhuge, Y. He, S. Takeda and T. Kawai: Nanoscale, 6 (2014) 7033-7038.

[2]Ultrafast and Wide Range Analysis of DNA Molecules Using Rigid Network Structure of Solid Nanowires, T. Yanagida, K. Nagashima, M. Kanai, G. Meng, Y. He, F. W. Zhuge and T. Kawai: Sci. Rep., 4 (2014) 5252.

[3]Cellulose Nanofiber Paper as an Ultra Flexible Nonvolatile Memory, K. Nagashima, H. Koga, F. W. Zhuge, M. Kanai, G. Meng, Y. He, M. Nogi and T. Yanagida: Sci. Rep., 4 (2014) 5532.

[4]Nanoscale Size-Selective Deposition of Nanowires by Micrometer Scale Hydrophilic Patterns, Y. He, K. Nagashima, M. Kanai, G. Meng, F. W. Zhuge, T. Kawai and T. Yanagida: Sci. Rep., 4 (2014) 5943.

[5]Modulation of Thermoelectric Power Factor via Radial Dopant Inhomogeneity in B-doped Si Nanowires, F. W. Zhuge, T. Yanagida, M. Kanai, K. Nagashima, G. Meng, Y. He and T. Kawai: J. Am. Chem. Soc., 136 (2014) 14100-14106.

International Conferences

[1]Cellulose Nanofiber Paper as an Ultra Flexible Nonvolatile Memory (poster), K. Nagashima, H. Koga, F. W. Zhuge, M. Kanai, G. Meng, Y. He, M. Nogi and T. Yanagida: 2014 MRS Fall Meeting.

[2]Nanoscale Size-Selective Assembly of Nanowires by Micrometer Scale Hydrophilic Patterns (poster), Y. He, K. Nagashima, M. Kanai, G. Meng, F. W. Zhuge, T. Kawai and T. Yanagida: 2014 MRS Fall Meeting.

[3]Composition and Crystal Phase Engineering of VLS Nanowires: Impact of Element Nucleation Competitions at Liquid-Solid Interface (poster), G. Meng, K. Nagashima, H. Yoshida, M. Kanai, F. W. Zhuge, Y. He, S. Takeda, T. Kawai and T. Yanagida: 2014 MRS Fall Meeting. [4]Fundamental Design Rule for Nanowire Alignment on Water Favorable Pattern (poster), Y. He, K. Nagashima, M. Kanai, G. Meng, F. W. Zhuge, T. Kawai and T. Yanagida: 2014 MRS Fall Meeting.
[5]Modulating Transport Properties in B-Doped Si Nanowires via Rationally Designed Dopant Inhomogeneity and Its Application in Thermoelectrics (oral), F. W. Zhuge, M. Kanai, K. Nagashima, G. Meng, Y. He, T. Kawai and T. Yanagida: 2014 MRS Fall Meeting.

[6]Modulation of Thermoelectric Power Factor via Radial Dopant Inhomogeneity in B-Doped Si Nanowires (oral), F. W. Zhuge, M. Kanai, K. Nagashima, G. Meng, Y. He, T. Kawai and T. Yanagida: 2014 MRS Fall Meeting.

[7]Doping in VLS Metal Oxide Nanowires: Manipulation of Conductivity and Crystal Phase (oral), G. Meng, K. Nagashima, M. Kanai, H. Yoshida, F. W. Zhuge, Y. He, S. Takeda, T. Kawai and T. Yanagida: 2014 MRS Fall Meeting.

Patents

[1]K20140155 Fabrication of Metal Oxide Semiconductor Sensor, JP2014-242191

Publications in Do	mestic Meetings		
The Japan Society of	of Applied Physics		6 papers
Grant-in-Aid for S	Scientific Research		
T. Yanagida	Synthesis of single crystallir nanostructure information	ne oxide nanowire based on	¥2,860,000
T. Yanagida	Molecular device using hete	rostructured nanowires	¥2,990,000
K. Nagashima	Synthesis of redox based sw nanowire	itching nanodevice using oxide	¥1,560,000
K. Nagashima	Synthesis of single crystallir intrinsic nanoscale functiona	ne oxide nanowire insulator toward lities of oxides	¥3,510,000
Entrusted Researc	ch		
T. Yanagida	Japan Science and Technology Agency	Development of ultra-low energy multi-functional sensors by combining the oxide channel and nanoscale thermal management	¥25,220,000
Contribution to R	esearch	-	
T. Yanagida	The Asahi Glass Foundation		¥2,000,000
T. Yanagida	Support Center for Advanced Research, Foundation	d Telecommunications Technology	¥500,000
Cooperative Resea	ırch		
T. Yanagida	Panasonic Co. Ltd.		¥500,000
T. Yanagida	Panasonic Co. Ltd.		¥905,000

Laboratory of Cellulose Nanofiber Materials Original Papers

[1]Cellulose nanofiber paper as an ultra flexible nonvolatile memory, K. Nagashima, H. Koga, U. Celano, F. Zhuge, M. Kanai, S. Rahong, G. Meng, Y. He, J. D. Boeck, M. Jurczak, W. Vandervorst, T. Kitaoka, M. Nogi, T. Yanagida: Sci. Rep., 4 (2014) 5532.

[2]Nanofibrillar chitin aerogels as renewable base catalysts, Y. Tsutsumi, H. Koga, Z.-D. Qi, T. Saito, A. Isogai: Biomacromolecules, 15 (11) (2014) 4314-4319.

[3]Silver nanowire electrodes: Conductivity improvement without post-treatment and application in capacitive pressure sensors, J. Wang, J. Jiu, T. Araki, M. Nogi, T. Sugahara, S. Nagao, H. Koga, P. He, K. Suganuma: Nano-Micro Lett., 7 (1) (2015) 51-58.

[4]A Miniaturized flexible antenna printed on high dielectric constant nanopaper composite, T. Inui, H.

Koga, M. Nogi, N. Komoda, K. Suganuma: Adv. Mater., 27 (6) (2015) 1112-1116.

[5]The role of Zn precipitates and Cl— anions in pitting corrosion of Sn-Zn solder alloys, J.-C. Liu, S. W. Park, S. Nagao, H. Koga, M. Nogi, J.-S. Ma, G. Zhang, K. Suganuma: Corros. Sci., 92 (2015) 263-271.

[6]Sol-gel-derived high-performance stacked transparent conductive oxide thin films, T. Sugahara, Y. Hirose, S. Cong, H. Koga, J. Jiu, M. Nogi, S. Nagao, K. Suganuma: J. Am. Ceram. Sci., 97 (10) (2014) 3238-3243.

[7]Highly sensitive and flexible pressure sensor based on silver nanowires filled elastomeric interlayer and silver nanowires electrodes, J. Wang, J. Jiu, M. Nogi, T. Sugahara, S. Nagao, H. Koga, P. He,K. Suganuma: Nanoscale, 7 (2015) 2926-2932.

[8]Facile identification of the critical content of multi-layer graphene oxide for epoxy composite with the optimal thermal properties, T. Zhou,S. Nagao, T. Sugahara, H. Koga, M. Nogi, K. Suganuma, T. T. Nge, Y. Nishina: RSC Adv., 5 (2015) 20376-20385.

[9]The effect of light and humidity on the stability of silver nanowire transparent electrodes, J. Jiu, J. Wang, T. Sugahara, S. Nagao, M. Nogi, H. Koga, K. Suganuma, M. Hara, E. Nakazawa, H. Uchida: RSC Adv., 5 (2015) 27657-27664.

International Conferences

[1]Uniform coating of conductive nanomaterials on cellulose nanofiber paper through a Papermaking Process (oral), H. Koga, M. Nogi, K. Suganuma: 6th Asian Coating Workshop (ACW2014), Kobe, Japan, May 8-9 (2014).

[2]Synthesis and application of silver nanowires (oral), J. Jiu, T. Araki, J. Wang, M. Nogi, T. Sugahara, S. Nagao, H. Koga, K. Suganuma, E. Nakazawa, M. Hara, H. Uchida: 1st International Conference on Polyol Mediated Synthesis (IC-PMS), Paris, France, June 22-25 (2014).

[3]High-Dielectric Paper Composite Consisting of Cellulose Nanofiber and Silver Nanowire (oral), T. Inui, H. Koga, M. Nogi, N. Komoda, K. Suganuma: IEEE NANO 2014, Toronto, Canada, August 18-21 (2014).

[4]Silver Nanowire: Synthesis, Conductivity Improvement and Application to Pressure Sensor (oral), J. Wang, T. Araki, J. Jiu, T. Sugahara, M. Nogi, S. Nagao, H. Koga, K. Suganuma: IEEE NANO 2014, Toronto, Canada, August 18-21 (2014).

[5]Printed silver nanowires track by laser process (oral), T. Araki, R. Mandamparambil, I. Yakimets, J. Brand, M. Nogi, H. Koga, J. Jiu, T. Sekitani, K. Suganuma: ICFPE 2014 (5th International Conference on Flexible and Printed Electronics), Beijing, China, October 21-23 (2014).

[6]Thermal stability of optical transparency in cellulose nanopaper using chemical nanofibrillated cellulose nanofibers (poster), H. Yagyu, T. Wu, M.-C. Hsieh, H. Koga, M. Nogi: ICFPE 2014 (5th International Conference on Flexible and Printed Electronics), Beijing, China, October 21-23 (2014).

[7]Transparent electrodes printed on transparent nanopaper (poster), A. Tanaka, M. Nogi, H. Yagyu, T. Horie, M.-C. Hsieh, H. Koga, K. Suganuma: ICFPE 2014 (5th International Conference on Flexible and Printed Electronics), Beijing, China, October 21-23 (2014).

[8]Paper-based supercapacitor electrodes prepared by a papermaking technique (oral), : ICFPE 2014 (5th International Conference on Flexible and Printed Electronics), Beijing, China, October 21-23 (2014).

[9] Highly heat-resistant bio-based nanofiber substrate for flexible electronics (oral), M.-C. Hsieh, H.

Koga, M. Nogi, K. Suganuma: CPMT Symposium Japan (ICSJ), Kyoto, Japan, November 4-6 (2014).

[10]Cellulose Nanofiber Paper as an Ultra Flexible Nonvolatile Memory (oral), K. Nagashima, H. Koga, U. Celano, F. W. Zhuge, M. Kanai, S. Rahong, G. Meng, Y. He, J. D. Boeck, M. Jurczak, W. Vandervorst, T. Kitaoka, M. Nogi, T. Yanagida: 2014 MRS Fall Meeting & Exhibit, Boston, USA, November 30-December 5 (2014).

[11]Flexible Paper Electronics Based on Cellulose Nanofiber Paper (invited), H. Koga, M. Nogi, K. Suganuma: IDW'14, Niigata, Japan, December 3-5 (2014).

[12]High-speed photo-reduction of graphene oxide for paper-based flexible supercapacitor (poster), H. Tonomura, H. Koga, Y. Nishina, M. Nogi, K. Suganuma: The 18th SANKEN International Symposium 2014, Osaka, Japan, December 10-11 (2014).

[13]Non-contact printing of silver nanowires for stretchable/ transparent electrodes (oral), T. Araki, R. Mandamparambil, I. Yakimets, J. Brand, M. Nogi, H. Koga, J. Jiu, T. Sekitani, K. Suganuma: LOPEC, Munich, Germany, March 3-5 (2015).

[14]Flexible Paper Electronics Prepared by using a Papermaking Technique (oral), H. Koga, M. Nogi: IAWPS2015, Tokyo, March 15-17 (2015).

[15]Small and Flexible Nanopaper Antenna for Wearable Electronics (oral), T. Inui, H. Koga, M. Nogi, K. Suganuma: IAWPS2015, Tokyo, March 15-17 (2015).

Review Papers

Colour Material Salon, M. Nogi, Journal of JSCM, Japan Society of Colour Material, 87[5] (2014), 183-184.

Transparent Cellulose Nanofiber Films and their electric device applications, M. Nogi, H. Koga, Optonews, Optoelectronics Industry and Technology Development Association, 9[1] (2014), 9-12.

Transprent Couductive Paper, H. Koga, M. Nogi, Cellulose Communications, Cellulose Society of Japan, 21[3] (2014), 112-116.

Device Integration on Transparent Paper, M. Nogi, Chemical Industry, Kako-sha, 9 (2014), 65-70.

Cellulose Nanopaper for Electronic Applications, M. Nogi, Engineering Materials, NIKKAN KOGYO SHIMBUN,LTD., 10 (2014), 35-39.

Chemically-Modified Cellulose Paper as a Microstructured Catalytic Reactor, H. Koga, T. Kitaoka, A. Isogai, molecules, MDPI AG, 20[1] (2015), 1495-1508.

Flexible Paper Electronics Prepared by Using the Papermaking Process, H. Koga, M. Nogi, Annals of the High Performance Paper Society, Japan, High Performance Paper Society, Japan, 53 (2015), 39-44.

Books

[1]Silver Nanowire-based Transparent Conductive Films H. Koga, M. Nogi, K. Suganuma, "Development of Conductive Inks and Process Optimization for Printed Electronics", Science & Technology, 2014.

[2]Plastic-free Transparent Cellulose Nanofiber Substrates M. Nogi, H. Koga, "Preparation and Applications of Cellulose Nanofibers", Technical Information Institute Co., Ltd., 2014.

[3]Metal Nanocatalysts/Nanocellulose Hybrids H. Koga, T. Kitaoka, "Preparation and Applications of

Cellulose Nanofibers", Technical Information Institute Co., Ltd., 2014.

[4]Transparent Conductive Paper Prepared by Using Silver Nanowires and Nanocellulose H. Koga, M. Nogi, "Preparation and Applications of Cellulose Nanofibers", Technical Information Institute Co., Ltd., 2014.

[5]Printable, Transparent, and Conductive Nanocomposites Composed of Nanocellulose and Carbon Nanotubes H. Koga, T. Saito, A. Isogai, "Preparation and Applications of Cellulose Nanofibers", Technical Information Institute Co., Ltd., 2014.

[6]Foldable Antenna Printed on Cellulose Nanofiber Substrates M. Nogi, H. Koga, "Preparation and Applications of Cellulose Nanofibers", Technical Information Institute Co., Ltd., 2014.

[7]Printed Conductive Lines on Cellulose Nanofiber Substrates M. Nogi, H. Koga, "Preparation and Applications of Cellulose Nanofibers", Technical Information Institute Co., Ltd., 2014.

[8] Transparent Nanopaper Prepared by Using Cellulose Nanofibers M. Nogi, "Functionalization and Applications of Transparent Films", Technical Information Institute Co., Ltd., 2014.

[9]Cellulose Nanofiber-based Transparent Materials with Low Thermal Expansion(N. Tanio) M. Nogi, "Material Development and Superior Performance of Transparent Polymers", CMC Publishing, 2014.

Patents

[1]K20130290 Conductive fibers, sheet electrodes, and their production techniques, JP2014-106142

Contributions to International Conferences and Journals

H. KOGA International Symposium on Wood Science and Technology 2015 (Local Committee) **Publications in Domestic Meetings** 21st annual meeting of the Cellulose Society of Japan 3 papers 53rd meeting of the High Performance Paper Society 1 paper 65th meeting of the Japan Wood Research Society 1 paper Grant-in-Aid for Scientific Research M. Nogi Re-development of paper solar cell for the improvement of ¥17,810,000 energy conversion M. Nogi Flexible non-volatile memory prepared by using cellulose ¥54,600,000 nanopaper H. Koga Printed paper reactor for efficient catalytic conversion ¥2,210,000 **Contribution to Research** M.Nogi The Murata Science Foundation ¥2,421,000 **Cooperative Research** M. Nogi ALBION Co. Ltd. ¥833,000

Beam Application Frontier Research Laboratory

Original Papers

[1]Molecular and physiological functions of sphingosine 1-phosphate transporters, T. Nishi, N. Kobayashi, Y. Hisano, A. Kawahara, A. Yamaguchi: Biochimica et Biophisica Acta (BBA) -Molecular and Cell Biology of Lipids, 1841 (5) (2014) 759-765.

[2]β-Lactam Selectivity of Multidrug Transporters AcrB and AcrD Resides in the Proximal Binding Pocket, N. Kobayashi, N. Tamura, HW. van Veen, A. Yamaguchi, S. Murakami: The Journal of Biological Chemistry, 289 (15) (2014) 10680-10690.

Review Papers

Structural basis of multidrug efflux transport, R. Nakashima, K. Sakurai, A. Yamaguchi, Experimental Medicine, Yodosya, 132[10] (2014), 106-112.

Publications in De	omestic Meetings		
The 40th Annual M	leeting of Japan Bioenerget	ics Group	1 paper
The 36th Symposiu	um on Biomembrane-Drug I	Interaction	1 paper
12th Physical Phar	ma Forum 2012 - The Next	Generation -	1 paper
The 14th Annual M	leeting of the Protein Societ	ty of Japan	1 paper
The 9th Annual Me	eeting of the Japan Transpor	ter Research Association	1 paper
Grant-in-Aid for	Scientific Research		1 1
R. Nakashima	Crystallographic study of	multidrug efflux proteins coupled	¥4,030,000
Entrusted Resear	ch		
A. Yamaguchi	JST Strategic Basic	Studies on the structural basis of	¥58,650,000
-	Research Programs,	multidrug efflux transport and the	
	CREST (H24.10.1~	development of multidrug	
	H27.3.31)	transporter inhibitors	
Cooperative Rese	arch	1	
A. Yamaguchi	Fine Co., Ltd		¥0,000

Department of Disease Glycomics

Original Papers

[1]Core fucosylation of IgG-BCR is required for antigen recognition and antibody production., Wenzhe Li, Rui Yu, Biao Ma, Yan Yang, Xinyan Jiao, Yang Liu, Hongyu Cao, Weijie Dong, Linhua Liu, Keli Ma, Tomohiko Fukuda, Qingping Liu, Tonghui Ma, Zhongfu Wang, Jianguo Gu, Jianing Zhang and Naoyuki Taniguchi: J Immunol., 194 (6) (2015) 2596-606.

[2]Loss of α 1,6-fucosyltransferase suppressed liver regeneration: implication of core fucose in the regulation of growth factor receptor-mediated cellular signaling., Wang Y, Fukuda T, Isaji T, Lu J, Gu W, Lee HH, Ohkubo Y, Kamada Y, Taniguchi N, Miyoshi E, Gu J.: Sci Rep., 5 (2015) 8264.

[3]An aberrant sugar modification of BACE1 blocks its lysosomal targeting in Alzheimer's disease., Kizuka Y, Kitazume S, Fujinawa R, Saito T, Iwata N, Saido TC, Nakano M, Yamaguchi Y, Hashimoto Y, Staufenbiel M, Hatsuta H, Murayama S, Manya H, Endo T, Taniguchi N.: EMBO Mol Med., 7 (2015) 175-89.

[4]Expression of Fucosyltransferase 8 Is Associated with an Unfavorable Clinical Outcome in Non-Small Cell Lung Cancers., Honma R, Kinoshita I, Miyoshi E, Tomaru U, Matsuno Y, Shimizu Y, Takeuchi S, Kobayashi Y, Kaga K, Taniguchi N, Dosaka-Akita H.: Oncology., 88 (5) (2015) .

[5]Ceramide galactosyltransferase expression is regulated positively by Nkx2.2 and negatively by OLIG2., Okahara K, Kizuka Y, Kitazume S, Ota F, Nakajima K, Hirabayashi Y, Maekawa M, Yoshikawa T and Taniguchi N.: Glycobiology, 24 (10) (2014) 926-934.

[6]Golgi N-glycan branching N-acetylglucosaminyltransferases I, V and VI promote nutrient uptake and metabolism., Abdel Rahman AM, Ryczko M, Nakano M, Pawling J, Rodrigues T, Johswich A, Taniguchi N and Dennis JW.: Glycobiology, 25 (2) (2014) 225-240.

[7]Synthesis of N-glycan units for assessment of substrate structural requirements of N-acetylglucosaminyltransferase III., Hanashima S, Korekane H, Taniguchi N and Yamaguchi Y.: Med Chem Lett., 24 (18) (2014) 4533-4537.

[8]Interaction of platelet endothelial cell adhesion molecule (PECAM) with α2,6-sialylated glycan regulates its cell surface residency and anti-apoptotic role., Kitazume S, Imamaki R, Kurimoto A, Ogawa

K, Kato M, Yamaguchi Y, Tanaka K, Ishida H, Ando H, Kiso M, Hashii N, Kawasaki N and Taniguchi N.: J Biol Chem., 289 (40) (2014) 27604-27613.

[9]Association of serum interleukin-27 with the exacerbation of chronic obstructive pulmonary disease., Angata T, Ishii T, Gao C, Ohtsubo K, Kitazume S, Gemma A, Kida K and Taniguchi N.: Physiol Rep., 2 (7) (2014) e12069.

[10]Polyamine modification by acrolein exclusively produces 1,5-diazacyclooctanes: a previously unrecognized mechanism for acrolein-mediated oxidative stress., Tsutsui A, Imamaki R, Kitazume S, Hanashima S, Yamaguchi Y, Kaneda M, Oishi S, Fujii N, Kurbangalieva A, Taniguchi N and Tanaka K.: Org Biomol Chem., 12 (28) (2014) 5151-5157.

[11] Reiko Fujinawa, Satoshi Kobayashi, Shinobu Kitazume, Naoyuki Taniguchi: THE LUNG perspectives, 22 (3) (2014) 180-185.

International Conferences

[1]Identification of ectonucleotide pyrophosphatase/phosphodiesterase 3 as a new modifier of glycan biosynthesis (oral), Naoyuki Taniguchi: Experimental Biology 2014, San Diego (USA).

[2]From Glycobiology to Systems Glycobiology for understanding the underlying mechanism of disease onset, biomarker and therapeutics (oral), Naoyuki Taniguchi: RIKEN-Max Planck Joint Research Center for Systems Chemical Biology, The 3rd symposium, Munich (Germany).

[3]Loss of Bisected glycan ameliorates Alzheimer's disease pathology in mouse brain (poster), Yasuhiko Kizuka, Shinobu Kitazume, Reiko Fujinawa, Takashi Saito, Nobuhisa Iwata, Takaomi Saido, Miyako Nakano, Yoshiki Yamaguchi, Yasuhiro Hashimoto, Matthias Staufenbiel, Hiroyuki Hatsuta, Shigeo Murayama, Hiroshi Manya, Tamao Endo, Naoyuki Taniguchi: RIKEN-Max Planck Joint Research Center for Systems Chemical Biology, The 4rd symposium, Munich (Germany).

[4]Systems Glycobiology Approach for Understating the Disease Onset, Biomarker and Therapeutics (invited), Naoyuki Taniguchi: Kyoto Sangyo University (KSU) International Symposium : Cutting-edge of Life Sciences, Kyoto (Japan).

[5]Upregulation of GnT-III and Wnt target genes in Fut8 null mice: A possible adaptive and compensation mechanism for glycan function (invited), Naoyuki Taniguchi: 9th International Symposium on Glycosyltransferases (Glyco-T 2014), Porto(Portugal).

[6]Chronic Obstructive pulmonary disease (COPD) meets glycobiology: the development of new therapeutics, keratin sulfate oligosaccharides (invited), Naoyuki Taniguchi: 7th AOHUPO/ 0th PST, Bangkok (Thailand).

[7]Systems glycobiology for understanding the underlying mechanism of disease onset, biomarker and therapeutics (invited), Naoyuki Taniguchi: 7th Santorini Conference Biologie Prospective, Santorini (Greece).

[8]Fut8-/- mice which lack the core fucose structure show the upregulated GnT-III gene and its product, a bisecting GlcNAc: A possible adaptive and compensatory mechanism for glycan function (invited), Naoyuki Taniguchi: 13th Human Proteome Organization World Congress (HUPO2014), Madrid (Spain).

[9]Systems Glycobiology Approach for Understating the Role of Glycans in Disease Onset, Biomarker and Therapeutics (invited), Naoyuki Taniguchi: 15th IUBMB-24th FAOBMB-TSBMB Conference, Taipei (Taiwan).

[10]Binding of Langerin/CD207 to keratan sulfate disaccharide, Gal (6SO3) β 1, 4-GlcNAc (6SO3) and

its triangle derivative in vitro and in vivo: possible drug targets for COPD (chronic obstructive pulmonary disease) (poster), Reiko Fujinawa, Fumi Ota, Congxiao Gao, Tetsuya Hirayama, Hiroki Kabata, Hiroaki Korekane, Shinobu Kitazume, Kazuaki Ohtsubo, Keiichi Yoshida, Yoshiki Yamaguchi, Bernd Lepenies, Christoph Rademacher, Tomoko Betsuyaku, Naoyuki Taniguchi: Joint Meeting of the Society for Glycobiology and the Japanese Society of Carbohydrate Research, Honolulu(USA).

[11]Development of a sensitive assay method of keratan sulfate disaccharide levels in mice plasma and bronchoalveolar lavage fluid (poster), Fumi Ota, Reiko Fujinawa, Hiroaki Korekane, Keiichi Yoshida, Naoyuki Taniguchi: Joint Meeting of the Society for Glycobiology and the Japanese Society of Carbohydrate Research, Honolulu(USA).

[12]Suppression of inflammatory response by Keratan sulfate disaccharide in the development of COPD model mice (poster), Congxiao Gao, Takayuki Yoshida, Fumi Ota, Reiko Fujinawa, Keiichi Yoshida, Tomoko Betsuyaku, Naoyuki Taniguchi: Joint Meeting of the Society for Glycobiology and the Japanese Society of Carbohydrate Research, Honolulu(USA).

[13]Epigenetic regulation of glycosyltransferase (poster), Yasuhiko Kizuka, Shinobu Kitazume, Naoyuki Taniguchi: Joint Meeting of the Society for Glycobiology and the Japanese Society of Carbohydrate Research, Honolulu(USA).

[14]High-throughput screening of GnT-III inhibitors using UDP-Glo system to develop a novel drug candidate for Alzheimer's disease (poster), Yasuhiko Kizuka, Shinobu Kitazume, Keiko Sato, Tetsuo Ohnuki, Mutsuko Kukimoto-Niino, Mikako Shirouzu, Minoru Yoshida, Laurie Engel, Hicham Zegzouti, Naoyuki Taniguchi: Joint Meeting of the Society for Glycobiology and the Japanese Society of Carbohydrate Research, Honolulu(USA).

Contributions to International Conferences and Journals

N. TANIGUCHI	Glycobiology (Editorial Board)	
N. TANIGUCHI	IUBMB life (Editorial Board)	
N. TANIGUCHI	IUBMB Biochemistry and Molecular Biology Education (Editorial B	oard)
N. TANIGUCHI	Nitric Oxide (Editorial Board)	
N. TANIGUCHI	Protein Expression and Purification (Editorial Board)	
N. TANIGUCHI	Biochemical and Biophysical Research Communications (Editor)	
N. TANIGUCHI	International Journal of Oncology (Editorial Academy)	
N. TANIGUCHI	Glycoconjugate Journal (Mini Review Editor)	
N. TANIGUCHI	Proteomics/ Proteomics-Clinical Applications (Senior Editor)	
N. TANIGUCHI	GlycoT (Scientific Advisory Board)	
N. TANIGUCHI	Cellular and Molecular Lide Sciences (Editorial Board)	
N. TANIGUCHI	Journal of Proteome Research (Editorial Advisory Board)	
N. TANIGUCHI	Clinical Proteomics (Editorial Board)	
N. TANIGUCHI	Antioxidants and Redox Signaling (Editorial Board)	
N. TANIGUCHI	Society for Glycobiology (President)	
Publications in Do	omestic Meetings	
The 33 rd Japanese A	Association for Airway Secretion Research	1 paper
The 87 th Annual N	feeting of the Japanese Biochemical Society	1 paper
The 12 th JCGG Sy	mposium	1 paper
Grant-in-Aid for S	Scientific Research	
K. Korekane	Biological significance of ENPP3-mediated regulation of glycan	¥5,070,000
	biosynthesis in cancer	
Other Research F	und	
C. Gao	GlaxoSmithKline	¥2,000,000

Department of Functional Nanomaterials and Nanodevices Original Papers [1]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.: J. Appl. Phys., 117 (6) (2015) 064502 (1-7).

[2]Estimation of dc transport dynamics in strongly correlated (La,Pr,Ca)MnO3 film using an insulator-metal composite model for terahertz conductivity, T. V. A. Nguyen, A. N. Hattori, M. Nagai, T. Nakamura, K. Fujiwara, M. Ashida, and H. Tanaka: Appl. Phys. Lett., 105 (2) (2014) 023502 (1-5).

[3]Noise-driven signal transmission device using molecular dynamics of organic polymers, N. Asakawa, K. Umemura, S. Fujise, K. Yazawa, T. Shimizu, M. Tansho, T. Kanki and H. Tanaka: J. Nanophotonics, 8 (2) (2014) 083077(1-15).

[4]Formation mechanism of a microscale domain and effect on transport properties in strained VO2 thin films on TiO2(001), K. Kawatani, T. Kanki and H. Tanaka: Phys. Rev. B, 90 (5) (2014) 054203(1-5).

[5]Dual field effects in electrolyte-gated spinel ferrite: electrostatic carrier doping and redox reactions, T. Ichimura, K. Fujiwara and H. Tanaka: Sci. Rep., 4 (2014) 5818-1-5.

[6]Artificial three Dimensional Oxide Nanostructures for High Performance Correlated Oxide
 Nanoelectronics, H. Tanaka, H. Takami, T. Kanki, A. N. Hattori, and K. Fujiwara: Jpn. J. Appl. Phys., 53
 (5S1) (2014) (p1-5).

[7]Local atomic configuration of graphene, buffer layer, and precursor layer on SiC(0001) by photoelectron diffraction, H. Matsui, F. Matsui, N. Maejima, T. Matsushita, T. Okamoto, A. N. Hattori, Y. Sano, K. Yamauchi, H. Daimon: Surf. Sci., 632 (2014) 98-102.

International Conferences

[1]Nonvolatile Transport Properties Induced by a Field Effect Accompanying Redox Processes in Ferrite Thin Films (invited), H.Tanaka, Kohei Fujiwara: Collaborative Conference on 3D & Materials Research (CC3DMR2014) .

[2]Nano-confinement effect in the extremely small 3D oxide nanostructures (invited), H.Tanaka: The 15th IUMRS-ICA (International Union of Materials Research Societies, International Conference in Asia).

[3]Functinal oxide nanoelectrnics and spintornics using Vanadate and Ferrite (oral), H.Tanaka: Academic Visit.

[4]Temperature and voltage induced multistep metal insulator transition in artificial VO2 nanowires on Al2O3 (0001) substrates (oral), H.Tanaka, H.Takami, T. Kanki: 2014 MRS Fall Meeting & Exhibit.

[5]Nanoimprint based directed self-assembly for production of heterostructured functional oxide nano dot arrays. (poster), K.Okada, T.Sakamoto, H.Tanaka: 2014 MRS Fall Meeting & Exhibit.

[6]Focus Session: Magnetic Oxide Thin Films and Heterostructures: Electric Field and Magnetoelectric Effects (invited), H.Tanaka: American Physical Society

[7]Reversible and Memristive Modulation of Transport Property in VO2 Nano-Wires by an Electric Field via Air Nano-Gap (invited), T. Kanki: The 15th IUMRS-ICA (International Union of Materials Research Societies, International Conference in Asia).

[8]Low Power Operation of Metal-Insulator Transition in Oxide Nano-Structures (oral), T. Kanki and H. Tanaka: The 1st International Symposium on Interactive Materials Science Cadet Program.

[9]Memristive Metal-Insulator Switch in Correlated Electron Oxide Nanowires Using Electric Field-Induced Redox Reaction (invited), T. Kanki: 4th international conference Nanotek & Expo.

[10]Reversible Control of Metal-Insulator Transition by the Local Peltier Effect in VO2 Nanowires (poster), T. Kanki, H.Takami, H.Tanaka: 2014 MRS Fall Meeting & Exhibit.
[11]Tunable Electrochemical Doping into VO2 Nanowires Using Planer-Type Field Effect Transistor (poster), T. Kanki, T. Sasaki, H. Tanaka: 2014 MRS Fall Meeting & Exhibit.

[12]Designing Transport Characteristics by Manipulating Metal-Insulator Domains through Oxide Nanostructures (invited), T. Kanki, H. Tanaka: The 18th SANKEN International Symposium & The 13th SANKEN Nanotechnology Symposium.

[13]Fabrication of the programmable three-dimensional nanostructures of functional metal oxides (poster), A. N. Hattori and H. Tanaka: European Conference on Surface Science (ECOSS30).

[14]Fabrication of three-dimensional epitaxial spinel ferrite nanowall wire structures by 3D-nanotemplate PLD technique (poster), A. N. Hattori, Y. Fujiwara, K. Fujiwara, and H. Tanaka: The 13th International Conference on Nanoimprint and Nanoprint Technology.

[15]Fabrication of Si nanoguide structures with a few tens of nm pitch using ultraviolet nanoimprint lithography (oral), A. N. Hattori, S. Ito, R. Okubo, M. Nakagawa, and H. Tanaka: The 7th International Symposium on Surface Science (ISSS-7).

[16]Identification of giant phase transition of single electric domain in (La,Pr,Ca)MnO3 epitaxial nanowall wire (poster), A. N. Hattori, Y. Fujiwara, T. V. A. Nguyen, K. Fujiwara, and H. Tanaka: The 7th International Symposium on Surface Science (ISSS-7).

[17]Control of transition properties in nanoscale phase-separated(La,Pr,Ca)MnO3 film by electric double layer gating (poster), A. N. Hattori, T. Nakamura, T. V. A. Nguyen, K. Fujiwara, H. Tanaka: 2014 MRS Fall Meeting & Exhibit.

[18]Gate-induced nonvolatile changes in the transport properties of spinel ferrite thin films (oral), K. Fujiwara and H. Tanaka: International Union of Materials Research Society–International Conference in Asia 2014.

[19]Growth of Complex Nanostructures of Metal Oxides Using a Shadow Effect (invited), K. Fujiwara, K. Okada, A. N. Hattori, and H. Tanaka: International Union of Materials Research Society–International Conference on Electronic Materials 2014.

[20]Electric-Field Devices Based on Ferrite Compounds (poster), K. Fujiwara and H. Tanaka: International Union of Materials Research Society–International Conference on Electronic Materials 2014.

[21]Field-Effect Carrier Doping in KTaO3 via Organic Parylene-C Insulator (poster), T. T. Wei, K. Fujiwara, and H. Tanaka: The 18th SANKEN International Symposium.

[22]Electric-Field Control of the Charge-Ordered Phase in YbFe2O4 Thin Films (poster), T. Hori, K. Fujiwara, and H. Tanaka: The 18th SANKEN International Symposium.

[23]Fabrication of Fe3O4 Thin Film-Based Resistors for Power Electronics (poster), S. Tsubota, K. Fujiwara, and H. Tanaka: The 18th SANKEN International Symposium.

[24]Characterization of Fe3O4 Thin Films as High-Temperature Resistive Materials (poster), S. Tsubota, K. Fujiwara, and H. Tanaka: 1st E-MRS/MRS-J Bilateral Symposia.

Review Papers

Controlling electron –spin behavior in functional oxide nanostructures, H.Tanaka, Manufacturing and Technology, Association for the Advancement of Manufacturing and Technology), 66[4] (2014), 33-37.

Oxide nanoelectronics using single domains with electronic phase transition, T.Kanki,H.Tanaka, Manufacturing and Technology, Association for the Advancement of Manufacturing and Technology), 66[3] (2014), 110-114.

Books

[1] Thin Films and Epitaxy:Basic Techniques(Thomas F. Kuech) H.Tanaka, "Handbook of Crystal Growth", ELSEVIER, 3 2015.

Patents

[1]ELECTRIC CURRENT-SPIN CURRENT CONVERSION DEVICE, 5590488

[2] Graphene Film formation method onto SiC substrate, JP 5644175

Contributions to International Conferences and Journals

K. Fujiwara International Union of Materials Research Societies - International Conference in Electronic Materials (Steering Committee)

Publications in	Domestic Meetings			
JSAP			3 papers	
MRS-Japan			1 paper	
2nd Nano-Macro	Alliance Young Researchers	s Workshop	2 papers	
MEXT Nanotech	nnology platform seminar on	thin film processing	1 paper	
ISIR/RIEC exc	change workshop		1 paper	
Grant-in-Aid fo	or Scientific Research			
H.Tanaka	3D correlated oxide nand and electronic phase cha	o-structures for nano-scaling phenomena nge memory application.	¥15,730,000	
H.Tanaka	Construction of function adaptive sensor applicati	al Oxide NEMS for environment on.	¥2,340,000	
T. Kanki	Total control of phase tra nano-scaled domains wit	Total control of phase transition, dinamics and spatial position of nano-scaled domains with strongly correlated electronic phase		
A. N. Hattori	Construction of 3d transi investigation their novel	Construction of 3d transition metal oxide nanostructures and investigation their novel properties		
K.Fujiwara	Electronic phase control state of layered ferrite	Electronic phase control of the room-temperature charge-ordered state of lavered ferrite		
Entrusted Rese	arch			
T.Kanki	Axell corporation University of Hyogo	Development of vertural harmonized and fuructral LED on computor display	¥325,000	
Contribution to	Research	1 5		
A. N. Hattori	Shisedo Science Grant		¥1,000,000	
K. Fujiwara	Iketani science and techn	ology foundation	¥1,000,000	
K. Fujiwara	Kumagai foundation for	science and technology	¥1,000,000	
Cooperative Re	search			
H.Tanaka	Murata Manufacturing	Co., Ltd.	¥1,670,000	
H.Tanaka	National Institute for M	Iaterials Science	¥0,000	
Other Research	Fund			
H.Tanaka	IMS(MEXT)		¥32,800,000	
H.Tanaka	Nippon Sheet Glass Four Engineering	ndation for Meterial Science and	¥100,000	

Department of Advanced Nanofabrication Original Papers

[1]Twin-peaks absorption spectra of excess electron in ionic liquids, R. M. Musat, T. Kondoh, Y. Yoshida,

Kenji Takahashi: Radiat. Phys. Chem., 100 (2014) 32-37.

[2]Measurement of < 20 fs bunch length using coherent transition radiation, I. Nozawa, K. Kan, J. Yang, A. Ogata, T. Kondoh, M. Gohdo, K. Norizawa, H. Kobayashi, H. Shibata, S. Gonda, and Y. Yoshida: Phys. Rev. ST Accel. Beams, 17 (2014) 072803.

International Conferences

[1]Femtosecond time-resolved electron diffraction and microscopy (invited), J. Yang: Advanced Lasers and Their Applications (ALTA) 2014.

[2]Possibility of Attosecond Pulse Radiolysis (invited), Y. Yoshida: the 6th Asian Forum for Accelerators and Detectors (AFAD2015).

[3]RF gun based Ultrafast Electron Microscopy (invited), J. Yang: the 6th Asian Forum for Accelerators and Detectors (AFAD2015).

[4]Pulse radiolysis using terahertz pulse (oral), K. Kan, J. Yang, A. Ogata, T. Kondoh, M. Gohdo, I. Nozawa, T. Toigawa, K. Norizawa, H. Kobayashi, Y. Yoshida: Advanced Lasers and Their Applications (ALTA) 2014.

[5]Pulse radiolysis using terahertz probe pulses (poster), K. Kan, J. Yang, A. Ogata, T. Kondoh, M. Gohdo, I. Nozawa, T. Toigawa, K. Norizawa, Y. Yoshida: the 5th International Particle Accelerator Conference (IPAC'14).

[6]Simulation study on electron beam acceleration using coherent Cherenkov radiation (poster), K. Kan, J. Yang, A. Ogata, T. Kondoh, M. Gohdo, I. Nozawa, T. Toigawa, K. Norizawa, Y. Yoshida, M. Hangyo, R. Kuroda, H. Toyokawa: the 5th International Particle Accelerator Conference (IPAC'14).

[7]Femtosecond time-resolved transmission electron microscopy using RF gun (poster), J. Yang, M. Gohdo, K. Kan, T. Kondoh, K. Tanimura, Y. Yoshida, J. Urakawa: the 5th International Particle Accelerator Conference (IPAC'14).

[8]Generation and diagnosis of ultrashort electron bunches from a photocathode RF gun linac (poster), I. Nozawa, K. Kan, J. Yang, A. Ogata, T. Kondoh, M. Gohdo, K. Norizawa, Y. Yoshida, H. Kobayashi,: the 5th International Particle Accelerator Conference (IPAC'14).

[9]Possibility of Attosecond Pulse Radiolysis (oral), Y. Yoshida: The 5th Asia Pacific Symposium on Radiation Chemistry, The 57th Annual Meeting of The Japanese Society of Radiation Chemistry.

[10]Development and Perspective of the Atto-second Pulse Radiolysis (oral), M. Gohdo, K. Kan, T. Kondoh, J. Yang, Y. Yoshida: The 5th Asia Pacific Symposium on Radiation Chemistry, The 57th Annual Meeting of The Japanese Society of Radiation Chemistry.

[11]Femtosecond Pulse Radiolysis Study on Spectrum and Reactivity of Solvated/Pre-solvated Electrons in n-alcohols (oral), T. Toigawa, K. Norizawa, T. Kondoh, M. Gohdo, K. Kan, J. Yang, Y. Yoshida: The 5th Asia Pacific Symposium on Radiation Chemistry, The 57th Annual Meeting of The Japanese Society of Radiation Chemistry.

[12]Formation of Dimer Radical Cation of Poly-α-methylstyrene by Direct Ionization in Solution (oral), T. Igahara, M. Gohdo, T. Kondoh, S. Tagawa, J. Yang, K. Kan, A. Ogata, Y. Yoshida: The 5th Asia Pacific Symposium on Radiation Chemistry, The 57th Annual Meeting of The Japanese Society of Radiation Chemistry.

[13] Time Dependent Behaviors of Electron in n-dodecane Studied by the Femtosecond Pulse Radiolysis

(oral), T. Kondoh, S. Nishii, K. Norizawa, K. Kan, J. Yang, M. Gohdo, S. Tagawa, Y. Yoshida,: The 5th Asia Pacific Symposium on Radiation Chemistry, The 57th Annual Meeting of The Japanese Society of Radiation Chemistry.

[14]Femtosecond Pulse Radiolysis Study of the Radiation Decomposition Process of n-dodecane (oral), S. Nishii, T. Kondoh, M. Gohdo, K. Kan, J. Yang, S. Tagawa, Y. Yoshida: The 5th Asia Pacific Symposium on Radiation Chemistry, The 57th Annual Meeting of The Japanese Society of Radiation Chemistry.

[15]Formation Process Study of Hydrated Electron in Water by Femtosecond Pulse Radiolysis (poster), S. Yamaso, T. Toigawa, T. Kondoh, M. Gohdo, K. Kan, J. Yang, Y. Yoshida: The 5th Asia Pacific Symposium on Radiation Chemistry, The 57th Annual Meeting of The Japanese Society of Radiation Chemistry.

[16]Radiation-Induced Decomposition Process of N-Dodecane Studied by Femtosecond Pulse Radiolysis (oral), Y. Yoshida: The 11th meeting of the ionizing radiation and polymers symposium (IRaP 2014).

[17]Initial Ionization G-Value of N-Dodecan Studies by a Femtosecond Pulse Radiolysis (poster), T. Kondoh, S. Nishii, M. Gohdo, K. Kan, J. Yang, K. Norizawa, S. Tagawa, Y. Yoshida: The 11th meeting of the ionizing radiation and polymers symposium (IRaP 2014).

[18]Formation of Dimer Radical Cation of Poly-α-Methylstyrene by Direct Ionization in Solution (poster), T. Igahara, T. Kondoh, M. Gohdo, K. Kan, J. Yang, S. Tagawa, Y. Yoshida: The 11th meeting of the ionizing radiation and polymers symposium (IRaP 2014).

[19]Generation and Bunch Length Measurement of Femtosecond and Attosecond Electron Bunches (poster), I. Nozawa, K. Kan, J. Yang, A. Ogata, T. Kondoh, M. Gohdo, Y. Yoshida: The 18th SANKEN International Symposium, The 13th SANKEN Nanotechnology Symposium, 10th Handai Nanoscience and Nanotechnology International Symposium, 2nd KANSAI Nanoscience and Nanotechnology.

[20]Measurement of Electron Beam Using a Photoconductive Antenna (poster), K. Kan, J. Yang, A. Ogata, M. Gohdo, T. Kondoh, S. Sakakihara, I. Nozawa, K. Norizawa, Y. Yoshida: The 18th SANKEN International Symposium, The 13th SANKEN Nanotechnology Symposium, 10th Handai Nanoscience and Nanotechnology International Symposium, 2nd KANSAI Nanoscience and Nanotechnology.

[21]Radiation induced initial process and decomposition process of n-dodecane as a model compound of polymer-resists using a femtosecond pulse radiolysis (poster), T. Kondoh, S. Nishii, M. Gohdo, K. Kan, J. Yang, K. Norizawa, S. Tagawa, Y. Yoshida: The 18th SANKEN International Symposium, The 13th SANKEN Nanotechnology Symposium, 10th Handai Nanoscience and Nanotechnology International Symposium, 2nd KANSAI Nanoscience and Nanotechnology.

[22]Design and demonstrations of RF gun based Ultrafast Electron Microscopy (poster), J. Yang, K. Kan, T. Kondoh, M. Gohdo, Y. Yoshida: The 18th SANKEN International Symposium, The 13th SANKEN Nanotechnology Symposium, 10th Handai Nanoscience and Nanotechnology International Symposium, 2nd KANSAI Nanoscience and Nanotechnology.

[23]UV Femtosecond Pulse Radiolysis Study of the Formation Process of Alkyl Radicals in n-Dodecane (poster), S. Nishii, T. Kondoh, M. Gohdo, K. Kan, J. Yang, S. Tagawa, Y. Yoshida: The 18th SANKEN International Symposium, The 13th SANKEN Nanotechnology Symposium, 10th Handai Nanoscience and Nanotechnology International Symposium, 2nd KANSAI Nanoscience and Nanotechnology.

[24]Development and perspective of the atto-second pulse radiolysis (poster), Masao Gohdo, Koichi Kan, Takafumi Kondoh, Jinfeng Yang, Yoichi Yoshida: The 29th Miller Conference.

[25]Pulse radiolysis study of polystyrene dimer phenyl cation radical in THF (poster), Masao Gohdo,

Takafumi Kondoh, Koichi Kan, Jinfeng Yang, Hiromi Shibata, Seiichi Tagawa, Yoichi Yoshida: The 29th Miller Conference.

[26]Accelerator based femtosecond time-resolved electron microscopy (invited), J. Yang: OPIC & PHOTONICS International Congress 2014.

[27]Development of femtosecond time-resolved relativistic-energy electron microscopy (poster), J. Yang, K. Tanimura, Y. Yoshida, J. Urakawa: 18th International Microscopy Congress.

Review Papers

Generation of Terahertz-waves using Ultrashort Electron Beams from a Photocathode Radio-frequency Gun Linac, Koichi Kan, Jinfeng Yang, Atsushi Ogata, Takafumi Kondoh, Masao Gohdo, Hiromi Shibata, Yoichi Yoshida, C, The Institute of Electrical Engineers of Japan, 134 (2014), 502-509.

Femtosecond Time-resolved Electron Microscopy, Jinfeng Yang, Yoichi Yoshida, Hiromi Shibata, C, The Institute of Electrical Engineers of Japan, 134 (2014), 515-520.

Femtosecond Pulse Radiolysis, Takafumi Kondoh, Jinfeng Yang, Koichi Kan, Masao Gohdo, Hiromi Shibata, Yoichi Yoshida, C, The Institute of Electrical Engineers of Japan, 134 (2014), 664-669.

Ultrafast Crystalline-structural Dynamics by Time-resolved MeV-electron Diffraction, N. Naruse, Y. Giret, J. Yang, K. Tanimura, Review of Laser Engineering, The Laser Society of Japan, 43 (2015), 144-148.

Contributions to International Conferences and Journals

Y. Yoshida	The 15th International Congress of Radiation Research (ICRR 2015) (Scientific		
	Committee)		
Publications in D	omestic Meetings		
Radiation Process	Symposium	2 papers	
Workshop on Rad	ioisotope and Radiation	2 papers	
Meeting of Particl	e Accelerator Society of Japan	8 papers	
Meeting of Atomic	c Energy Society of Japan	7 papers	
Symposium of app	plication using quantum beam in Takasaki	1 paper	
Annual Meeting o	n Photochemistry	1 paper	
Workshop on high	blightness/rf electron gun	2 papers	
Academic Degree	25		
Master Degree	Primary process of radiation chemistry of resist material by using fe	mto second pulse	
for Engineering	radiolysis		
T. Igahara			
Master Degree	Generation and measurement of ultrashort electron bunches with du	rations of	
for Engineering	femtoseconds and attoseconds		
I. Nozawa			
Master Degree	Development of High Repetition-rate Photocathode RF-gun for Ultr	afast Electron	
for Engineering	Microscopy		
L. Li			
Grant-in-Aid for	Scientific Research		
Y. Yoshida	Development of attosecond pulse radiolysis	¥21,060,000	
J. Yang	Study on femtosecond-time-resolved transmission electron	¥14,300,000	
	microscope		
K. Kan	Pulse radiolysis in terahertz range	¥2,080,000	
M. Gohdo	Development of a spacially resolved time expansion single-shot	¥2,080,000	
	pulse radiolysis		
Contribution to I	Research		
Y. Yoshida	Nisshin International Co.,Ltd	¥1,000,000	
K. Kan	TEPCO Memorial Foundation	¥200,000	
Cooperative Rese	earch		

Daikin Industries, Ltd.	¥4,320,000
Nisshin International Co.,Ltd	¥416,000
JAEA	¥0,000
JAEA	¥0,000
AIST	¥0,000
	Daikin Industries, Ltd. Nisshin International Co.,Ltd JAEA JAEA AIST

Department of Nanocharacterization for Nanostructures and Functions Original Papers

[1]Elucidation of the Origin of Grown-in Defects in Carbon Nanotubes, Hideto Yoshida, Seiji Takeda: Carbon, 70 (2014) 266-272.

[2]A Flux Induced Crystal Phase Transition in the Vapor-Liquid-Solid Growth of Indium-Tin Oxide Nanowires, Gang Meng, Takeshi Yanagida, Hideto Yoshida, Kazuki Nagashima, Masaki Kanai, Fuwei Zhuge, Yong He, Annop Klamchuen, Sakon Rahong, Xiaodong Fang, Seiji Takeda, Tomoji Kawai: Nanoscale, 6 (12) (2014) 7033-7038.

[3]Electron diffraction study of the sillenites $Bi_{12}SiO_{20}$, $Bi_{25}FeO_{39}$ and $Bi_{25}InO_{39}$: Evidence of short-range ordering of oxygen-vacancies in the trivalent sillenites, Craig A. Scurti, Nicolas Auvray, Michael W. Lufaso, Seiji Takeda, Hideo Kohno, D. J. Arenas: AIP Adv., 4 (8) (2014) 087125-1--087125-10.

[4]Structurally Inhomogeneous Nanoparticulate Catalysts in Cobalt-catalyzed Carbon Nanotube Growth, Yusuke Kohigashi, Hideto Yoshida, Yoshikzu Homma, Seiji Takeda: Appl. Phys. Lett., 105 (7) (2014) 073108-1--073108-4.

[5]In situ Transmission Electron Microscopy of Individual Carbon Nanotetrahedron/nanoribbon Structures in Joule Heating, Yusuke Masuda, Hideto Yoshida, Seiji Takeda, Hideo Kohno: Appl. Phys. Lett., 105 (8) (2014) 083107-1--083107-5.

[6]Oxidation and Reduction Processes of Platinum Nanoparticles Observed at the Atomic Scale by Environmental Transmission Electron Microscopy, Hideto Yoshida, Hiroki Omote, Seiji Takeda: Nanoscale, 6 (21) (2014) 13113-13118.

International Conferences

[1]Surface and interface structures in metal nanoparticulate catalysts in reaction environments (invited), S. Takeda: TAILOR 2014 Workshop "Tailored Surfaces in Operando Conditions: Structure and Reactivity" Les Oliviers, Saint Paul de Vence, France, April 8-11, 2014.

[2]Structures of the gold nanoparticulate catalysts in reaction environments (invited), S. Takeda: TMU International Kick Off Workshop for the Research Center for Gold Chemistry, International House, Tokyo Metropolitan University, Tokyo, Japan, May 14–15, 2014.

[3]Effect of Pretreatment on CO Oxidation over Palladium Catalysts Supported on Zr-rich Ceria Zirconia (poster), N. Kamiuchi, M. Haneda, M. Ozawa: The 7th Tokyo Conference on Advanced Catalytic Science and Technology (TOCAT7).

[4]Catalytically active atomic-structures in metal nanoparticulate catalysts studied by quantitative environmental TEM (invited), S.Takeda, H. Yoshida, Y. Kuwauchi: 248th ACS National Meeting & Exposition, San Francisco, USA, August 10-14, 2014.

[5]Quantitative Environmental TEM in Gold Nanoparticulate Catalysts (invited), S. Takeda: The 3rd International Symposium on Advanced Electron Microscopy for Catalysis, Seeon Monastery, Germany, September 3-6, 2014.

[6]Catalytically active structures in Au nanoparticulate catalysts studied by quantitative environmental

TEM (oral), Y. Kuwauchi, H. Yoshida, S. Takeda: 18th International Microscopy Congress, Prague, Czech Republic, September 7-12, 2014.

[7]Phase Control in Transition-Metal Oxide Films through Interfacial Octahedral Connections (poster), R. Aso, D. Kan, Y. Shimakawa, H. Kurata: 18th International Microscopy Congress, Prague, Czech Republic, September 7-12, 2014.

[8]In-Situ Environmental TEM Observation of the Formation of Defects in Growing Carbon Nanotubes (poster), H. Yoshida, S. Takeda: 18th International Microscopy Congress, Prague, Czech Republic, September 7-12, 2014.

[9]Formation Mechanism of Grown-in Defects in Carbon Nanotubes (poster), H. Yoshida, S. Takeda: The 18th SANKEN International Symposium / The 13th SANKEN Nanotechnology Symposium, The Congrès Convention Center, Osaka, Japan, December 10-11, 2014.

[10]In-situ TEM observation of an all-solid-state lithium-ion secondary battery (poster), K. Soma, H. Yoshida, G. Kobayashi, S. Takeda: The 18th SANKEN International Symposium / The 13th SANKEN Nanotechnology Symposium, The Congrès Convention Center, Osaka, Japan, December 10-11, 2014.

[11]Oxidation and Reduction Processes of Platinum Nanoparticles observed by Atomic-Scale Environmental Transmission Electron Microscopy (poster), H. Yoshida, H. Omote, S. Takeda: The 18th SANKEN International Symposium / The 13th SANKEN Nanotechnology Symposium, The Congrès Convention Center, Osaka, Japan, December 10-11, 2014.

Publications in Do	mestic Meetings	
The Japanese Society of Microscopy 2014		
Nano-Macro Mater	ials, Devices and System Research Alliance Meeting 2014	1 paper
The 75th JSAP Aut	umn Meeting, 2014	3 papers
Opening Internation	nal Symposium JSM Next-generation Microscopic Science	1 paper
Workshop of nanoc	arbon research department in Tokyo University of Science	1 paper
Super-High Resolut	tion Microscopy Meeting 2014	1 paper
Academic Degrees		
Master Degree for	Structures and electrical conductivity of nano-gap gold electrod	es under gas
Engineering	atmospheres	
Y. Ogawa		
Master Degree for	Fabrication and in-situ observation of Pd nano-gap for hydrogen	n gas sensor
Engineering		
T. Tamaoka		
Grant-in-Aid for S	Scientific Research	
S. Takeda	Atomic-scale dynamic analysis of nano-gap electrode	¥6,500,000
	interacting with gas molecules	
N. Kamiuchi	Elucidation of the mechanisms of activation and deactivation on	¥2,600,000
	supported metal catalysts by Environmental TEM	
Contribution to Re	esearch	
S. Takeda	UBE Scientific Analysis Laboratory, Inc	¥2,000,000
S. Takeda	Nippon Steel & Sumitomo Metal Corporation	¥500,000
Cooperative Resea	nrch	
S. Takeda	National Institute of Advanced Industrial Science and	¥0,000
	Technology	

Department of Theoretical Nanotechnology

Original Papers

[1]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.

[2]One-dimensional edge states with giant spin splitting in a bismuth thin film, A. Takayama, T. Sato, S. Souma, T. Oguchi, and T. Takahashi: Phys. Rev. Lett., 114 (2015) 066402/1-5.
[3]Topological proximity effect in a topological insulator hybrid, T. Shoman, A. Takayama, T. Sato, S. Souma, T. Takahashi, T. Oguchi, K. Segawa, and Y. Ando: Nature Commun., 6 (2015) 6547/1-6.

[4]Signature of high \$T_c\$ around 25K in higher quality heavily boron-doped diamond, H. Okazaki, T. Wakita, T. Muro, T. Nakamura, Y. Muraoka, T. Yokoya, S. Kurihara, H. Kawarada, T. Oguchi, and Y. Takano: Appl. Phys. Lett., 106 (2015) 052691/1-4.

[5]Theoretical study of the structure of boron carbide $B_{12}C_2$, K. Shirai, K. Sakuma, and N. Uemura: Phys. Rev. B, 90 (2014) 064109/1-10.

[6]Origin of the band dispersion in a metal phthalocyanine crystal, S. Yanagisawa, K. Yamauchi, T. Inaoka, T. Oguchi, I. Hamada: Phys. Rev. B, 90 (2014) 245141/1-6.

[7]Ab-initio Prediction of Magnetoelectricity in Infinite-Layer CaFeO2 and MgFeO2, K. Yamauchi, T. Oguchi, S. Picozzi: J. Phys. Soc. Jpn., 83 (2014) 094712/1-6.

[8]Giant spin-driven ferroelectric polarization in TbMnO3 under high pressure, T. Aoyama, K. Yamauchi, A. Iyama, S. Picozzi, K. Shimizu, T. Kimura: Nature Commun., 5 (2014) 5927/1-7.

[9]First-principles study on structural and electronic properties of α -S and Na-S crystals, H. Momida, T. Yamashita and T. Oguchi: J. Phys. Soc. Jpn., 83 (2014) 124713/1-8.

[10]Ab initio study of electronic, magnetic, and spectroscopic properties in A- and B-site-ordered perovskite CaCu3Fe2Sb2O12, H. Fujii, M. Toyoda, H. Momida, M. Mizumaki, S. Kimura, and T. Oguchi: Physical Review B, 90 (1) (2014) 014430/1-8.

[11]Symmetry-breaking 60°-spin order in the A-site-ordered perovskite LaMn3V4O12, T. Saito, M. Toyoda, C. Ritter, S. Zhang, T. Oguchi, J. P. Attfield, and Y. Shimakawa: Physical Review B, 90 (21) (2014) 214405/1-6.

[12]Ab Initio Study on Pressure-Induced Phase Transition in LaCu3Fe4O12, K. Isoyama, M. Toyoda, K. Yamauchi, and T. Oguchi: J. Phys. Soc. Jpn., 84 (2015) 034709/1-5.

International Conferences

[1]Defect structure of boron carbides (invited), K. Shirai, K. Sakuma, and N. Uemura: Materials Science & Technology 2014 (MS&T14).

[2]Defect states of boron carbide $B_{13}C_2$ (invited), K. Shirai, K. Sakuma, and N. Uemura: The 18th International Symposium on Boron, Borides and Related Materials.

[3]First Principles study on a new structure of α -tetragonal boron (poster), Naoki Uemura¹, Koun Shirai¹, Hagen Eckert², Jens Kunstmann: The 18th International Symposium on Boron, Borides and Related Materials.

[4]First-principles calculation of single copper impurity in silicon (poster), T. Fujimura and K. Shirai: The 7th Forum on the Science and Technology of Silicon Materials 2014 (Hamamatsu).

[5]Effect of Dynamics on The Elastic Softening of Vacancy in Si (poster), Koun Shirai and Jun Ishisada: The 7th Forum on the Science and Technology of Silicon Materials 2014 (Hamamatsu).

[6]First-principles study of Na₂C₆O₆ as a sodium-ion battery cathode (poster), T. Yamashita, H. Momida

and T. Oguchi: MRS 2014 Spring Meeting, San Francisco, USA, April 21-25, 2014.

[7]First-principles study of discharge reactions in Na/FeS2 battery systems (poster), H. Momida and T. Oguchi: MRS 2014 Spring Meeting, San Francisco, USA, April 21-25, 2014.

[8]Theoretical investigation on the structural stability of Na2+xC6O6 as a sodium-ion battery cathode (poster), T. Yamashita, H. Momida and T. Oguchi: The 17th International Meeting on Lithium Batteries (IMLB2014), Como, Italy, June 10-14, 2014.

[9]Discharge reaction mechanism of FeS2 cathodes in Na batteries: First-principles calculations (poster), H. Momida and T. Oguchi: The 17th International Meeting on Lithium Batteries (IMLB2014), Como, Italy, June 10-14, 2014.

[10]First-principles study of piezoelectricity in AlN-based materials (invited), H. Momida: The 31st International Korea-Japan Seminar on Ceramics (KJ-Ceramics 31), Changwon, Korea, November 26-29, 2014.

[11]First-principles study of reaction mechanism in sodium batteries (oral), H. Momida: One-day Symposium of Computational Nano-Materials Design: New Strategic Materials, Osaka, Japan, January 26, 2015.

[12]A-site magnetic ordering in quadruple perovskite oxides (invited), M. Toyoda, K. Yamauchi, T. Oguchi: The 18th SANKEN International Symposium and the 13th SANKEN Nanotechnology Symposium.

[13]A-site magnetic ordering in quadruple perovskite oxides (oral), M. Toyoda, K. Yamauchi, T. Oguchi: APS March Meeting 2015.

[14]Structural determination of a ternary compound (BN)8C2 by first-principles calculations (poster), Sho-hei Komori and Koun Shirai: The 18th SANKEN International Symposium, and The 13th SANKEN Manotechnology Symposium.

Contributions to International Conferences and Journals

T. Oguchi	The 17th Asian Workshop on First-Principles Electronic Structure Calculation	on
	(International Organizing Committee)	
K. Shirai	The 18th International Symposium on Boron, Borides and Related Materials	1
	(ISBB-2014) (International Organizing Committee)	
T. Oguchi	NPJ Computational Materials (Editorial Board)	
Publications in Do	mestic Meetings	
The Physical Society	y of Japan	9 papers
The Japan Society o	f Applied Physics	1 paper
The Electrochemical	l Society of Japan	1 paper
Academic Degrees		
Master Degree for	Structural study of ternary compound (BN)4C by first-principles calculati	on
Science		
S. Komori		
Master Degree for	Effects of strains on the thermoelectric properties of ATiO3 (A=Ca, Ba) st	udied by
Engineering	first-principles calculation	
T. Saijou		
Doctor Degree for	Ab initio study on electronic states in ACu3Fe4O12 (A=Ca, Sr, La)	
Science		
K. Isoyama		
Grant-in-Aid for S	cientific Research	
K.Yamauchi	Band engineering of topological insulators by using ¥1	,560,000

	transition-metal oxides		
Entrusted Research			
T.Oguchi	JST	Electronic Structure Analysis by	¥14,950,000
		First-Principles Calculations	
Cooperative Researc	ch		
T.Oguchi	DENSO CORPORATION		¥1,068,000
Other Research Fun	d		
T. Oguchi	MEXT		¥4,600,000

Department of Soft Nanomaterials Original Papers

[1]Electron-Donor Function of Methanofullerenes in Donor–Acceptor Bulk Heterojunction Systems, Y. Ie, M. Karakawa, S. Jinnai, H. Yoshida, A. Saeki, S. Seki, S. Yamamoto, H. Ohkita, Y. Aso: Chem. Commun, 50 (31) (2014) 4123-4125.

[2]Solution-Processable n-Type Semiconducting Materials Containing a Carbonyl-Bridged Thiazole-Fused System, Y. Ie, C. Sato, M. Nitani, H. Tada, Y. Aso: Chem. Lett., 43 (10) (2014) 1640-1642.

[3]Synthesis, Properties, and n-Type Transistor Characteristics of π -Conjugated Compounds Having a Carbonyl-Bridged Thiazole-Fused Polycyclic System, Y. Ie, C. Sato, M. Nitani, H. Tada, Y. Aso: J. Fluorine Chem., 174 (2015) 75-80.

[4]Synthesis, Properties, and n-Type Transistor Characteristics of π -Conjugated Compounds Having a Carbonyl-Bridged Thiazole-Fused Polycyclic System, Y. Ie, C. Sato, M. Nitani, H. Tada, Y. Aso: Chem. Eur. J., 20 (50) (2014) 16509-16515.

[5]Enhanced Photovoltaic Performance of Amorphous Copolymers Based on Dithienosilole and Dioxocycloalkene-annelated Thiophene, J. Huang, Y. Ie, M. Karakawa, M. Saito, I. Osaka, Y. Aso: Chem. Mater., 26 (24) (2014) 6971-6978.

[6]Air-Stable n-Type Organic Field-Effect Transistors Based on

4,9-Dihydro-s-indaceno[1,2-b:5,6-b']dithiazole-4,9-dione Unit, Y. Ie, M. Ueta, M. Nitani, N. Tohnai, M. Miyata, H. Tada, Y. Aso: Chem. Mater., 27 (2) (2015) 648.

[7] A Series of π -Extended Thiadiazoles Fused with Electron-Donating Heteroaromatic Moieties: Synthesis, Properties, and Polymorphic Crystals, S.-i. Kato, T. Furuya, M. Nitani, N. Hasebe, Y. Ie, Y. Aso, T. Yoshihara, S. Tobita, Y. Nakamura: Chem. Eur. J., 21 (7) (2015) 3115-3118.

[8]N-phenyl[60]fulleropyrrolidines: Alternative Acceptor Materials to PC61BM for High Performance Organic Photovoltaic Cells, M. Karakawa, T. Nagai, K. Adachi, Y. Ie, Y. Aso: J. Mater. Chem. A, 2 (48) (2014) 20889-20895.

International Conferences

[1]Synthesis, Properties, and Photovoltaic Performance of Low-Bandgap Copolymers Based on Dithienosilole and Dioxocycloalkene-annelated Thiophene (oral), Y. Ie, J. Huang, M. Karakawa, Y. Aso: 2014 MRS Fall Meeting.

[2]Development of Organic Semiconducting Materials for Organic Photovoltaics (invited), Y. Ie, Y. Aso: The 18th SANKEN International the 13th SANKEN Nanotechnology Symposium.

[3]Naphthalene bis(dicarboximide)- and Perylene bis(dicarboximide)-based Acceptors: Synthesis, Properties, and Solar Cell Performance (poster), S. Chatterjee, Y. Ie, M. Karakawa, Y. Aso: The 18th SANKEN International the 13th SANKEN Nanotechnology Symposium.

[4]Novel Naphtho[2,3-c]thiophene-4,9-dione-Based Copolymers as p-Type Semiconductors for Bulk-Heterojunction Organic Photovoltaic Devices (oral), J. Huang, Y. Ie, M. Karakawa, Y. Aso: KJF International Conference on Organic Materials for Electronics and Photonics.

[5]Fluorine Atoms Containing Fulleropyrrolidine Derivatives for Organic Solar Cells (poster), M. Karakawa, T. Nagai, K. Adachi, Y. Ie, Y. Aso: KJF International Conference on Organic Materials for Electronics and Photonics.

[6]N-Phenyl-substituted Fulleropyrrolidine Derivatives for High Performance Organic Photovoltaics (oral), M. Karakawa, T. Nagai, K. Adachi, Y. Ie, Y. Aso: The 22nd International Conference for Science and Technology of Synthetic Metals (ICSM2014).

[7]Photovoltaic Performances of Novel Donor–Acceptor Copolymers Based on Naphtho[2,3-c]thiophene-4,9-dione as Acceptor Units (poster), J. Huang, Y. Ie, M. Karakawa, Y. Aso: The 22nd International Conference for Science and Technology of Synthetic Metals (ICSM2014).

[8]Synthesis, Properties, and n-Type Performances of Electronegative π -Conjugated Systems Having Fluorine Substituents (invited), Y. Ie: International Conference on Fluorine Chemistry 2014 Tokyo.

[9]Fulleropyrrolidine Derivatives for Organic Photovoltaics: Influence of Introduced Fluorine Atoms on Device Performance (poster), T. Nagai, M. Karakawa, Y. Ie, K. Adachi, Y. Aso: International Conference on Fluorine Chemistry 2014 Tokyo.

[10]Synthesis, Properties, and n-Type Organic Photovoltaic Performances of Three-dimensional Electron-accepting Compounds Containing Perylene Bis(dicarboxyimide)s (oral), Y. Ie, T. Sakurai, S. Jinnai, M. Karakawa, Y. Aso: Grand Renewable Energy 2014.

[11]Development of New pi-Conjugated Systems towards Organic Semiconducting Materials (invited), Y. Ie: 8th Singapore International Chemistry Conference (SICC-8).

[12]Novel Donor–Acceptor p-Type Copolymers Based on Dioxoring-Annelated [c]Thiophene Units for Bulk-Heterojunction Organic Photovoltaics (plenary), J. Huang, Y. Ie, M. Karakawa, Y. Aso: International Symposium on Polymer Science and Technology (MACRO2015).

Review Papers

Development of Electron-transporting π -Conjugated Compounds and Their Application to Solution-processed Organic Field-effect Transistors, Y. Ie, Y. Aso, CHEMICAL INDUATRY, KAGAKU KOGYO SYA, 65 (2014), 30-36.

Books

[1] Materials for Organic Photovoltaic Cells: Applications of Novel Fulleropyrrolidine Derivatives for Organic Photovoltaic Cells (Y. Matsuo) M. Karakawa, Y. Aso, "Cutting-edge Technology in Fullerene Derivatives and Endohedral Fullerenes", CMC Publishing Co.,Ltd., (178–186) 2014.

Publications in Domestic Meetings

	8	
The Chemical Society of Japan		9 papers
Symposium on Orga	nic pi-Systems	2 papers
Symposium on Main	Element Chemistry	1 paper
Symposium on Physi	ical Organic Cheistry	3 papers
The Japan Society of Applied Physics		2 papers
The Society of Polyn	ner Science, Japan	1 paper
Academic Degrees		
Master Degree for	Synthesis and Properties of New Pyradinodithiazole Derivatives and	

Engineering Semibonductor Performance of Its-containing π -Conjugated Copolymers

S. Sasada			
Master Degree for	Development of Tripodal	Anchor Compounds toward π -Channel A	dsorption and
Engineering	Characterization of Mono	layers on Gold or Graphite Electrodes	
A. Tashiro			
Grant-in-Aid for	Scientific Research		
Y. Aso	Development of molecular el	ectronics on the basis of the synthesis	¥10,400,000
	of pricisely designed molecul	ar wires	
Y. Ie	Development of functional pi	-conjugated systems for	¥10,140,000
	single-molecular photovoltaid	28	
Y. Ie	Develoment of functional pi-	conjugated systems toward	¥1,300,000
	elucidation of charge-transpo	rting mechanism in single-molecular	
	devices		
Y. Ie	Development and investigation	on of new functional materials for	¥3,640,000
	molecular architectonics		
Entrusted Resear	ch		
Y. Aso	Japan Science and	Practical implementation of acceptor	¥3,172,000
	Technology Agency	materials for organic thin-film solar	
		cells	
Y. Ie	Japan Science and	Evaluation of organic field-effect	¥4,160,000
	Technology Agency	tansistor devices	
Cooperative Rese	arch		
Y. Aso	Daikin Industries, Ltd		¥2,500,000
Y. Aso	ISHIHARA SANGYO KA	AISHA, LTD	¥3,654,000
Y. Aso	Sumitomo Chemical Co., 1	Ltd.	¥833,000
M. Karakawa	TOYO INK SC		¥0,000

Department of Bio-Nanotechnology Original Papers

[1]Detection of post-translational modifications in single peptides using electron tunnelling currents, T. Ohshiro, M Tsutsui, K. Yokota, M. Furuhashi, M. Taniguchi, T. Kawai: Nature Nanotechnology, 9 (2014) 835-840.

[2]Molecular Wiring Method Based on Polymerization or Copolymerization of an Insulated pi-Conjugated Monomer, J. Terao, K. Homma, Y. Konoshima, M. Taniguchi, M. Kiguchi, Y. Komoto, M. Horikawa, Y. Naito, T. Fujihara, Y. Tsuji: Bulletin of the Chemical Society of Japan, 87 (2014) 871-873.

[3]Graphene/hexagonal boron nitride/graphene nanopore for electrical detection of single molecules, Y. He, M. Tsutsui, S. Ryuzaki, K. Yokota, M. Taniguchi and T. Kawai: NPG Asia Materials, 6 (2014) 1-9.

[4]Discrimination of equi-sized nanoparticles by surface charge state using low-aspect-ratio pore sensors, A. Arima, M. Tsutsui, and M. Taniguchi: Applied Physics Letters, 104 (2014) 163112- 163115.

[5]Fabrications of insulator-protected nanometer-sized electrode gaps, A. Arima, M. Tsutsui, T. Morikawa, K. Yokota and M. Taniguchi: Journal of Applied Physics, 115 (2014) 11431-11434.

[6]Nonequilibrium Ionic Response of Biased Mechanically Controllable Break Junction (MCBJ) Electrodes, K. Doi, M. Tsutsui, T. Ohshiro, CC Chien, M. Zwolak, M. Taniguchi, T. Kawai, S. Kawano, and M. Di Ventra: The Journal of Physical Chemistry C, 118 (2014) 3758–3765.

[7]Thermoelectric Voltage Measurements of Atomic and Molecular Wires Using Microheater-Embedded Mechanically-Controllable Break Junctions, T. Morikawa, A. Arima, M. Tsutsui and M. Taniguchi: Nanoscale, 6 (2014) 8235-8241.

[8]Electrode-embedded nanopores for label-free single-molecule sequencing by electric currents, K.

Yokota, M. Tsutsui and M. Taniguchi: RSC Advances, 4 (2014) 15886–15899.

[9]Selective Multidetection Using Nanopores, M. Taniguchi: Analytical Chemistry, 87 (2014) 188-199.

International Conferences

[1]Single Molecular Technologies to Identify Central Dogma (invited), M. Taniguchi: The 6th IEEE International Nanoelectronics Conference 2014 (IEEE INEC 2014).

[2]Single-molecule electrical sequencing of biomolecules (invited), M. Taniguchi: The 7th International Symposium on Surface Science (ISSS-7).

[3]Tunneling current measurements for single-molecule DNA sequencing (invited), M. Tsutsui: NCTS – NCTU Seminar.

[4]Single Molecule Electrical Sequencing Technology (invited), M. Taniguchi: PITTOCON 2015 CONFERENCE & EXPO.

[5]STM and Gating Nanopores for Single Molecule DNA and RNA Electrical Sequencing (invited), T. Kawai: DIPC School "Scanning Probe Microscopy (Tribute to Heinrich Roher)".

[6]SINGLE-MOLECULE SEQUENCING TECHNOLOGIES OF BIOMOLECULES VIA ELECTRIC CURRENTS (plenary), M. Taniguchi: The 18th International Conference on Miniaturized Systems for Chemistry and Life Sciences (MicroTAS 2014).

[7]Single Molecule DNA and RNA Sequencing by Gating Nanopore systems (invited), T. Kawai: The 7th International Symposium on Surface Science (ISSS-7).

[8]Future of Nanotechnology - Dreams and Sciences - (invited), T. Kawai: 18th SANKEN International Symposium and the 13th SANKEN Nanotechnology Symposium.

Review Papers

Ultra-high-speed DNA and RNA sequencing using single molecular detection technology, T.Kawai, M.Taniguchi, OYO BUTURI, The Japan Society of Applied Physics, 83 (2014), 363-365.

Single molecule sequencer -Decoding DNA, RNA, and peptide-, M.Taniguchi, Forum on Biomolecular Chemistry, Forum on Biomolecular Chemistry, 47 (2015), 9-14.

Grant-in-Aid for Scientific Research

M.Taniguchi	Development of single mole	¥15,210,000	
M.Taniguchi	Single molecule sequencing	¥42,510,000	
M.Tsutsui	Development of method and	devices for thermoelectric	¥3,900,000
	measurements of one-dimen	sional quantum wires	
M.Tsutsui	Development of single-mole control units	ecule sensors with electrophoresis	¥5,850,000
H.Tanaka	Single molecule sequencing	using graphene	¥2,470,000
K.Yokota	Elucidation of material transport phenomena in nananospace and single molecule impedance measurements		¥3,250,000
T.Kawai	Ultra high speed detection of epi-genetic feature of long DNA by nano-channel electrodes		¥17,810,000
Entrusted Research	1		
M.Tsutsui	Ministry of Internal	Development of organic	¥8,632,000
	Affairs and	thermoelectric devices	
	Communications		
T.Kawai	Japan Science and	Development of InSECT system	¥25,300,000

	Technology Agency	using nano-micro pore	
Contribution to Re	search		
M.Tsutsui	Inamori Foundation		¥1,000,000
M.Tsutsui	The Asahi Glass Foundation		¥2,000,000
Cooperative Resea	rch		
M.Taniguchi	Quantum Biosystems Inc.		¥0,000
Other Research Fu	nd		
M.Taniguchi	Kyoto University(MEXT)		¥36,000,000

Department of Nanotechnology for Environmental and Energy Applications Original Papers

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[8]Superconductor derived from a topological insulator heterostructure, Satoshi Sasaki, Kouji Segawa, and Yoichi Ando: Phys. Rev. B, 90 (22) (2014) 220504(R)/1-5.

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[1]Topological Insulators and Superconductors (invited), Y. Ando: OIST International Workshop on Novel Quantum Materials and Phases (NQMP2014).

[2]Topological Insulators and Superconductors (invited), Y. Ando: New Trends in Topological Inslators (NTTI) 2014.

[3]Progress toward Topological Insulator Devices (invited), Y. Ando: 32nd International Conference on the Physics of Semiconductors (ICPS 2014).

[4]Topological Insulators and Superconductors (invited), Y. Ando: Workshop on Novel Quantum States in Condensed Matter (NQS2014).

[5]Topological Superconductivity Based on Topological Insulators (invited), Y. Ando: International Conference on Topological Quantum Phenomena (TQP2014).

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[9]Manipulation of topological states in a topological-insulator heterostructure (poster), T. Sato, K. Nakayama, Y. Tanaka, S. Souma, T. Takahashi, K. Eto, S. Sasaki, K. Segawa, and Y. Ando: International Conference on Topological Quantum Phenomena (TQP2014).

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Topological Superconductors, Yoichi Ando, Parity, Maruzen, 30 (2015), 16-17.

Books

[1]Introduction to Topological Insulators Yoichi Ando, "Introduction to Topological Insulators", Kodansha, (1-236) 2014.

Contributions to International Conferences and Journals

Y. Ando	International Conference on Topological Quantum Phenomena (TQP2014)		
	(Organaizing Committee)		
Publications	in Domestic Meetings		
Fall Meeting	of the Physical Society of Japan 2014	9 papers	
The 70th Ann	ual Meeting of the Physical Society of Japan	3 papers	
Grant-in-Aid	for Scientific Research		
Y.Ando	Explorations of Novel Quantum Phenomena in Topological	¥25,740,000	
	Insulators and Superconductors		

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[1]Bayesian estimation of causal direction in acyclic structural equation models with individual-specific confounder variables and non-Gaussian distributions, S. Shimizu, K. Bollen: Journal of Machine Learning Research, 15 (-) (2014) 2629-2652.

[2]Application of continuous and structural ARMA modeling for noise analysis of a BWR coupled core and plant instability event, M. Demeshko, A. Dokhane, T. Washio, H. Ferroukhi, Y. Kawahara and C. Aguirre: Annals of Nuclear Energy, 75 (-) (2015) 645-657.

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[3]A non-Gaussian approach for estimating possible causal direction in the presence of latent confounders (invited), S. Shimizu: Conference on Statistics and Causality 2014.

[4]Estimation of causal direction in the presence of latent confounders and linear non-Gaussian structural equation models (invited), S. Shimizu: Causal Modeling and Machine Learning.

[5]A performance comparison of generative and discriminative models in causal and anticausal problems (poster), P. Blöbaum, S. Shimizu and T. Washio: 17th International Conference on Artificial Intelligence and Statistics.

[6]On approximate non-submodular minimization via tree-structured supermodularity (poster), Y. Kawahara, R. Iyer and J. Bilmes: Proc. of NIPS 2014 Workshop on Discrete and Combinatoria.

[7]Multiple Testing Correction in Graph Mining (invited), M. Sugiyama: Tokyo Workshop on Statistically Sound Data Mining.

Review Papers

Anomaly Detection of Informatical Quantum States by Using Machine Learning, K. Fukui, Artificial Intelligence, The Japanese Society for Artificial Intelligence, 30 (2015), 217-223.

Contributions to International Conferences and Journals

M. SUGIYAMA	The 25th European Conference on Machine Learning and 18th Principles and
	Practice of Knowledge Discovery in Databases (Program Committee)
M. SUGIYAMA	The 6th Asian Conference on Machine Learning (Program Committee)
T. WASHIO	Neural Information Processing Systems Foundation 2014 (NIPS 2014) (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	IEEE International Conference on Data Mining 2015 (ICDM2015) (Con	ntest Chair)	
T WASHIO	The 19th Pacific-Asia Conference on Knowledge Discovery and Data M	Aining 2015	
1. 0/10/110	(PAKDD2015) (Publicity Chair)	11111 <u>g</u> 2013	
T WASHIO	ACM SIG-KDD'15: The 21st ACM SIGKDD Conference on Knowledge	e Discoverv	
1. 0/10/110	and Data Mining (Program Committee)	je Discovery	
T. WASHIO	The 19th Pacific-Asia Conference on Knowledge Discovery and Data M	<i>A</i> ining	
	(PAKDD2014) (Senior Program Committee Member)		
T. WASHIO	The 2015 SIAM Data Mining Conference (SDM 2015) (Program Com	nittee)	
T. WASHIO	IEEE International Conference on Data Mining 2015 (ICDM2015) (Pro	gram	
	Committee)	Brann	
T. WASHIO	Society for Industrial and Applied Mathematics. Division of Data Minir	ig and	
	Analytics, Society for Industrial and Applied Mathematics (Program Di	rector)	
T. WASHIO	DS-2014: the Seventeenth International Conference on Discovery Scien	ce (Program	
	Committee)	(110grain	
T. WASHIO	ISAI-isAI 2014 (Advisory Board Member)		
T. WASHIO	ACM SIGKDD'14: The 20th ACM SIGKDD Conference on Knowledge	e Discoverv	
	and Data Mining (Program Committee)		
T. WASHIO	ECML/PKDD 2014: The European Conference on Machine Learning a	nd Principles	
	and Practice of Knowledge Discovery in Databases 2014 (Program Con	imittee)	
T. WASHIO	The Second IEEE ICDM (IEEE International Conference on Data Minin	ng)	
	Workshop on Causal Discovery (CD 2014) (Organizing Committee Men	mber)	
T.WASHIO Editional Board of Artificial Intelligence Encyclopedia Iananese Society of			
	Artificial Intelligence(Editional Board Member)		
T. WASHIO	Annual Conference of the Japanese Society for Artificial Intelligence (P	rogram	
	Chair)	C	
Y. KAWAHARA	Workshop on Graph-based Algorithms for Big Data and its Applications	s (Program	
	Co-Chair)		
Y. KAWAHARA	The 6th Asian Conference on Machine Learning (Program Committee)		
Y. KAWAHARA	The 17th International Conference on Artificial Intelligence and Statistic	cs (Program	
	Committee)		
Y. KAWAHARA	The 23rd International World Wide Web Conference (Program Committee)	ee)	
Y. KAWAHARA	2014 SIAM International Conference on Data Mining (Program Commi	ittee)	
Publications in Dor	nestic Meetings		
The 28th Annual Co	nference of the Japanese Society for Artificial Intelligence	5 papers	
The 95th Workshop	of Special Interest Group on Fundamental Problems of Artificial	1 paper	
Intelligence			
The 94th Workshop	of Special Interest Group on Fundamental Problems of Artificial	1 paper	
Intelligence			
Workshop of the Co	operation with Mathematics Program on Probabilistic Graphical Models	1 paper	
The 28th Annual Co	nference of the Japan Society of Artificial Intelligence	3 papers	
Grant-in-Aid for So	cientific Research		
T. Washio	Development and Application of Statistical	¥13,520,000	
]	Estimation/Simulation Principle for Super High Dimensional		
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Department of Nanodevices for Medical Applications

Original Papers [1]Cytosine-bulge dependent fluorescence quenching for real-time hairpin primer PCR, F. Takei, C. Chen, G. Yu, T. Shibata, C. Dohno, K. Nakatani: Chem. Commun., 50 (2014) 15195-15198.

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[1]Novel PCR Monitoring System Using Hairpin Primer Having Cytosine-Bulge and Covalent Binding Fluorescence Molecule (poster), F. Takei, C. Chen, G. Yu, C. Dohno, K. Nakatani: XXI Round Table on Nucleosides, Nucleotides and Nucleic acids.

[2]Development of Novel PCR Primers for Facile Gene Detection (invited), K. Nakatani: A3RONA 2014 China.

[3]Toward new FET devices detecting DNA (oral), R. K. Verma, A. Michikawa, N. Sabani, F. Takei, K. Nakatani: 3rd imec Handai International Symposium.

Publications in	Domestic Meeti	ings	
The 95rd CSJ A	nnual Meeting 20	015	3 papers
The 76th JSAP	Spring Meeting		1 paper
Grant-in-Aid fo	or Scientific Res	earch	
F. Takei	The high sen method	sitive virus detection system using hairpin primer PCR	¥6,500,000
Entrusted Rese	arch		
K. Nakatani	JST	Development of Digital Hairpin Primer OCR for Diagnosis of Hepatitis	¥9,185,000
Cooperative Re	esearch		
K. Nakatani	NITTO KAS	SEI co.,ltd.	¥864,000
K. Nakatani	FURUKAW CO.,LTD.	A ELECTRIC ADVANCED ENGINEERING	¥0,000

Nanotechnology Open Facilities

[1]Introduction about Nanotechnology Open Facilities, Osaka University, K. Norizawa, A. Kitajima, K. Higuchi, M. Kashiwakura: KANSAI Nanoscience and Nanotechnology Handai Nanoscience and Nanotechnology international Symposium.

Review Papers

Activity "Nanofabrication Platform" in Osaka University, K.Norizawa, ENGINEERING MATERIALS, THE NIKKAN KOGYO SHIMBUN,LTD, 62[9] (2014), 81-83.

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Patents

[1] Spintronics Units and Logical Operation Elements, 5601976

Comprehensive Analysis Center

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[1]Diffusion of oxygen in amorphous Al2O3, Ta2O5, and Nb2O5, M. Tane, T. Suzuki: J. Appl. Phys, 116 (2014) 033504.

[2]Synthesis, Electronic, and Crystal Structures of Methoxycarbonyl-substituted 2,5-Di(1,3-dithiol-2-ylidene)-1,3-dithiolane-4-thione Derivatives, T. Suzuki: Chem. Lett., 43 (2014) 1224-1226.

[3]Manipulating γ -cyclodextrin-mediated photocyclodimerization of anthracenecarboxylate by wavelength, temperature, solvent and host, D. Zhou: Photochem. Photobiol. Sci., 13 (2014) 190-198.

International Conferences

[1]Ir Catalyzed Asymmetric Tandem Reaction of meso-Diols and Aldehydes (poster), T.Suzuki, D.Y.Zhou,K.Asano,H.Sasai: nd International Synposium on C-H activation.

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[3]Ir Ca	talyzed Asymmetri	c Tandem Reaction of meso-Diols and Aldehydes (poster)), T.Suzuki,
D.Y.Zho	ou,K.Asano,H.Sasa	i: 18th SANKEN international Symposium.	
Contrib	outions to Internat	ional Conferences and Journals	
T.SUZU	VKI 2014	ICOMC (Organaizing Committee)	
D.Y. Zh	ou 2014	ICOMC (Organaizing Committee)	
Publica	tions in Domestic	Meetings	
The sy	mposium of progre	ess of reaction and synthesis	1 paper
Sympos	ium on Physical Or	rganic Chemistry	1 paper
Grant-i	n-Aid for Scientifi	ic Research	
T.Suzuk	i Ultima	te asymmetric synthesis of bioactive compounds using	¥2,210,000
	hydrog	gen borrowing reaction	
Contrib	oution to Research		
T.Suzuk	i JSR		¥500,000
Cooper	ative Research		
T.Suzuk	i panaso	onic Corporation	¥500,000
T.Suzuk	i Panaso	onic Corporation	¥487,000

Reserch Laboratory for Quantum Beam Science

Original Papers

[1]Development of a high-power solid-state switch using static induction thyristors for a klystron modulator, A. Tokuchi, F. Kamitsukasa, K. Furukawa, K. Kawase, R. Kato, A. Irizawa, M. Fujimoto, H. Osumi, S. Funakoshi, R. Tsutsumi, S. Suemine, Y. Honda, G. Isoyama: Nucl. Instrum. Meth A, 769 (2015) 72-78.

[2]Selenium-Selenium Bond Cleavage of Diaryl Diselenide Radical Anions During Pulse Radiolysis, S. Tojo, M. Fujitsuka, A. Ouchi, T. Majima, Tetsuro: ChemPlusChem, 80 (1) (2015) 68-73.

[3]Structural Study of Various Substituted Biphenyls and Their Radical Anions Based on Time-Resolved Resonance Raman Spectroscopy Combined with Pulse Radiolysis, J. Choi, W. Dae, S. Tojo, M. Fujitsuka, T. Majima: Journal of Physical Chemistry A, 119 (5) (2015) 851-856.

[4]Configurational changes of heme followed by cytochrome c folding reaction, J. Choi, W. Dae, S. Tojo, M. Fujitsuka, T. Majima: Molecular BioSystems, 11 (1) (2015) 218-222.

[5]Solvent Dynamics Regulated Electron Transfer in S2-Excited Sb and Ge Tetraphenylporphyrins with an Electron Donor Substituent at the Meso-Position, M. Fujitsuka, T. Shiragami, W. Cho, S.Tojo, M. Yasuda, T. Majima: Journal of Physical Chemistry A, 118 (22) (2014) 3926-3933.

[6]Dynamics in the heme geometry of myoglobin induced by the one-electron reduction, J. Choi, S. Tojo, M. Fujitsuka, T. Majima: International Journal of Radiation Biology, 90 (6) (2014) 459-467.

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[1]Characterization of melting process of PTFE using positron annihilation spectroscopy (invited), Y. Honda, S. Nishijima: 11th International Workshop on Positron and Positronium Chemistry.

[2]Feasibility of classification of clay minerals by using PAS (poster), Y. Honda, Y. Yoshida, Y. Akiyama, S. Nishijima: 11th International Workshop on Positron and Positronium Chemistry.

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Grant-m-		Scientific	NUSUALUI

S.Tojo	The Decomposition of organic pollutants in controlled reaction sites		¥780,000
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Y.Honda	Ministry of the	Construction of Decontamination	¥2,106,000
	Environment	Scenario Based on the Dynamic States	
		of Cesium and Development of	
		Decontamination Method by Magnetic	
		Force Control	
Cooperative Res	earch		
Y.Honda	Daikin Industries, Ltd.		¥2,500,000