ISIR
OSAKA UNIVERSITY

MEMOIRS OF

The Institute of Scientific and Industrial Research

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Contents

Foreword

Katsuaki Suganuma
Director of the Institute of Scientific and Industrial Research

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

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

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

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

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

Outline of ISIR

1. Research Activities

1) History and Organization

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

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

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

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

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

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

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

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

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

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

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

【Organization】（31-March , 2019）

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

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

Mitsubishi Electric Collaborative Research Division for Wide-area Security Technology
Screen-Single-Molecule Analysis
Nano-Lithography Research
Comprehensive Analysis Center
Research Laboratory for Quantum Beam Science
Center for Research Education and Training
International Collaborative Research Center

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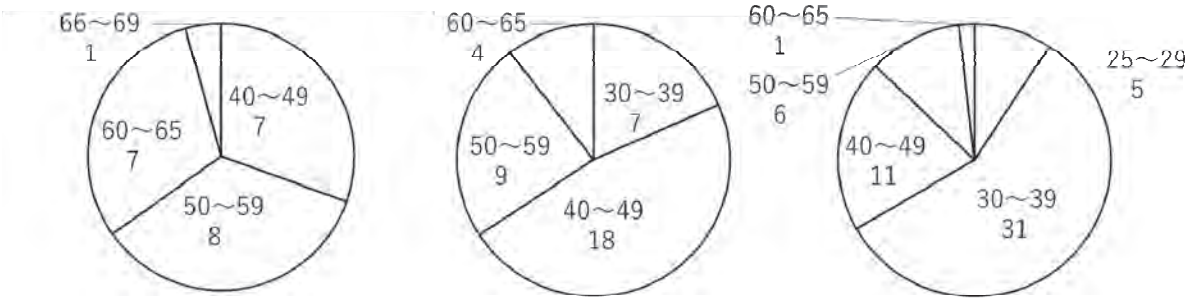
Service Facilities	Workshop
	Laboratory for Radio-Isotope Experiments
	Electronic Processing Laboratory
	Academia Industry Relations Office
	Office of Information Network
	Public Relations Office
	Library
	Planning Office
	Facilities Management Office
Technical	Machine Group
	Measurement Group
Administrative Office	General Affairs Division
	Research Cooperation Division

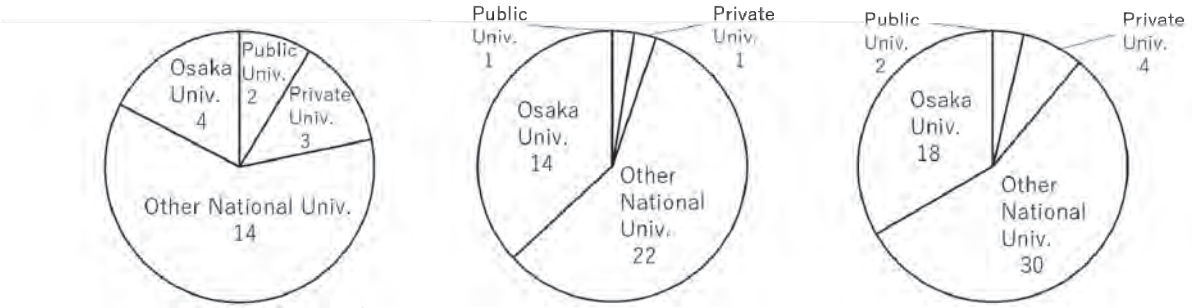
Staffs' Age (years old) –As of Mar.31.2019

Professors | **Associate Professors** | **Assistant Professors**



Staffs' Alma Master –As of Mar.31.2019

Professors | **Associate Professors** | **Assistant Professors**



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

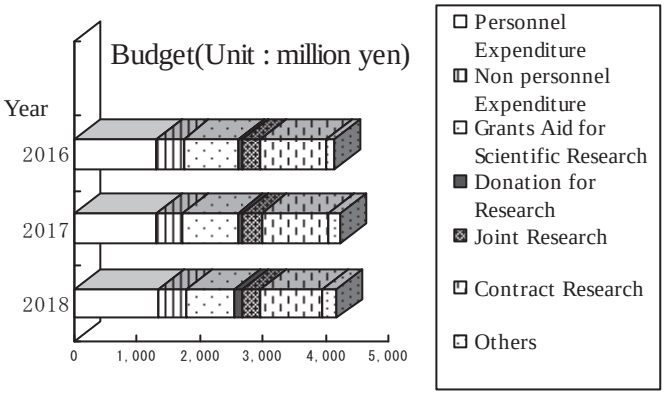
under the Director has been formed, and Advisory Board has been set up to introduce opinions from outside into the Institute.

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 2018 is 769,296,000yen.

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



(Unit : kilo yen , ( ) Number)

Division / Year	Information and Quantum Sciences	Advanced Materials and Beam Science	Biological and Molecular Sciences	Nanoscience and Nanotechnology Center
2018	51,100 (9)	42,080 (21)	6,789 (10)	10,500 (7)

Division / Year	Special Projects	Others	Total
2018	0 (0)	2,500 (2)	112,969 (49)

・Cooperative Researches and Contract Researches in the fiscal year 2018 are as follows: Cooperative Researches are carried out with 131 organizations and the budget for the fiscal year 2018 is 289,888,000 yen. The number of Contract Researches is 60 and the budget for the fiscal year 2018 is 999,296,000 yen.

4) International Research

Quantum System Electronics	Ruhr University Bochum	Germany	Research on photon-electron spin conversion
	University of Regensburg	Germany	Research on SiGe self-assembled quantum dots
Quantum System Electronics	Max Planck Institute Stuttgart	Germany	Research on photon-electron conversioni transition metal dichalchogenide
Semiconductor Electronics	Oxford University	UK	Liquid-AFM measurementsof glyco-functionalizedgraphene
Advanced Electronic Devices	imec	Belgium The Netherlands	Flexible Electronics
Intelligent Media	Peking University	China	Computer vision
	Drexel University	USA	
	University of Rajshahi	Bangladesh	
	Hanoi University of Science and Technology	Vietnam	
	Vietnam National University of Agriculture	Vietnam	
	Chonnam National University	Korea	
Reasoning for Intelligence	Max-Planck-Institute	Germany	Statistical Causal Inference
	Nanyang Technological University	Singapore	Representative selection with structured sparsity
	Federation University Australia	Australia	Machine Learning
Knowledge Science	Honda Research InstituteUSA, Inc.	USA	Adaptive Information Presentation in Cars
	Carnegie Mellon University	USA	Automatic Tailor-made Spoken Dialogue System for Individual Users
Architecture for Intelligence	imec	Belgium	Brain signal analysis
	Chulalongkorn University	Thailand	Machine Learning

	University of the Philippines Manila	Philippines	
	University of Leuven	Belgium	
	Thammasat University	Thailand	Introductive Logic Programing
	De La Salle University-Manila	Philippines	Empathic Computing
Architecture for Intelligence	University of California, San Diego	USA	Brain signal analysis
Functionalized Natural Materials	Chinese academy of sciences	China	Development of paper photodetector by using perovskite nanowires and nanocellulose
Semiconductor Materials and Processes	Slovak Academy of Science	Slovakia	Control of Si surface properties by the chemical methods and improvement of conversion efficiencies of crystalline Si solar cells
	Zilina University	Slovakia	Fabrication of ultralow reflectivity Si surfaces by surface structure chemical transfer method and their properties
	Hangyang University	Korea	Defect elimination in IGZO thin films by cyanide method and improvement of electrical properties
	Inner Mongolia Normal University	China	Improvement of Si device characteristics by nitric acid oxidation method
	Università di Perugia	Italy	Reaction of hydrogen molecules with hydroxyl radicals
Advanced Hard Materials	Hanyang University	Korea	Academic Exchange in the field of Nanochemical Engineered New Functional Materials
	Korea Institute of Ceramic Engineering and Technology	Korea	Low-powered (<15 mW) smart sensors for multiple gas detection by functionalized nano-structured materials
	Sun Moon University	Korea	Development of Multifunctional

			Nanomaterials and Processing Technology for Eco-friendly Applications
	Korea Institute of Industrial Technology	Korea	Bulk Fluorescent Ceramic Fabrication Technology and Application with Rare Earth
Advanced Interconnection Materials	Donghua University Ewha Womans University	China Korea	Or anic/inor anic Nanoh brid Platforms for Precision 1¥1mor Ima in and Therapy
Excited Solid-State Dynamics	Peter Grünberg Institut (PGI-3), Forschungszentrum Jülich, Germany	Germany	Phonon physics of graphene and related materials by using newly developed high-resolution electron energy loss spectroscopy
	Ecole Polytechnique, Laboratoire des Solides Irradies, Paris-Saclay University	France	Ultrafast carrier dynamics in semiconductors
Accelerator Science	La Sapienzza Univ, INFN	Italy	Study using THz-far infrared enlectromagnetic wave from SR
Beam Materials Science	Paris-Sud University	France	Study the reaction between a hydrated electron and hydronium ion at elevated temperatures
	University of Notre-Dame	USA	Study on thermalization process of electron in polar liquids produced by ionizing radiation
	University of Science and Technology of China	China	Study on modeing of radiolysis of high temperature water under mixed radiation field.
Molecular Excitation Chemistry	Pohang University of Science and Technology	Korea	photoresponsible materials research
	Shanghai University	China	Environmental science research
	Chungnam National University	Korea	Advanced materials research
	Korea Atomic Energy	Korea	Quantum Beam Science Research

	Research Institute		
Synthetic Organic Chemistry	RWTH Aachen University	Germany	Development of novel asymmetric Brønsted Acid Catalyzed Substitution
	Bielefeld University	Germany	Development of combination process of organocatalysis and biocatalysis
	Paris-Sud University	France	development of organocatalyzed [4+2] annulation
	University of Burgundy	France	development of chiral phosphine catalyst and its application to asymmetric catalysis
Synthetic Organic Chemistry	Chung-Ang University	Korea	development of chiral vanadium catalyst
Regulatory Bioorganic Chemistry	University of Toronto	Canada	Regulation of repeat instability using small molecules
	Adam Mickiewicz University	Poland	Binding analysis of CUG repeat-binding molecules
	Polish Academy of Sciences	Poland	Structural analysis of small molecule-nucleic acid complex
	Weizmann Institute of Science	Israel	Regulation of microRNA function using small molecules
Organic Fine Chemicals	Department of Medical Sciences, Thailand	Thailand	Development of PNA device for dengue virus infection
	Eindhoven University of Technology	The Netherlands	Regulation of 14-3-3 functions by use of fusicoccin derivatives
	McGill university	Canada	neurite outgrowth effect of fusiccocin
Biomolecular Science and Reaction	Academia Sinica	Taiwan	Application of ZZ-BNC for novel SPR sensor
Biomolecular Science and Regulation	The University of Hong Kong	Hong Kong	Function of drug efflux systems
	French National Institute for Agricultural Research（INRA）	France	Regulation of drug efflux systems
	Emory University	USA	Noninvasive autonomous control of

			neuronal activity deep inside brain with cell ular activity-dependent chemiluminogenetic probes
	University of Oxford	UK	Maintaining and differentiating iPS cells to cardiomyocytes. pH imaging in lysosomes in cardiomyocytes with genetically encoded indicator.
	NanoScope Technologies, LLC	USA	Development of a technology for an optical control and imaging of in vivo brain function with high time resolution
Biomolecular Science and Engineering	DRVision Technologies LLC	USA	Live-cell fluorescent probes for neurological diseases
	Albert Einstein College of Medicine	USA	Development of near-infrared chemiluminescent protein
	Vanderbilt University	USA	Measurement of Mg2+ dynamics in cyanobacteria with MARIO
	University of Alberta	Canada	Development of genetically encoded FRET-based Ca2+ indicators using novel red chrom-oprotein
Functional Nanomaterials and Nanotechnology	Indian Institue of Technology, Hyderabard	India	Sn oxide-based gas sensors
	Genova University	Italy	Functional Oxide-MEMS
	Purdue University	USA	3D correlated oxide nano-structures for nano-scaling phenomena and electronic phase change memory application.
Nanocharacteri-zation for Nanostructures and Functions	University of Kansas	USA	ETEM observation of nanomaterials under catalytic reaction conditions
	Utrecht University	The Netherlands	ETEM observation of Fischer-Tropsch synthesis catalysts
	Lawrence Berkeley National Laboratory	USA	In situ surface analyses of supported metal catalysts
	Harvard University	USA	Analysis and characterization of molecular materials using electron microscopy
	FEI Company	USA	Development of a high resolution

			environmental TEM
Theoretical Nanotechnology	Uppsala University	Sweden	Materials Design toward Environmental and Energy Issues
	University of Jember	Indonesia	The density functional theory and its computational applications
	Pusan National University	Korea	Electronic states of transition-metal oxides
Theoretical Nanotechnology	CNR	Italy	Electronic structure in transition-metal oxides
Theoretical Nanotechnology	Forschungszentrum Jülich	Germany	Materials design by first-principles calculations
Soft Nanomaterials	Indian Institute of Chemical Biology	India	Cheical Biology Applications of Organic Electron Acceptors
	Max Plank Institute (Mainz Laboratory)	Germany	Printable Organic Semiconductors and Flexible Devices
Bio-Nanotechnology	Huazhong University of Science and Technology	China	Microfludics
Comprehensive Analysis Center	Carnegie Institution of Washington Geophysical Laboratory,	USA	Structure transition of dielectric substance
	Sichuan University	China	Photochemistry of supramacromolecular complex

5) Symposia, Seminars, Workshops and Lectures

2017/4/14	Seminar on the research of the bacterial drug efflux systems
2017/5/25-5/26	Symposium on Photovoltaic Materials and Technologies
2017/6/1	Lecture on Functional AlN Thin Films and Their Physica Properties
2017/6/12/-6/13	QTech2017
2017/6/15	Research Forum on development of small-molecule drug targeting nucleic acids
2017/6/19	6th imec-Handai international symposium
2017/6/22	Core to core seminar
2017/7/1	45th Kansai Joint Speech Seminar
2017/7/21	Workshop of "Development of beam chemistry using accelerator and elucidation of radiation induced chemical reaction"

2017/8/8	Research Forum on development of small-molecule drug targeting nucleic acids
2017/8/18	Seminar on the Design and Advanced Function of Novel Materials
2017/9/11-9/12	Workshop on Nano Spin Conversion Science 2018
2017/9/29	Joint research meeting: Okada Group (Tokyo Tech) and Komatani Lab (Osaka U)
2017/10/2-2017/10/3	Satellite Workshop of Kanamori Memorial Symposium — Recent Progress in Materials Science for Spintronics and Energy Applications
2017/10/12	Research Forum on development of small-molecule drug targeting nucleic acids
2017/10/17	JST-TU Delft Quantum Technology Workshop
2017/10/27-10/29	12th Korea-Japan Symposium on Frontier Photoscience
2017/11/16-17	The 14th Japan Catechinology
2017/11/26-12/1	Workshop on Innovative Nanodevice and Systems 2017
2017/11/30	H29 Printed Electronics Sympojium/3rd Workshop
2017/12/4-12/5	22nd Physics and Applications of Spin-related Phenomena in Semiconductors (PASPS-22)
2017/12/15	Research Forum on development of small-molecule drug targeting nucleic acids
2017/12/23	日本物理学会大阪支部公開シンポジウム「量子力学 90 年」
2018/1/17	1st SANKEN JSPS Symposium for the Circulation of Talented Researchers “Global Networking on Molecular Technology Research”
2018/1/26	Printed Electronics Association : Public Symposium
2018/2/2	大阪大学物質・材料科学研究推進機構講演会
2018/2/9	Seminar for Young Researchers on SANKEN Nanotechnology Center
2018/2/16	兵庫県マテリアルズ・インフォマティクス講演会
2018/3/9	Seminar on Photochemical Functions of Materials for Biorogical Viewoint
2018/3/16	4th Osaka University-KAERI Workshop on Radiation Research
2018/3/16	Symposium on Frontier Researches of Functional Oxide Devices and Materials
2018/3/18	The 2018 Annual Meeting of the Japan Society for Bioscience, Biotechnology, and Agrochemistry, Symposium
2018/3/19	Seminar on the research of the bacterial drug efflux systems
2018/3/19	The 65th JSAP Spring Meeting
2018/3/20	The 98th CSJ Annual Meeting

Other Lectures and Seminars

2017/4/10	Takashi Okada	Kwansei Gakuin University	Emeritus Prof.	Molecular Graph and data mining

2017/4/14	Masayuki Ohzeki	Tohoku Univ.	Assoc. Prof.	Introduction to the Machine Learning
2017/4/20	Takeo Kawabata	Institute of Chemistry, Kyoto University	Professor	不斉及び位置選択的分子変換の新機軸
2017/5/12	Thierry Epicier	University of Lyon	Professor	Towards Operando and real time 3D analysis of Nanocatalysts in Environmental TEM
2017/5/29	Shigeru Arai	Graduate School and Faculty of Pharmaceutical Sciences, Chiba University	Assoc.Prof.	コプシアアルカロイドの全合成研究
2017/6/1	Padmalochan Panda	Indira Gandhi Centre for Atomic Research (IGCAR)	Ph.D,Student	Deep UV region usable pure and doped AlN thin films and its physical properties
2017/6/2	Radu Orghidan	NTTData Romania	Senior Presales Consultant	Recent topics on computer visions and robotics
2017/6/5	Yasuyuki Kita	Ritsumeikan University	Professor	創薬を志向し、ヨウ素原子の特性を活用したメタルフリーカップリング反応の開拓
2017/6/22	N. Shioda	Gifu Pharmaceutical University	Assoc. Prof.	Drug development toward neurological disorders based on G-Qplex
2017/7/6	Hiroki Funashima	Dept. of Physics, Kobe University	Research Lecturer	Thermoelectric chalcogenide thermoelectric mineral
2017/7/13	Inuzuka Nobuhiro	Nagoya Institute of Technology	Professor	つながりと論理を重視した知識発見アルゴリズム
2017/7/14	Luca Pellegrino	CNR-SPIN and University of Genova	Researcher	VO2: a solid state actuator for micro/nanorobotics
2017/8/8	Vincenzo Aquilanti	Accademia Nazionale dei Lincei, Roma Accademia Nazionale delle Scienze, Università di Perugia	Emeritus Prof.	Orienting molecules: Stereodirectional and Chiral Features of Photo- and Reaction Dynamics

2017/8/18	Toshihiro NAKAMURA	Hosei University	Assoc. Prof.	Random lasing in semiconductor micro/nano-structures
2017/9/20	Koji MORIMOTO	Faculty of Pharmaceutical Sciences, Ritsumeikan University	Assis. Prof.	ヘテロ原子を有する芳香族化合物類の革新的なメタルフリー酸化的結合形成
2017/9/20	Tetsuo NARUMI	Graduate School of Integrated Science and Technology, Shizuoka University	Assoc.Pprof.	ペプチド結合等価体によるアミロイドペプチドの凝集機構解明
2017/9/29	Gang Chen	Nanyang Technological University	Assis. Prof. (PI)	RNA Technology, Basic and Application
2017/10/25	Timothy John Maxwell	SLAC National Accelerator Laboratory	Research Associate	Longitudinal Beam Dynamics and Diagnostics at the LCLS
2017/12/5	Luca Pellegrino	CNR-SPIN and University of Genova	Researcher	Perspectives of VO2 for new applications in micro/nano actuators
2017/12/7	Artoto Arkundato	University of Jember	Lecturer	Study of Liquid Lead Corrosion of Fast Nuclear Reactor and Its Mitigation by Using Molecular Dynamics Method
2017/12/11	Fumitoshi KAKIUCHI	Faculty of Science, Keio University	Professor	Palladium-catalyzed Aromatic C-H Functionalization by Means of Electrochemical Oxidation
2018/1/16	Yasukazu Murakami	Kyushu Univ.	Professor	Toward Ultrahigh Precision of Electron Holography: Imaging of Electromagnetic Field in Nanostructure Materials
2018/1/17	Dimitrios Peroulis	Purdue Univ.	Professor	Multifunctional RF Frontends for High-Frequency AI Sensors
2018/1/18	Michi-To Suzuki	Center for Emergent Matter Science (CEMS), RIKEN	Research Scientist	Cluster multipole theory for macroscopic phenomena in antiferromagnets

2018/1/18	Gustav Bihlmayer	Forschungszentrum Jülich	Scientist	Magnetic topological materials
2018/1/18	Daisuke Okuyama	Institute of Multidisciplinary Research for Advanced Materials, Tohoku Univ.	Assis. Prof.	Observation of crystal and magnetic structures on noncentrosymmetric magnets
2018/1/18	Johannes Daniel Reim	Institute of Multidisciplinary Research for Advanced Materials, Tohoku Univ.	Assis. Prof.	Ferro- and antiferromagnetic skyrmions from a neutron scattering perspective: Two case studies
2018/1/18	Jean-Jacques Toulmé	University of Bordeaux	Prof. (PI)	RNA aptamer, Basic and Application
2018/1/26	Hideo Hosono	Tokyo Institute of Technology	Professor	Transparent oxide semiconductor technologies for organic electronics
2018/1/26	Junichi Takeya	University of Tokyo	Professor	Organic integrated circuits and printed electronics
2018/2/1	Prof. Dr. Christian Ottmann	Eindhoven University of Technology	Assoc. Professor	Small-molecule stabilization of Protein-Protein Interactions
2018/3/9	Taito Itabashi	Towada Municipal Central Hospital	Chief Manager of Orthopedics	Clinical application of optical function and long term antimicrobial expression
2018/3/9	Yukihiro MORIMOTO	Ushio Inc.	Project Manager	Mechanism of photo functionalization inducing Osseo integration
2018/7/14	Daniele Marre	CNR-SPIN and University of Genova	Professor	An overview on the activities at CNR-SPIN and University of Genova in condensed matter physics.

7) Public Information Activity

Public information activity of ISIR in 2018 is as follows:

- Bulletin of ISIR (in both Japanese and English)
- Memoirs of the Institute of Scientific and Industrial Research, Osaka University (in English)

- Annual Report of ISIR (in Japanese)
- SANKEN News Letters(in Japanese)
- Report on SANKEN Techno Salon (in Japanese)
- WWW home-page (http://www.sanken.osaka-u.ac.jp/)

8) Research Reports

The number of scientific and technological papers published in 2018 is 259. The details are described in the part of activity of divisions and facilities.

9) Scientific Awards

2018/3/28	K.KISHI S.TAKIZAWA H.SASAI	Best presentation award of 138th Annual Meeting of the Pharmaceutical Society of Japan (AMPSJ)
2018/3/22	K.FUKUI	Knowledge-based Systems Outstanding Reviewer Award
2018/3/14	T.SEKITANI	JEITA Venture Award
2018/3/13	R.TAKEDA	IPSJ Yamashita SIG Research Award
2018/3/12	K.HAYASHI	ANLP Annual Meeting Excellent Paper
2018/2/16	T.ONO Y.KANAI K.INOUE K.MATSUMOTO	Academic-industrial Alliance Award
2018/2/15	T.NAGAI	The Photobiology Association of Japan award
2017/12/27	T.MATSUMOTO	2018 Albert Nelson Marquis Lifetime Achievement Award
2017/12/25	S.NAGAO T.SUGAHARA K.SUGANUMA	MES2017 best paper award
2017/11/23	T.GOTO	The 33rd International Korea-Japan Seminar on Ceramics, Young Ceramist Best Presentation Award
2017/11/23	Y.ONITSUKA	2nd prize in the Best Young Researcher Contribution Contest
2017/11/22	S.YAMASAKI	Japan Science and Technology Agency, President Award
2017/11/8	K.KAIHATSU	The 15th Award of Kansai Branch, Synthetic Organic Chemistry
2017/11/5	S.YAMASAKI	The 2nd COI Young Innovation Pitch, Best Presenter Award
2017/10/31	Z.XU	2017 National Tsing Hua University -Osaka University Life Science Student Symposium,Outstanding

		presentation
2017/10/26	M. N.HOSSAIN	20th International Symposium on Calcium Binding Proteins and Calcium Function in Health and Disease (CaBP20), Excellent Poster Award
2017/10/23	H.SHINODA	The 55th Annual Meeting of The Biophysical Society of Japan, Student Presentation Award
2017/10/20	T.SEKITANI	16th Docomo Mobile Science Award, Basic Science, Excellence Award
2017/10/5	A.ARIMA M.TSUTSUI W.TONOMURA K.YOKOTA M.TANIGUCHI	化学とマイクロ・ナノシステム学会 第 36 回研究会優秀研究賞
2017/9/28	N.TAKEMURA	VRSJ Outstanding Paper Award
2017/9/28	M,FUJITSUKA	Japanese Society of Radiation Chemistry Award
2017/9/20	T.SEKINO T.GOTO S.CHO	Session Incentive Award, the 30th Fall Meeting
2017/9/15	M.TANIGUCHI	International Investigator Awards of the Japan Society for Molecular Science
2017/9/13	Y.MAKIHARA	IEICE Contribution award
2017/9/7	H.KOBAYASHI T.MATSUMOTO	Key Scientific Article
2017/9/1	M.SOMIYA	2017 JARI/JSEV Oral Presentation Award
2017/8/9	T.AOKI H.SASAKI S.TAKIZAWA M.SAKO	Kansai blanch of The Society of Synthetic Organic Chemistry, Japan Poster Award
2017/8/9	I.MITSUGAMI	MIRU Reviewer Award
2017/7/24	Y.Zhang	The31st Grand Prize for the Advanced Technology Award The Fujisankei Business i Prize
2017/7/13	H.KOGA	Young Scientist Award of the Cellulose Society of Japan
2017/7/4	M.SAKO H.SASAKI S.TAKIZAWA	GSC Poster Award

2017/6/27	M.SUGIYAMA T.UEMURA S.YOSHIMOTO M.AKIYAMA T.ARAKI T.SEKITANI	9th International Conference on Molecular Electronics and Bioelectronics, Best Poster Award
2017/6/26	M.NUMAO K.FUKUI	JSAI Incentive Award
2017/5/29	M.TANE	Honda Memorial Young Researcher Award
2017/5/16	S.YOSHIMOTO T.ARAKI T.UEMURA S.NEZU T.SEKITANI	Workshop on LSIs and Systems 2017, Best Poster Award (General)
2017/5/16	M.SUGIYAMA T.UEMURA S.YOSHIMOTO M.AKIYAMA T.ARAKI T.SEKITANI	Young Researchers Conference, The Institute of Electronics, Information and Communication Engineers 2017, Best Poster Award
2017/4/21	T.OKAJIMA	Nagase Research Promotion Award

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, 2018 is as follows.

Field / Course	Science	Engineering	Engineering Science	Pharma-ceutical Science	Information Science and Technology	Frontier Biosciences	Total
Master Course	42	61	15	1	18	-	137
Doctor Course	25	39	3	1	14	12	94
Total	67	100	18	2	32	12	231

Number of students who had obtained Master's or Doctor's Degree in FY2018 is as follows.

Field / Degree	Science	Engineering	Pharma-ceutical Science	Information Science and Technology	Frontier Biosciences	Total
Master’s Degree	14	20	0	9	-	43
Doctor’s Degree	9	7	1	4	1	22
Total	23	23	1	13	1	65

3. International Exchange

1) Exchange Agreement

At Present, academic exchange agreements are concluded with the following 37 organizations.

Otto-von-Guericke University, Magdeburg (Faculty of Natural Science)
Chonnam National University
Pukyong National University (Basic Science Research Institute)
Forschungszentrum Jülich GmbH
Pusan National University(College of Natural Sciences)
Hanyang University
National Taiwan University
Centre National de la Recherche Scientifique
Chungnam National University College of Natural Sciences
RWTH Aachen University
Peking University The School of Electronics Enginering and Computer Science
Tammasat University
University of Geneva(Faculty of Science)

Inner Mongolia Normal University
University of Augsburg
De La Salle University(College of Computer Studies)
Assiut University
Interuniversitair Micro-Electronica Centrum vzw (IMEC)
University of Bordeaux
Bielefeld University（Faculty of Chemistry）
Pacific Northwest National Laboratory
Korea Institute of Ceramic Engineering and Technology
Advanced Radiation Technology Institute/Korea Atomic Energy Research Institute
Eindhoven University of Technology (Department of Mechanical Engineering)
Chulalongkorn University (Department of Computer Engineering, Faculty of Engineering)
Sun Moon University (College of Engineering)
École polytechnique
University of Paris-Saclay
University of Science and Technology Beijing(School of Materials Science and Engineering)
University of Genoa
University of Cologne (Faculty of Mathematics and Natural Sciences)
National Chiao Tung University(College of Science)
Shenzhen University
Uppsala University(Department of Physics and Astronoomy)
Fraunhofer Institute For Integrated Systems and Device Technology IISB
The Hebrew University of Jerusalem
The University of Hong Kong(School of Biological Sciences)

2) Foreign Researchers and Students

The Number of foreign researchers and students staying in ISIR as of March 31, 2019 is 118 in total. Details are, Assistant Professor(include of specially appointed staffs) (2), Specially Appointed Associate Professor(7), Specially Appointed Researcher(2), Part-time Employee (21), Graduate Students 62(Doctor Course,46, Master Course,16), Undergraduate Student(2), Special Auditor(2).,Research Students (19).

Their nationalities are; China(54), Korea(16), Thailand(6), Viet Nam(8), Indonesia(2), Bangladesh(7), Egypt(1), The Netherland(3), Philippine(3), India(6), Iran(1), Costa

Rica(1),Sri Lanka(2), Germany(1), Syrian(2), Taiwan(1), Macau(1), Hungary(1), Brazil(1), Myanmar(1).

The Number of visiting Research Scholar in 2018 is 36. Their nationalities are; China(12), Thailand(3), U.S.A.(5), Korea(1), Germany(3), Egypt(1), Sweden(1), Slovenia(1), Denmark(1), Bangladesh(6), Belgium(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 356 in total.

Number of ISIR staffs who have been working as committee members of International Conferences or Editorial Board of international academic journals are 146 in total. For more details, see the part of activity of divisions and facilities.

4. Concluding Remarks

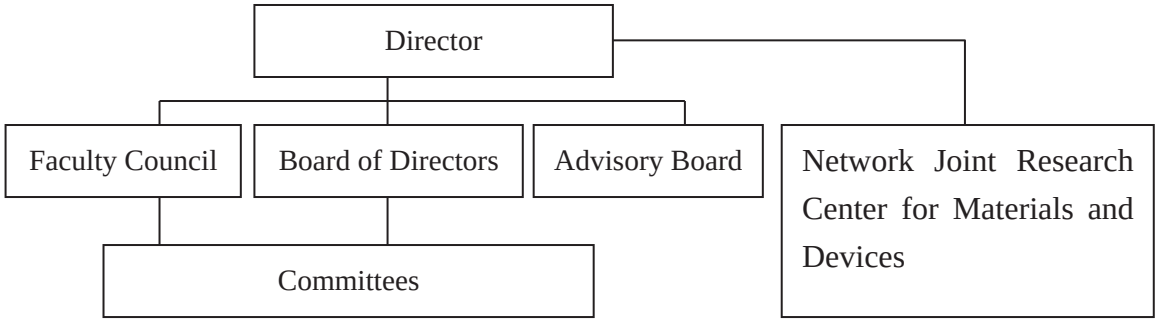
(1) Organization and Management System

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. 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.

Administrative Office （31-March , 2019）

Director : Yoshinobu Ishikura

General Affairs Division

Staffs: Masahiro KOMAKI
Satoshi KAJIURA
Sachiko YAMAMOTO
Tomoko SAWADA
Mie SHIMOE
Ritsuko Kitamura

Supporting Staffs: Ayano KOMAI
Akiko AKAMATSU
Aki Kouno

Research Cooperation Division

Staffs: Kenji Nishikawa
Natsuko Kitanohashi
Takeshi NAKASHIMA
Seiko Okamoto
Yasuko MUTSUI
Yasushi Matsuura
Shingo TABATA
Yusuke AKAO
Yuka Konishi
Momoko SAKAI
Fumiko SHINJO
Emi MIZUGUCHI
Etsuko UNO

Supporting Staffs: Yutaka Kurokui
Kazune OTANI
KOTO MIYAGOU
Yumi AKUTSU

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 (Quantum System Electronics, 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.

Research Projects

- Quantum information technologies using photons and spins and materials research for semiconductor spintronic devices
- Quantum nanodevices and biosensor application using graphene and nanotube
- Development of noise-robust spoken dialogue robots and knowledge acquisition through dialogues
- Computer vision-based gait video analysis and its application to person authentication, medicine, and dairy
- Introduction of sensors to Constructive Adaptive User Interfaces
- Machine learning for complex and big data, statistical causal inference and measurement informatics

Department of Quantum System Electronics

Professor: Akira OIWA
Associate Professor: Shigehiko HASEGAWA
Assistant Professor: Haruki KIYAMA, Takafumi FUJITA
Specially Appointed Researcher: Yuji SAKAI
Guest Researcher: Shuichi EMURA
Postdoctoral Researcher: Yijin ZHANG
Graduate Students: Tomohiro NAKAGAWA, Rio FUKAI, Moe TANAKA, Tomoki CHATANI, Ryota HAYASHI, Takuro KOJIMA, Sanshiro FUJIMORI, Yuta MATSUMOTO, Yoichi KIDO, Akifumi OKAMOTO
Under Graduate Students: Hiroki IDENISHI, Genki FUKUDA
Student Researchers: Gabriel Gulak MAIA, Junwei GAO (1.10.2018-)
Supporting Staff: Akiko WATANABE, Tomomi KANEKO (1.12.2018-)

Outline

In our department, we search for and study novel quantum and spintronic devices that control the quantum mechanical properties of light, electrons and especially spins. We focus on single-electron spins to join the technologies of low-dimensional transport and nano-fabrication. Here, we develop quantum information processors based on quantum dots and quantum interfaces that convert quantum states between single photons and single electron spins, which is necessitated for instance in long distant quantum communication. Moreover, on the search of unique semiconductor materials, we grow magnetic semiconductors by introducing magnetic materials in non-magnetic semiconductors. As a whole, we study the growth, characterize materials and perform accurate quantum transport measurements to explore new phenomena emerging from photon, electron and spin degrees of freedom inside quantum nano-structures.

Research Projects

Formation of a gate-defined quantum dot in a photonic crystal nanocavity

In order to realize quantum repeaters which are required for long-distance quantum information communication, we propose the quantum state conversion from photon polarization state to electron spin state in GaAs based gate-controlled quantum dots. However, the conversion efficiency from photon to electron spin is very low. Photonic crystal nanocavities can be used for improving the conversion efficiency from photons to electrons because nanocavities confine a photon. In addition, the efficiency as a quantum repeater will also be improved by creating a gate-controlled quantum dot in the region where photons are strongly confined. In 2018, a single gate-controlled quantum dot was fabricated on a GaAs/AlGaAs quantum well substrate, and then a double hetero

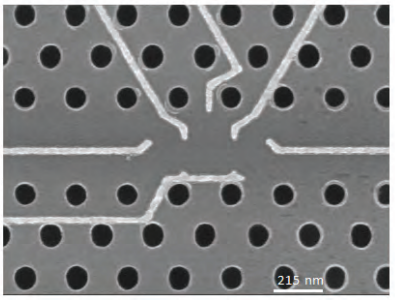


Fig.1 Scanning electron micrograph picture of the gate-defined quantum dot in a double-heterointerface photonic crystal structure

photonic crystal structure (period: 211 nm, radius: 55 nm) was fabricated by dry etching (Fig.1). The photonic crystal structure was designed to match the cavity mode and the emission wavelength of the quantum well, and it was confirmed by micro-photoluminescence. Moreover, we observed the quantum dot controlled by gate voltages in the electrical conductivity measurement.

Multiple quantum dot operation in a (110) GaAs quantum well

Semiconductor quantum dots provide fast electrical control and detection of electron spin states. We focus on GaAs quantum wells grown on a (110) crystal plane, opposed to a (001) substrate in which only the light hole is Zeeman split and useable for the quantum state conversion. A higher efficiency is achievable by selective excitation of the Zeeman level of the heavy hole state. In previous reports of (110) GaAs substrates, ensemble electron spin relaxation or transfer experiments had been performed owing to its in-plane anisotropy, but single electron control has not been achieved except for our single quantum dot operation. We are successful in counting electrons in up to a triple quantum dot in the latest results (Fig.2). This is an important step for single photo-excited electron spin detection using a (110) quantum well and high rate quantum state conversion.

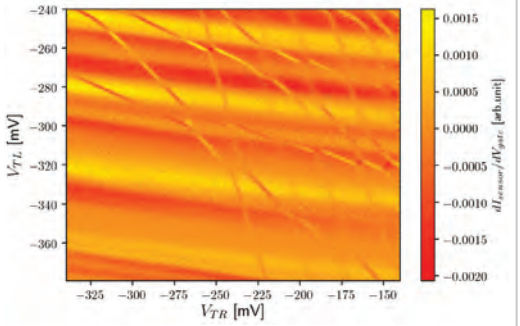


Fig.2 Charging lines showing addition of single electrons, each slope representing the electrons in a triple quantum dot formed in a (110) GaAs QW.

Crystal Growth and Characterization of Nitride-based Magnetic Semiconductors toward Application to Spintronic Devices

Dilute magnetic semiconductors (DMSs) are gathering great interest as a candidate for novel functional materials. Nitride-based DMSs such as GaCrN, GaGdN, and GaSmN have been grown by using plasma-assisted molecular beam epitaxy. It has been reported that these materials show hysteresis loops in the magnetization curves even at room temperature (RT). In order to improve their magnetic properties, we have proposed digital alloys consisting of GdN/GaN short-period superlattices (SLs). Cross-sectional scanning transmission electron microscope observation (Fig.3) indicates that a wurtzite GdN(1ML)/GaN(20MLs) SL is formed as designed. The GdN(1ML)/GaN(20MLs) SL exhibited hysteresis loops in the magnetization curves even at RT but primarily paramagnetism. Reducing GaN layer thickness in SLs to 15 MLs increased a ferromagnetic component in the magnetization curve more than an order of magnitude. The findings provide evidence that digital alloys consisting of GdN/GaN short-period SLs have the potential to become novel ferromagnetic semiconductors.

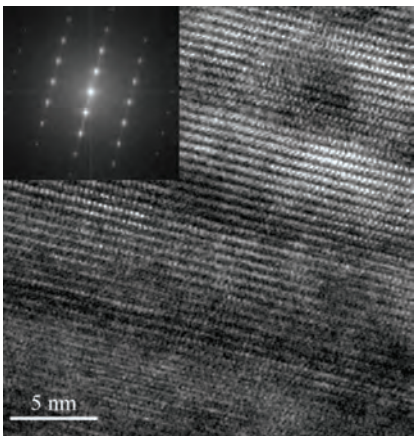


Fig.3 Cross-sectional scanning transmission electron microscope image for a GdN(1ML)/GaN(20MLs) SL and the corresponding diffraction pattern (inset).

Department of Semiconductor Electronics

Associate Professor:	Koichi INOUE
Assistant Professors:	Yasushi KANAI, Takao ONO
Technical Staffs:	Kiyoji SAKANO, Masami TANIOKU, Maiko NAMPO, Kaori YAMAMOTO
Supporting Staffs:	Naoko BUNGO

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.

Research Projects

Enhancement of sensitivity of graphene biosensor using porphyrin linker[1)]

Graphene biosensor detects surface charges of the target captured on graphene surface in high sensitivity. Target-specific receptor molecules are modified on the graphene surface. For this modification, receptor is modified via linker molecule, which forms π stacking to graphene and covalent bond to the receptor. With this linker, receptor is modified without any defect in graphene structure. Surface density of linkers on graphene is important for the sensitivity of the graphene biosensor. We applied a new linker molecule, tetrakis(4-carboxyphenyl)porphyrin (TCPP), instead of conventional 1-pyrenebutanoic acid succinimidyl ester (PBASE) linker to enhance the sensor sensitivity. TCPP has larger π-conjugated system compared to PBASE and four carboxyl groups as binding sites in a molecule (Fig. 1(a)).

Here, we used immunoglobulin E (IgE) as a target, and IgE aptamer as a receptor. Figure 1(b) shows the experimental result. Graphene biosensor using TCPP linker showed electrical response at lower IgE concentration compared to that using PBASE linker, that is, TCPP linker enhanced the sensitivity in one digit. Also, maximum sensor response was also enhanced by using TCPP linker, because receptors were modified more densely on graphene.

1) Takuya Kawata, Takao Ono, Yasushi Kanai, Yasuhide Ohno, Kenzo Maehashi, Koichi Inoue and Kazuhiko Matsumoto, “Improved sensitivity of a graphene FET

biosensor using porphyrin linkers" *Japanese Journal of Applied Physics*, **57**, 065103 (2018).

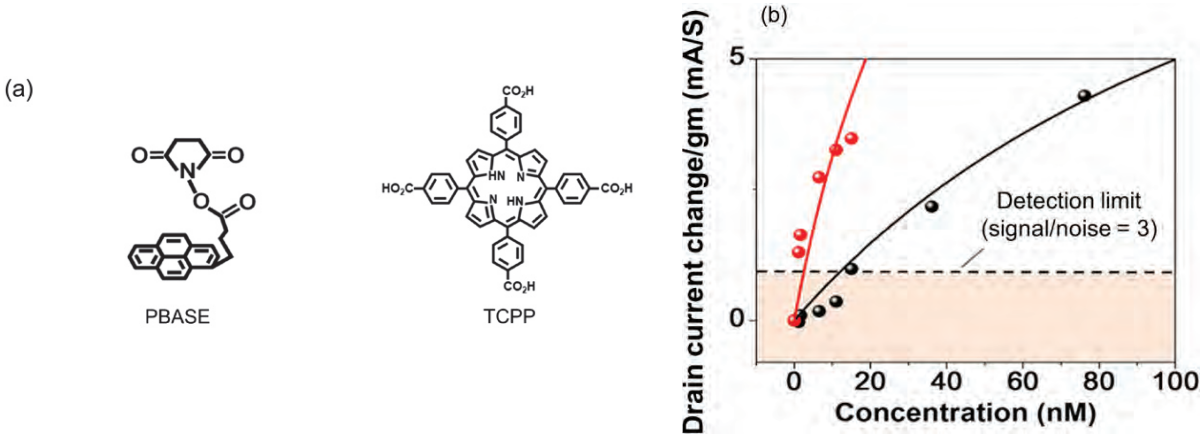


Fig.1: Enhanced sensitivity using TCPP linker. (a) Chemical structure of PBASE and TCPP. (b) Target concentration vs. drain current changes of graphene transistor functionalized by PBASE linker (black) and TCPP linker (red). Copyright 2018 The Japan Society of Applied Physics.

Detection of small peptides on graphene FETs by open sandwich immunoassay.

In graphene field effect transistor (FET) biosensors, when bio-materials are adsorbed on graphene, electrical properties of graphene FETs are changed and bio-materials are detected. However, if materials do not change graphene electrical properties, graphene FETs cannot detect it. In this study, we use an open sandwich immunoassay to solve the problem. In the open sandwich immunoassay, antibodies consist of two fragments (V_H and V_L). Figure 2 shows a schematic of the open sandwich immunoassay on graphene. When V_H are modified on graphene and detectable materials were modified on V_L, undetectable antigens can be detected via V_L. Here, we have demonstrated the open sandwich immunoassay to detect small peptides on graphene FETs

Figure 3 shows time course of I_d/g_m at source-drain voltage V_d of 0.1 V and top-gate

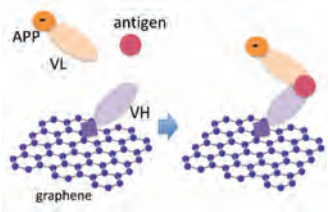


Fig. 2 Schematic image of the open sandwich immunoassay on V_H modified graphene.

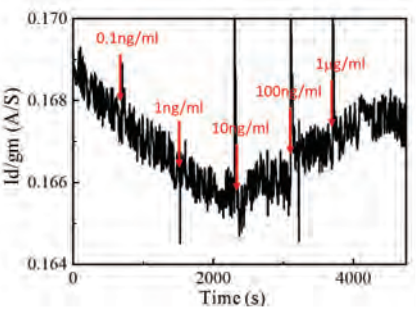


Fig. 3 Time course of I_d/g_m at V_D of 0.1 V for V_H modified graphene at various concentration of BGP-C7.

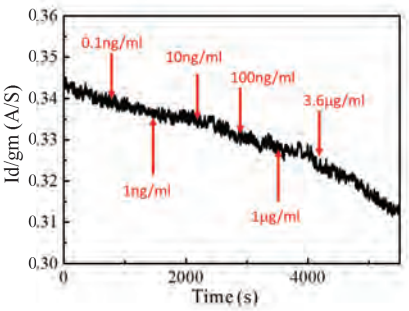


Fig. 4 Time course of I_d/g_m at V_D of 0.1 V for V_H modified graphene at various concentration of BGP-C10dv.

voltage V_g of 0.1 V for a V_H modified graphene FET at various concentration of BGP-C7 as the antigen. At V_g = 0.1, the transport is hole. At low concentration of V_H, I_d/g_m does not change. After V_H of 10 ng/ml, I_d/g_m increased stepwisely upon sequential increases in the BGP-C7 concentration. This result indicates that BGP-C7 and V_L bond on graphene surface and tuned the electrical characteristics of graphene at high concentrations of BGP-C7. Because minus ions were modified on V_L, the hole transport increased. Dissociation constant of BGP-C7 is about 10 ng/ml evaluated from ELISA. Results of a graphene FET almost agree with ELISA measurement results. Figure 4 shows time course of I_d/g_m at V_d of 0.1 V and V_g of 0.1 V for a V_H modified graphene FET at various concentration of BGP-C10dv which is not the antigen. I_d/g_m does not depend on concentrations of BGP-C10dv. Electrical characteristics of the graphene FET does not change by increase of non-antigenic materials. These results indicate that BGP-C7 can be selectively detected by open sandwich immunoassay using graphene FETs.

Department of Advanced Electron Devices

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Assoc. Prof.	Koichi SUDOH
Spec. App. Assoc. Prof.	Takafumi UEMURA, Shintaro IZUMI
Assist. Prof.	Teppei ARAKI
Spec. App. Assist. Prof.	Yuki NODA
Guest Assoc. Prof.	Hiroki OHTA
Guest Assist. Prof.	Shusuke YOSHIMOTO
Spec. App. Researcher	Toshikazu NEZU
Guest Researcher	Esther Karner-Petritz, Andreas Petritz
Technician	Mihoko AKIYAMA, Hirokazu IIDA, Yumi INOUE, Naoko KURIHIRA, Yoshiko HARADA, Takashi INAMI, Hiroshi OHTA, Naomi TOYOSHIMA, Makiko KIMURA, Masaru SHIMIZU, Kazuko IWAKI, Noriko YAHIRO Kazami NABIKA
Graduate Students	Masaya KONDO, Ashuya TAKEMOTO, Masahiro SHUGIYAMA, Fumika TANABE, Keisuke SAKAGUCHI, Mayuko FUJII, Mizuki MATSUBA, Misaki INAOKA
Under Graduate Students	Shogo AMANO, Satoshi TAKANE
Internship students	Johan KOOT, Tim R. Y. CANTADOR、Silke KOSER, Hana Kei WARNER
Supporting Staff	Fumio KURAHASHI, Taki HONMA, TomokoTAKAHASHI, Michi UEDA

Outlines

In this department, we study flexible and organic electronics that can be applied for “excellent electrical and mechanical properties,” “self-assembly phenomenon” and “low energy processability” based on material science, applied physics, and electronic engineering. High integration technology of organic transistors was realized by technological development in a wide range of areas specific to organic materials such as molecular stacking, material physical property, interface control, and circuit design. Furthermore, we are trying to establish and demonstrate the following usefulness; “the fundamental technology of flexible organic transistors” and “excellent mechanical characteristics in ultra-flexible electronics and stretchable electronics.”

In addition to the above flexible devices and their circuit technologies, we are working on ultra-low-power wireless communication technology, big data analysis technology, etc. in order to realize IoT sensors. These technologies make it possible to construct real space sensing and analysis in real time. So far, we have developed wearable biometric sensors, implant sensors, structural health care sensors, IT sensors for agriculture, and so on. In other words, organic-based electronic devices and functional materials that are soft materials create a new science and reach an application such as information communication technology, which is socially proven.

Research Projects

A Sheet-type Wireless electroencephalogram (EEG) Sensor System using Flexible and Stretchable Electronics

A sheet-type wireless electroencephalogram (EEG) sensor system using flexible and stretchable electronics has been successfully developed on flexible substrates. The EEG sensor system can be attached to the forehead using a biocompatible gel with the stretchable, and biocompatible electrode sheet and can monitor bioelectric potentials with less than 1 microvolts. The sensor is compactly designed for 3 cm × 9 cm × 6 mm with a weight of 12 g. Results show that the proposed sheet-system demonstrates promising performance in diagnosing brain-related diseases including the Alzheimer's disease using frequency domain analysis.

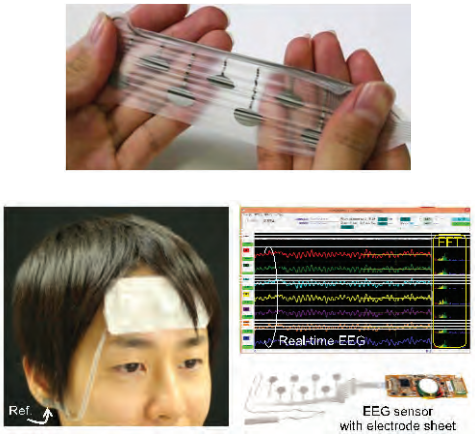

Fig. 1. Strechable electrode, imperceptible EEG sensor mounted on the forehead, wave viewer software connected to the EEG system with a flexible substrate.

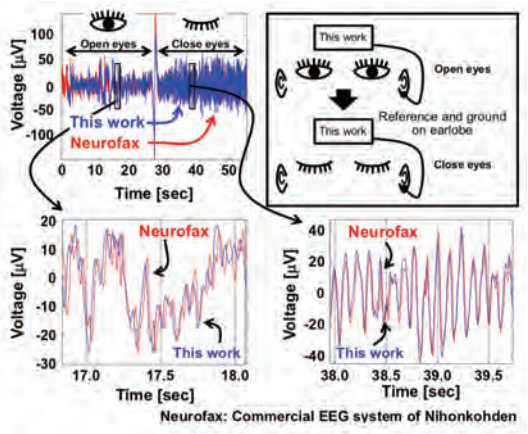

Fig. 2. EEG recorded using a conventional Neurofax (Nihon Kohden) and the proposed EEG system.

Large-scale Structural Health Sensor

By utilizing flexible sensor technology, we developed into a highly desired structural health sensor for diagnosis and deterioration judgment of bridges and tunnels. In conventional infrastructure management, experts have conducted on-site inspections and collected information. On the other hand, in this research, we developed a sheet-type IoT infrastructure sensor system that enables infrastructure management simply by attachment on a structure. A sensor is a plurality of edge-nodes collecting data and arranging a sensor group which detects distortion, natural potential, chloride ion concentration, and vibration. A gateway collecting data from edge-nodes enables communication to the cloud network. The system is connected by long-term reliable carbon wiring. The sensor system visualizes potential deteriorations and prioritizes of repair and reinforcement. In other words, it will be possible to monitor the status of infrastructure, assess the health of the infrastructure, and offer measures of proposal services, etc., contributing to safe and secure living.

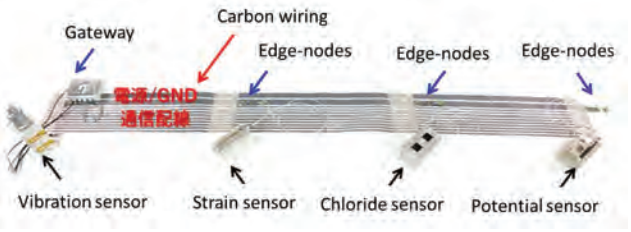

Fig. 3. Appearance of sheet type IoT infrastructure sensor

Department of Intelligent Media

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Assistant Professor: Fumio OKURA
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Outlines

The studies in this lab 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, and intension 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

Research Projects

Probabilistic Plant Modeling via Multi-View Image-to-Image Translation

This paper describes a method for inferring three-dimensional (3D) plant branch structures that are hidden under leaves from multi-view observations. Unlike previous geometric approaches that heavily rely on the visibility of the branches or use parametric branching models, our method makes statistical inferences of branch structures in a probabilistic framework. By inferring the probability of branch existence using a Bayesian extension of image-to-image translation applied to each of multi-view images, our method generates a probabilistic plant 3D model, which represents the 3D branching pattern that cannot be directly observed. Experiments demonstrate the usefulness of the proposed approach in generating convincing branch structures in comparison to prior approaches.

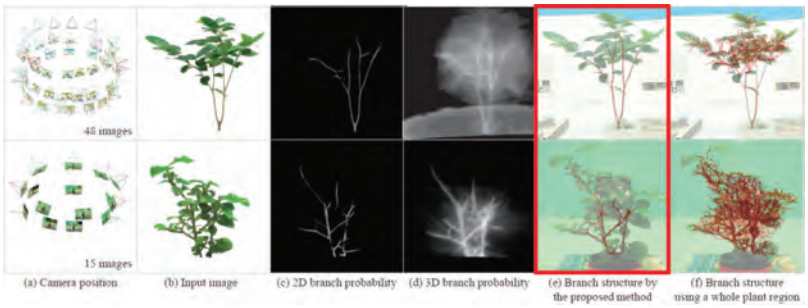

Fig. 1 Results using real plants. Using input images where the foreground plants are extracted (b), the proposed approach generates convincing branch structures (e), in comparison to branch structures generated by a previous tree reconstruction approach (f).

Early Detection of Lower MMSE Scores in Elderly Based on Dual-Task Gait

The dual-task paradigm is a promising procedure for estimating cognitive status and may also be collaterally used to reduce cognitive decline and prevent dementia. In this paper, we use the mini- mental state exam (MMSE) to the assess cognitive status in the elderly as a reference and investigate the potential of using machine learning for early detecting cognitive impairment in the elderly. Although many studies have suggested that dual-task performance, in which participants perform a cognitive task while walking, is associated with cognition, they only considered the correlation between cognitive parameters and simple gait feature, such as gait speed, through the statistical analysis. We instead use a Kinect sensor to capture participants' whole-body movements and extract a rich gait feature that has the ability to exhibit different tendencies of movements between healthy and cognitive-impaired elderlies. In our experiments, a classifier based on the dual-task gait feature achieved a higher performance than the one based on the single-task feature; the performance of the rich gait feature was better than that of a simple one, and; an optimal detection performance was achieved with an MMSE cutoff score of 25. We positively validated that the proposed method could early detect elderly with lower MMSE scores based on dual-task gait feature with a promising performance.

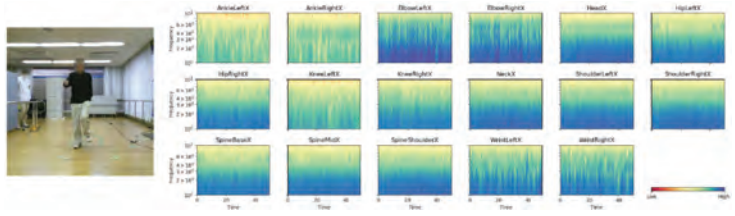

Fig. 2 Data acquisition (left) and wavelet spectrum of each body joint in log scale (right)

Department of Reasoning for Intelligence

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Outlines

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

Research Projects

Measurement Oriented Machine Learning

Along the development of IoT Society, the importance of the information processing for advanced measurement technologies are increasing. Based on this background, we worked on the study of machine learning for the advanced measurements including one molecule measurement, individual virus measurement, super-resolution microscope, and olfactory measurement. In this year, we extended our principles and methods of the noise reduction in the mixture of objective and noise pulses using pattern recognition of the pulse shapes. Under practical measurement environments, the ratio between the objective and noise pulses (SNR) often largely changes from time to time. However, the standard machine learning models trained in a given SNR show severe performance degradation under the largely different SNR. In this study, we newly proposed a maximum likelihood principle for the highly robust noise reduction against such large variation of the SNR.

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 evaluated the prediction performance of our proposed algorithm for searching causal structures in data sets generated by some non-linear process with arbitrary noise.

Operator-theoretic data analysis for dynamical systems

We develop novel machine learning methods for operator-theoretic data analysis (OTDA) of dynamic processes. OTDA and its empirical algorithm, named dynamic mode decomposition (DMD), has recently attracted attention in a variety of scientific fields. In this year, we developed algorithms for OTDA based on principles discussed in machine learning such as DMD for structured data sequences and metrics on nonlinear dynamical systems. Moreover, we applied those to spatiotemporal data from several physical processes such as collective motions in sports, and confirmed its effectiveness in those applications.

Making Machine Learning Models Interpretable

Modern machine learning models are highly complex which makes users hard to understand the internal mechanism of the models. In this study, we focused on the ensemble of decision trees, which is one of the most standard models. The tree ensemble is also known for its complex structure and is regarded as black-box in practice. For such an ensemble, we proposed a model simplification method that makes the complex model readable to the users. The proposed method is based on the framework of Bayesian model selection. With this framework, we constructed an algorithm that (i) is able to determine the degree of readability automatically, and (ii) is able compute efficiently. In real models, we confirmed that the proposed algorithm can make models readable better than existing methods.

Department of Knowledge Science

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Under Graduate Students:	Taisei KAKIBUCHI, Riku SATO
Research Student	Naoya KOBAYASHI
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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.

Research Projects

Development of Human-Robot Interaction System based on Machine Learning

The fundamental functions for robots that interact with humans are the detection and direction estimation of speech, voice activity detection and speech recognition (Fig.1). We improve the accuracy and the processing efficiency of speech recognition based on machine learning techniques, such as generative model and discriminative model.

We developed a neural network structure that predicts sound class from raw speech signals. The architecture follows and optimizes the process of conventional speech feature extraction. We found that the complex-valued liner filter could capture the periodic patterns of harmonic structure of speech signal and could improve the recognition accuracy.

Fig.1 Human-robot interaction

We also developed a detection technique of out-of-vocabulary (OOV) words from the syllable-recognition results of user utterances. We extended a Bayesian word segmentation model, which is one of the major methods in natural language processing, by considering the generative process of vocabulary set. Experiments showed that our method improved the detection accuracy of OOV words, especially in Japanese.

Knowledge Acquisition through Dialogues

To acquire new knowledge from an interlocutor's utterance is one of intelligent

abilities of human beings. We have addressed the issue to construct a system that gets smarter as we talk to it.

In this fiscal year, we comapred users' impressions between confirmation requests in the implicit confirmation (Figure 2) and explicit confirmation requests such as "What is xxx?" We empirically investigated the assumption that "consecutive explicit confirmation requests are more annoying than implicit ones", which is the premise of the implicit confirmation. Empirical results showed that users' impressions tend to be worse when explicit confirmation requests are repeated than when implicit ones are repeated.

Fig. 2 Example of implicit confirmation

We also started developing a method to select questions to acquire knowledge using knowledge graph completion. We formalized a problem to select the content of a question that is useful if it is acquired, and that is not an obvious mistake, which would reduce the user's motivation to continue talking with the system. We presented a part of the results to try solving this problem at the 9th Dialogue System Symposium and received a Young Sientist Award.

Compression of Large-scale Knowledge Graphs

Knowledge graphs are indispensable resources for knowledge-intensive applications such as dialog and question answering systems. Tensor decomposition techniques like CP encode a large-scale knowledge graph into a low-dimensional latent feature space and have proven useful in completing missing links accurately in the knowledge graph. When handling huge knowledge graphs in resource-limited environments, however, it is a serious problem that a tensor decomposition model requires a large amount of computational memories to store the parameters.

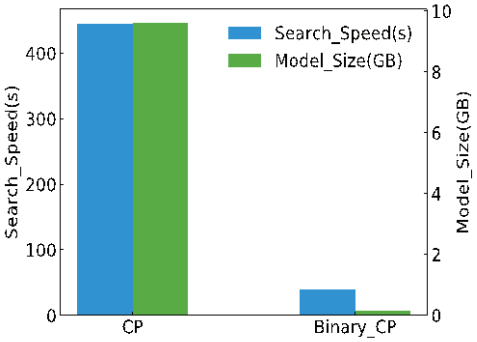

Fig.3 Computation time and model size of BCP

In this year, to reduce the memory requirement, we present a novel method (BCP) for binarizing the parameters of the CP tensor decomposition by introducing a quantization function to the optimization problem. This method replaces floating point–valued parameters with binary ones after training, which drastically reduces the model size at run time. Moreover, a fast score computation technique can be developed with bitwise operations (Fig.3).

We presented our study on BCP at an international conference.

Department of Architecture for Intelligence

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Research Students:	Boonprakong Nattapat (1.10.2018-)
Technical Support Staff:	Katsuyuki TANAKA (19.11.2018-)
Supporting Staff:	Megumi TANABE (-30.9.2018), Mitsuyo OHTSUKA, Akiko YAMAMOTO, Makiko KUROKI (1.7.2018-)

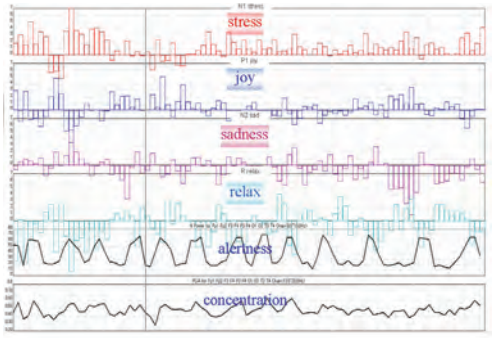
Outlines

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

Research Projects

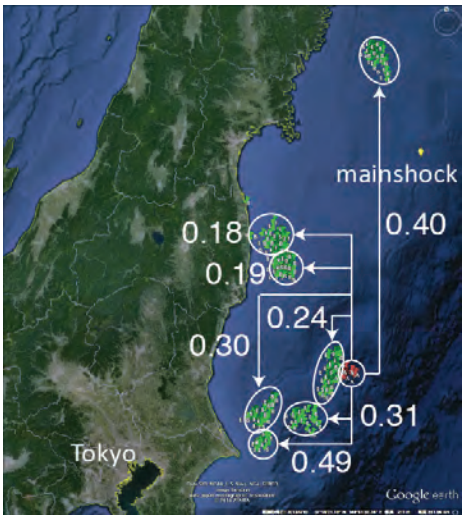
Constructive Adaptive User Interfaces

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



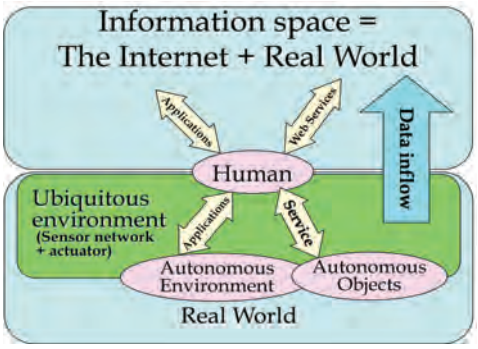
Knowledge Discovery from Event Sequence Data

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



Intelligent Ubiquitous Sensor-Networks

In recent years, progress in computer technology, the appearance of IPv6, the development of various radio technology including IEEE802.11, and the practical use of radio-tags like RFID have greatly activated studies of ubiquitous computing like sensor-networks. But, the purpose of many proposed ubiquitous systems is to present information of the virtual-world like the Internet to humans living in the real-world by using physical properties like monitors and loudspeakers, etc. On the other hand, our purpose is to construct a framework to enable flexible and real-time interaction between humans and the real-world. Keyword is resonance. Each human has his own natural frequency, which is a metaphor for personality or daily habitual behaviors. In the proposed framework, each human behavior reacts with the environment and the environment performs sensor-data mining and extracts each human's natural frequency. The real-world that we assume in this study is homes and offices, etc., where daily habitual behaviors of humans are easy to extract. So, we call the real-world "the environment." The environment learns the daily habitual behaviors of each human, and performs the most suitable interaction to whoever should receive it. To embody this interaction framework, the environment must be an autonomous action entity, and it is necessary to construct this entity as a massively multi-agent system to enable management and control of various broadly dispersed sensors and physical properties for interaction and to enable real-time interaction with humans. To begin with, we have set up several interaction devices between humans and the environment as well as various kinds of many sensors.



Division of Advanced Materials and Beam Science

Outline

This division is composed of seven departments with the following research fields: Functionalized Natural 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.

Research Projects

- Fabrication of ultra-low reflectance Si surfaces by surface structure chemical transfer method and improvement of efficiencies of crystalline Si solar cells
- Si nanopowder produced from Si swarf for hydrogen generation and battery materials
- Development and multifunction tuning of ceramic-based materials via nanostructure and hetero-interface design
- Micromechanics-based extraction of single-crystalline elastic constants from polycrystalline samples with crystallographic texture
- Development of oxide nanotubes having novel photo-chemical multifunctions by advanced structure tuning
- Development of printed flexible wiring and interconnection and characterization of their basic properties
- Development of WBG semiconductor system integration and basic interconnection research
- Direct observation of ultrafast structural phase transition of Si using time-resolved transmission electron diffraction
- Ultrafast dynamics of holes injected into Si valence band using two-photon photoemission spectroscopy
- Development of L-band RF photocathode
- Characterization of free-electron laser coherence
- Development of resist processes for extreme ultraviolet and electron beam lithography
- Development of resist materials for extreme ultraviolet and electron beam lithography
- Chemical reactions induced in condensed matter by quantum beam
- Preparation process of nanopapers
- Estimation of intrinsic birefringence of cellulose

Department of Functionalized Natural Materials

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Assistant Professor:	Kojiro UETANI
Supporting Staff:	Hitomi YAGYU
	Yuki AKUZAWA (10.7.2018 -)
	Tokiko NISHIMOTO (1.10.2018 -)
	Yasuko HASHIMOTO (1.4. 2018 - 30.9. 2018)

Outlines

Cellulose nanofibers with widths of 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 (Fig. 1). At present, we are conducting the research and development of flexible nanopaper electronics.

Fig. 1 Transparent nanopaper.

Research Projects

Preparation process of nanopapers (*Colloid and Interfaces* **2018**, *2*(4), 71.)

Nanopaper, known as clear paper, can be made by drying and laminating 3 to 15 nm wide cellulose nanofibers suspended in water. It has been reported that the structures and properties of the nanopaper are significantly different (*Nanoscale Horiz*. **2018**, *3*, 28-34) depending on the conditions which the suspension goes through (for example, vacuum filtration and oven drying). However, it has not been clear how the drying process affects the structure of nanopaper, and it makes difficult to control the performance of the formed nanopapers. In our laboratory, we aimed to clarify the structure of nanofibers in this drying process by observing over time.

The time-dependent birefringence change was observed to investigate the aggregate state of the nanofibers in the suspension during drying. the optical anisotropy occurs when the nanofibers align. We have successively observed the birefringence on the drying suspensions in the oven by constructing a unique observation system (Fig. 2). We took a birefringence image of the suspension every 5 minute and observed the change

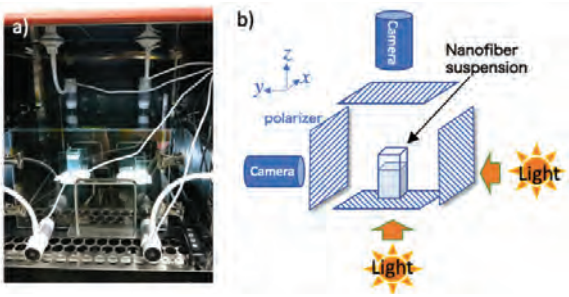

Fig. 2 Drying process analysing system. (a) Arrangement in actual oven, and (b) Schematic of each arrangement.

over time. As a result, it was found that the drying suspension showed the birefringence with each passage of time. The nanofibers exhibited the self-aligning sequence to form the orientational structure in stages. When drying proceeds from the uniform dispersion state at the early stage of drying (Fig. 3a), the concentrated layer of nanofibers was formed in the vicinity of the liquid surface, and strong birefringence was observed from the side (Fig. 3b). After further drying, the birefringence was also observed from above. The nanofibers were found to begin arranging in the plane of the layer (Fig. 3c). Finally, it could be dried as nanopaper with a chiral nematic structure (Fig. 3d). Such drying behavior was confirmed regardless of the initial concentration, and we succeeded in elucidating the universal phenomena during drying the nanofiber suspensions.

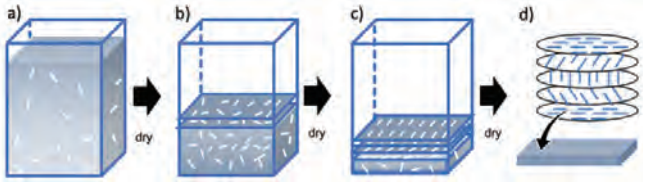

Fig. 3 A schematic diagram showing the drying process of nanopaper suspension.

Estimation of intrinsic birefringence of cellulose（*ACS Macro Lett.* **2019**, *8*(3), 250-254.）

As mentioned above, cellulose nanopapers were found to have the optical anisotropy due to the manufacturing method. Chain polymers have anisotropy in the refractive index, i.e. the intrinsic birefringence, which is the maximum difference in refractive index when the molecular chain is stretched. However, the intrinsic birefringence of cellulose was not clear, and the reported values were largely different.

In this research, we adopted a new technical approach to solve the problems of conventional measurement methods, and tried to derive the intrinsic birefringence of cellulose. We used the nata-de-coco cellulose nanofibers having the extended chain crystals of cellulose to mechanically stretch to unidirectionally align the nanofibers. Then, the birefringence mapping images were taken by the retardation distribution analysing system, and multiple retardation data of more than 110,000 points for the one angle of view were acquired (Fig. 4). This multipoint measurement allow the distribution analysis of birefringences at many points. The averaged birefringences showed a good linear correlation with the degree of orientation derived from the X-ray diffraction analysis (Figure 5). Intrinsic birefringence is defined as the birefringence value at the maximum degree of orientation, therefore, we derived the intrinsic birefringence of cellulose by extrapolating the approximate line to be 0.09. This value is greater than those for the general plastic materials. Our results showed that cellulose could be applicated as a optical compensation materials.

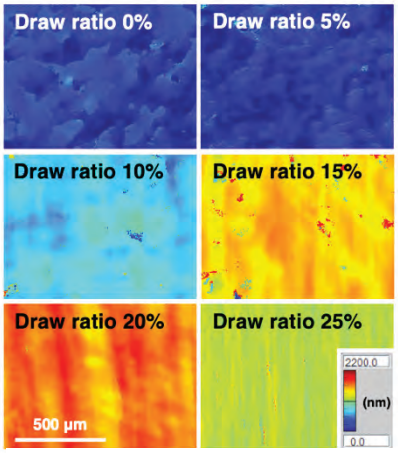

Fig. 4 Distribution of birefringence retardation of each oriented nanopaper.

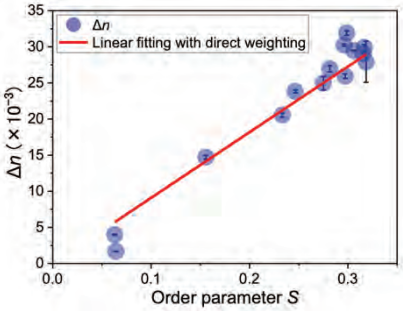

Fig. 5 Correlation between orientation degree parameter and birefringence.

Department of Semiconductor Materials and Processes

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Assistant Professor: Kentaro IMAMURA, Toshiro YAMAGUCHI
Specially Appointed Professor: Kazuhiko MATSUMOTO, Sumio TERAKAWA, Masatoshi TNIGUCHI
Specially Appointed Researcher: Yuki KOBAYASI,
Specially Appointed Technical Staff: Chika KUROSAKI
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Supporting Staff: Miharu NAKAMOTO

Outlines

The modern society is based on semiconductor technology. Our research aims at development of novel materials for hydrogen generation, improvement of the characteristics of semiconductor products and development of semiconductor devices with new structures with development of new semiconductor chemical processes. For this purpose, we study 1) crystalline Si solar cells to solve energy and environmental problem, 2) application of Si nanopowder produced from Si swarf to batteries and 3) Si composition for hydrogen generation.

Research Projects

Effective passivation for nanocrystalline Si layer/crystalline Si solar cells by use of phosphosilicate glass [Original paper 1]

We have investigated the phosphosilicate glass (PSG) passivation effect on electrical characteristics of the <nanocrystalline Si (nc-Si)/crystalline Si> structure fabricated by use of the surface structure chemical transfer (SSCT) method. Cross-sectional SEM measurements show that PSG can penetrate into nano-sized pores of the nc-Si layer. For thick nc-Si layer, e.g., ~ 300 nm, however, un-filled nano-sized pores remain in the deep region of the layer. It is founded that complete PSG filling of the nano-sized pores in the nc-Si layer with its thickness less than ~160 nm greatly improves the effective minority carrier lifetime. The valence band maximum is found to shift toward the lower energy by the SSCT treatment, indicating the band-gap widening of the nc-Si layer. When pores in the nc-Si layer is completely filled with PSG, the effective minority carrier lifetime increases with the thickness of the nc-Si layer, suggesting formation of the graded band-gap structure which can suppress recombination of photo-generated electron-hole pairs.

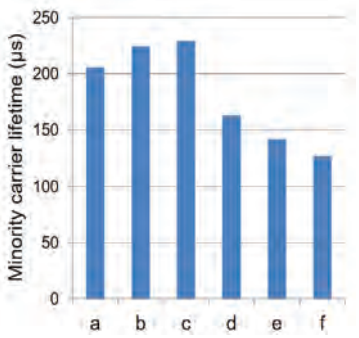


Fig. 1 Minority carrier lifetime of the <PSG-passivated nc-Si/crystalline Si> symmetric structure formed by the SSCT treatment for the following periods: (a) 2.5 s, (b) 5 s, (c) 7.5 s, (d) 10 s, (e) 12.5 s, and (f) 15 s.

Planarization mechanism for 6H–SiC (0001) Si-faced surfaces using electrochemical reactions [Original paper 3]

We have developed a fast planarization method of 6H–SiC (0001) Si-faced surfaces using electrochemical reactions. In this method, a working electrode of a rotating Pt disc electrode is physically contacted with an SiC wafer immersed in an HF solution, and a potential of 2 or 3 V with respect to the Ag/AgCl reference electrode is applied to the Pt disk electrode. After the planarization process with the applied voltage of 3 V for 1 h, relatively flat surfaces with the 0.09 nm average roughness (Ra) value are obtained, but a 1 ~ 2 nm carbon-rich layer is present on the surfaces. A subsequent planarization process with the applied voltage of 2 V for 1 h almost completely removes the carbon-rich layer, resulting in atomically flat surfaces with the 0.05 nm Ra value. Under the condition of the applied voltage of 2 V, the concentration of OH radicals generated during water electrolysis decreases to one-half of that generated under 3 V. The oxidation rate of C atoms is proportional to the concentration of OH radicals while that of Si atoms is proportional to the square of the concentration. Under the condition of the applied voltage of 2 V, therefore, oxidation of C atoms proceeds more dominantly than that of Si atoms, resulting in absence of the carbon-rich layer.

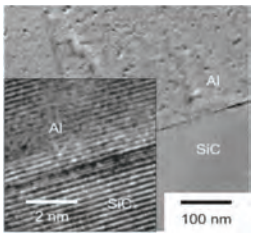


Fig. 2 Cross-sectional TEM micrographs of the SiC wafers after the two-step planarization reaction.

Hydrogen generation by reaction of Si nanopowder with water for medical use

Hydroxyl radicals (·OH) are generated in the body for various reasons, e.g. metabolism, smoking, alcohol, and stress. Hydroxyl radicals possess the highest oxidation-reduction potential among reactive oxygen species. Hydroxyl radicals oxidize cells to cause various diseases such as Alzheimer's disease, Parkinson's disease, and kidney failure. We have developed a method of hydrogen generation by the reaction of Si nanopowder with water having neutral pH. Si and SiO_2 are nonpoisonous materials, Si nanopowder can be taken to generate hydrogen in the body. The average crystallite size of Si nanopowder was 23.5 nm while it aggregated to form agglomerates with sizes larger than 0.1 μm. Due to the large size of agglomerates, Si nanopowder is expected not to be absorbed directly from digestive organs. On the other hand, the hydrogen generation rate was found to be dependent on the size of crystallites, but not on the size of agglomerates. Figure 3 shows the hydrogen volume generated by the reaction of Si nanopowder with water under conditions similar to those in bowels, i.e., pH 8.3 and 36ºC. Without surface treatment of Si nanopoweder, the hydrogen generation rate was very low. With the surface treatment, the hydrogen generation rate greatly increased, and 240 mL hydrogen was generated in 24 h. It should be noted that 240 mL hydrogen corresponds to that included in 13 L saturated hydrogen-rich water. We found that hydroxyl ions act as catalyst for the hydrogen generation reaction. Therefore, Si nanopowder does not react in stomach with the acidic condition due to gastric acid (pH: 1.5~2.0) and it reacts in bowels under the alkaline condition because of pancreatic juices (pH: 7.8~8.7). Hydrogen generated in bowels are effectively absorbed, circulate in the body and eliminate hydroxyl radicals in the body. Therefore, Si nanopowder is expected to prevent various diseases caused by oxidation stress.

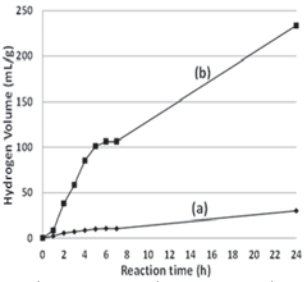


Fig. 3 Hydrogen volume generated by the reaction of Si nanopowder with water under pH8.3 and 36°C.

Department of Advanced Hard Materials

Professor: Tohru SEKINO
Associate Professor: Masakazu TANE
Assistant Professor: Tomoyo GOTO
Assistant Professor: Sung Hun CHO
Specially Appointed Assistant Professor: Shengfang SHI (2018.11.1-present)
Specially Appointed Researcher: Hisataka NISHIDA, Hideki HASHIMOTO
Graduate Students: Sotaro BABA, Shengfang SHI, Shunghun EOM
Yong Hyun CHO, Yeongjun SEO, Hyunsu PARK
Hiroki EDAMATSU, Kota TSUKATANI
Chisato KAKO, Yoshifumi KONDO
Hiroki NISHIO
Supporting Staff: Mitsuru NISHISAKO

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 as structure components for various devices and instruments, next generation biocompatible, environmental and energy materials, all which are the strongly demanded materials to solve crucial problems arising in our society.

Research Projects

Sorption capacity of Cs^+ on titania nanotubes synthesized by solution processing

Titania nanotubes (TNTs) have nanometer-sized tubular morphologies with layered structures. TNTs are candidate sorbents for the removal of many heavy metals and radionuclides. In this study, we investigated the Cs^+ sorption capacity of TNTs synthesized by a solution chemical method in comparison with those of zeolite. The sorption density of Cs^+ per gram of TNT was lower than that of zeolite. The sorption isotherm of Cs^+ on TNTs was fitted with the Langmuir model, and maximum adsorbed Cs^+ masses (Q_{max}) on TNTs was calculated as 1.06 mmol/g. From the Elemental analysis, the residual Na^+ concentration in TNTs decreased with increasing the adsorbed Cs^+ concentration. These results clearly showed that the Cs^+ was intercalated into the layered structures of the TNTs by ion-exchange with Na^+.

Development of Multitask-type Advanced Ceramic-based Composites with Integrated Functions.

The composites consisting of nano/micro size metal and functional substance can indicate the multitasking function by controlling the anisotropic or percolation structure (Fig.1). We have developed Al_2O_3/Ti composites by novel processing based on the in situ decomposition and sintering of TiH_2 and Al_2O_3. This composite is the homogeneous dispersion of Ti in Al_2O_3 and it has percolation structure contributes the electrical conductivity to insulator Al_2O_3. Nanostrurured TiO_2 could be formed on the surface, resulted in addition of photocatalytic function to the composites. In addition, this composite shows the room-temperature crack healing function by the electrochemical anodization at room temperature; it was demonstrated that the bending strength of crack-induced composites, which was approximately 61% of the crack-free composites' strength, was completely recovered after the crack-healing procedure at room temperature under appropriate anodization conditions.

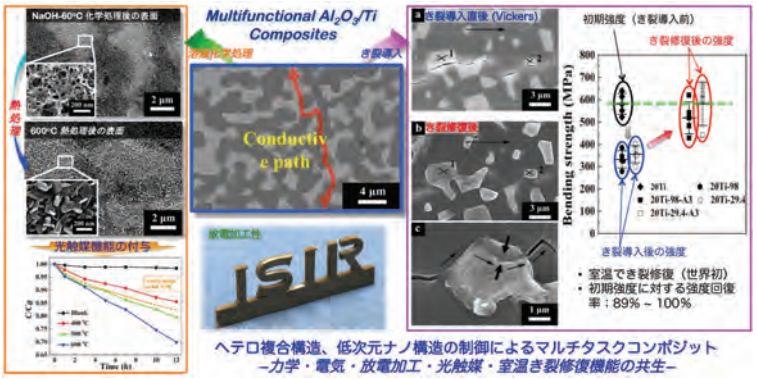


Fig.1 Multitask-type Advanced Ceramic-based Composites with Integrated Functions.

Elastic properties of carbon fibers

The anisotropic elastic properties in carbon fibers were studied. Aluminum-based composites containing five types of carbon fibers were prepared, and their anisotropic elastic properties were measured. Then, all the independent elastic stiffness components of the carbon fibers were extracted from those of the composites using a composite model based on Eshelby's inclusion theory, Mori–Tanaka mean-field theory, and effective-medium approximation. Fig. 2 shows the dependence of Young's modulus on loading direction in M30S carbon fibers; θ is the angle from the longitudinal axis of the carbon fibers. The Young's modulus is highest in the longitudinal direction of carbon fibers, and the Young's modulus monotonically decreases with increasing angle θ. Moreover, we newly developed a nanocomposite microstructure model that can fully reproduce all the anisotropic constants of carbon fibers. The analysis using the developed model revealed that the shape of the graphite-crystal inclusions, composesed of graphite nanocrystallites, dominantly affects the anisotropy in the Young's modulus.

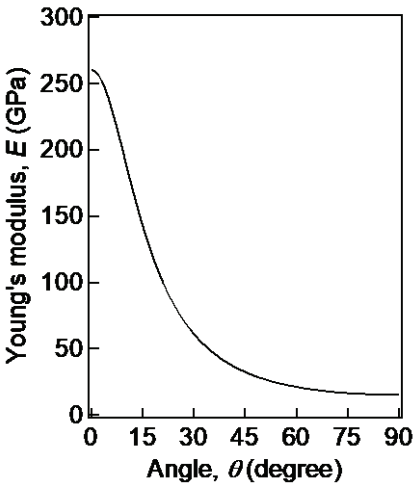


Fig. 2 Dependence of Young's modulus on loading direction in M30S carbon fibers; θ is the angle from the longitudinal axis of the carbon fibers.

Department of Advanced Interconnection Materials

Professor: Katsuaki Suganuma
Associate Professor: Shijo Nagao, Tohru Sugahara
Specially Appointed Assistant Professor: Hao Zhang, Chuantong Chen, Ekubaru Yusfu
Specially Appointed Research: Norio Asatani, Yukiharu Kimoto, Akio Shimoyama, Naoki Satou, Aiji Suetake, Leila Alipour
Graduate Students: Takuya Misaki, Dawei Hu, Lingying Li, Shyuhei Takada, Wanli Li, Seungjun Noh, Yue Gao, Chanyang Choe, Jeyun Yeom, Kim Dongjin
Supporting Staff: Naomi Keenan, Seiyo Okuda, Sachiko Moribe, Noriko Kagami, Maki Tsurumoto

Outline

Through the nano-technologies and the knowledge for organic/inorganic materials, we are conducting the development of environmentally conscious electronics system integration technologies for energy saving technology and also for IoT, i.e. bonding materials, power electronics interconnection and packaging materials, sensing devices and interface materials for the electronics devices by solution process.

Research Projects

Enhancement of bonding strength in Ag sinter joining on Au surface finished substrate by increasing Au grain-size

Ag sinter joining on the Au surface finished substrate is a hot topic due to the Au surface finished substrate has excellent thermal and electrical properties as well as a chemical resistivity. In this work, we successfully increased the bonding strength of Ag sinter joining on the ENEPIG surface finished substrate via a simple preheating process. Two different kinds of Ag paste were experimented, and several times higher results can be achieved on the preheated substrate. To clarify the mechanism of the increment in bonding strength on the preheated substrate, the SEM observation of fracture

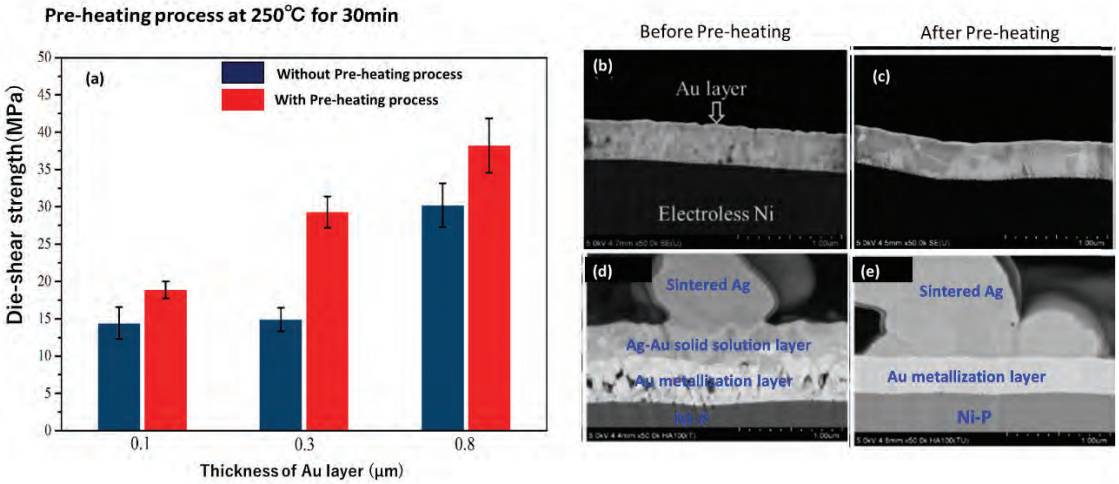


Figure 1. Improvement of bonding strength in Ni / Au plated metallized structure and Ag sintered paste bonding material.

microstructures, cross-section parts and the surface changes of the preheated substrate were conducted. The results indicate that the microstructure of Au layer has a huge effect on the bonding strength, and the strategy of preheating can be utilized on all kinds of Au surface finished substrates.

Flexible thermoelectric generator module: a silver bullet to fix waste energy issues

An inexpensive large-scale flexible thermoelectric generator (FlexTEG) module with high mechanical reliability for highly efficient power generation is developed. Through a change in direction of the top electrodes at the two sides of the module and the use of integrated circuit packaging of semiconductor chips, the FlexTEG module has more flexibility in any uniaxial direction. This improved efficiency of recovery, or thermoelectric conversion, of waste heat from a curved heat source, enhancing the module's mechanical reliability as less mechanical stress is placed on semiconductor chips in the module.

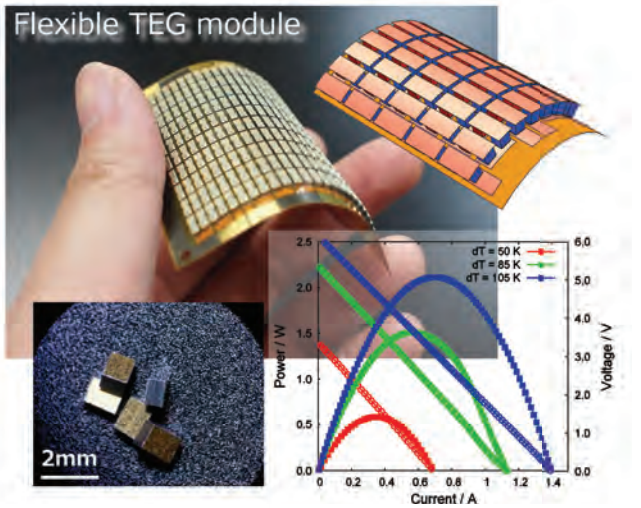


Figure 2. Photo and schematic design of the FlexTEG module, photo of Bismuth-telluride (Bi-Te) semiconductor chips, and voltage and power as a function of the current for the FlexTEG module at different temperature gradients characteristics at each temperatures

Technique to easily fabricate ceramic films used as OPV inter-layers developed

As environmental and energy issues have become increasingly aggravated in recent years, photovoltaic (PV) cells are drawing attention as a new energy source. However, since the cost of silicon PV cells is still high, it's important to reduce the cost of PV cells. On the other hand, organic photovoltaic (OPV) cells using organic compounds have several advantages: they are lightweight, flexible, and sophisticated, and their production cost is low. For these reasons, they are anticipated as next-generation PV cells.

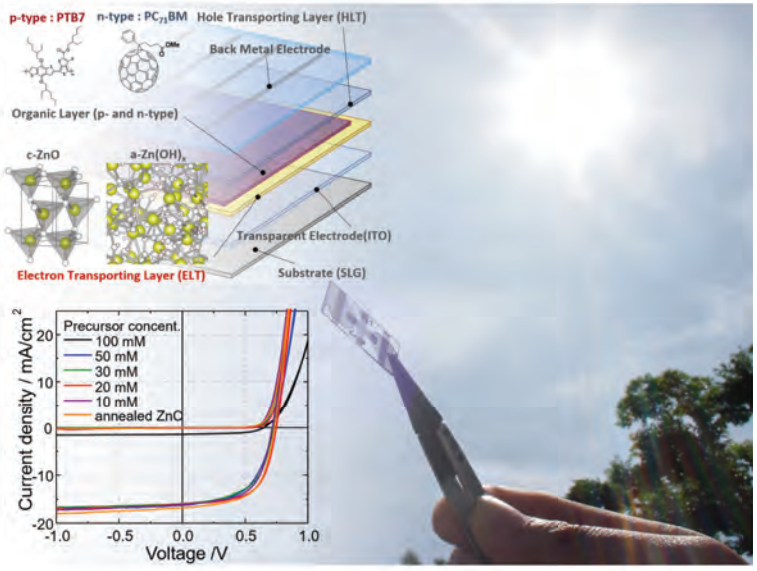


Figure 3. Organic photo voltaic solar cells and schematic figure of the cell structure. Current density voltage (JV) characteristics during light irradiation and dark condition.

Department of Excited Solid-State Dynamics

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

Outline

For fabricating highly functional nano-structured devices in future technology, it is essential to establish the ways to control structures and compositions of materials at the atomic level. In this department, we aim to establish the fundamentals for controlling the modes of atomic binding in solids via excitation-induced atomic reactions. For this purpose, we elucidate the fundamentals of many-body interactions including electron-lattice, electron-electron, spin-orbit interactions, which rule the physics concerning the excitation-induced processes, by using extensive experimental studies.

Research Projects

Observation of the phase-shift of the wavefunction in epitaxial graphene on SiC during the scattering.

The Dirac cone of graphene is located at the K-point of the Brillouin zone in the k-space. One can take the polar coordinate system around the K-point for describing the wavefuntion of the Dirac cone, and the energy is approximately proportional to the distance from the K-point, but nothing to do with the argument. Therefore, the argument can be regarded as "phase" of the wavefunction. It is known that this phase can be probed by the photoelectron intensity in angle-resolved photoelectron spectroscopy (ARPES) using the polarized photon beam. Meanwhile, it is also known that the duplication of the Dirac cone occurs in the ARPES spectra of the epitaxial graphene on SiC, and is of interesting since it gives a crucial information for the modification of the epitaxial graphene. In previous researches, the replicas are well explained by the photoelectron diffraction at the buffer layer and SiC substrate, then the phototelectron-intensity distribution is preserved during the diffraction. In our research, however, we found the strong resonant enhancement in intensity of the replicas at the photon energy of 11eV, and more interestingly, the phase-shift is clearly observed in the ARPES-map.

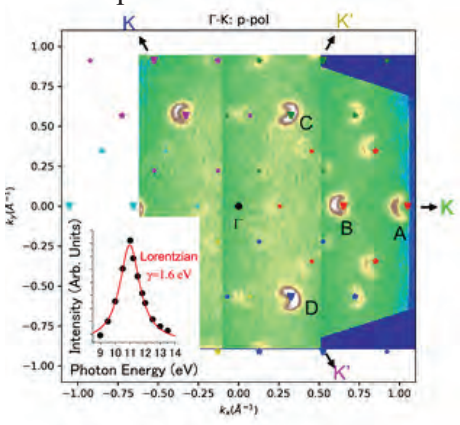


Fig.1 ARPES map at the resonance.

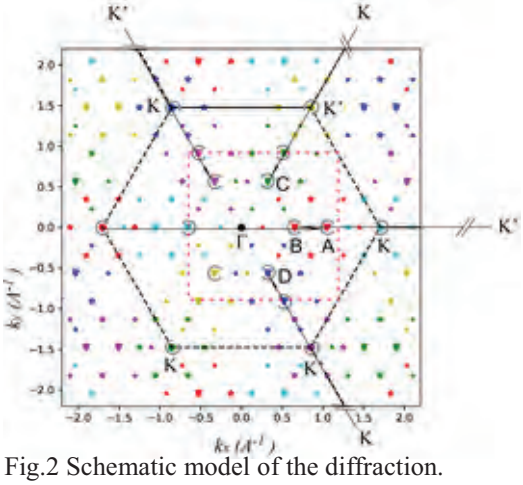


Fig.2 Schematic model of the diffraction.

Fig. 1 shows the photoelectron-intensity at the Fermi level where many replicas of the Dirac cone are shown. There are the results of the diffraction due to the SiC substrate as shown in Fig. 2. In Fig.1, photon energy is tuned so as the resonant enhancement of the replica-intensity is achieved as shown in the inset of the Fig.1. One can probe the "phase" term from the intensity distribution of the replicas. These show the four-fold symmetry although original intensity distributions at the K-points shows the six-fold symmetry. This is a clear discrepancy against the previous non-resonant photoelectron diffraction cases. This means that the phases are not preserved during the photoelectron diffraction at the resonant condition, and the phase-shift of the wavefunction at the scattering can be probed experimentally.

Dispersion of the excited state in NbSe2 by the use of the photon-energy dependent angle-resolved photoelectron spectroscopy.

The electronic-excitation dynamics of the material is a key issue for understanding and developing the functional optical device. Transition-metal-dichalcogenides (TMDC) attracts interests of many researchers because of its unique 2D character. Here, we report the photon-energy dependent angle-resolved photoelectron spectroscopy (ARPES) of $NbSe_2$(2H), which has been one of the most studied TMDC, and examine the band-dispersion of the excited state. A summary of EDC spectra at the normal emission (Γ-point) is displayed in Fig. 3, where the photoelectron intensity is shown as a color map as functions of the binding energy and photon energy. The valence band positions are indicated by the vertical intensity enhancements at the binding energies of ~2.0, ~1.1, ~0.9eV below the Fermi level. It is an ordinal analysis in the photoelectron spectroscopy. On the other hand, the slight enhancement along the tilted lines are attributed to the empty bands with energy positions indicated. Moreover, at some of the points where these two lines cross to each other (when the photon energy agrees with the difference between the valence and conduction band), considerable enhancements are observed. It is ascribed to the resonant photoexcitation, and it is possible to precisely determine the energy position of the empty band. Then, the angle-resolved measurement leads us to determine the dispersion of the excited band into which the electron is excited from a specific valence band (Figs.2 and 3). This procedure is basically similar to the optical spectroscopy, but superior since the dispersion relation can be probed.

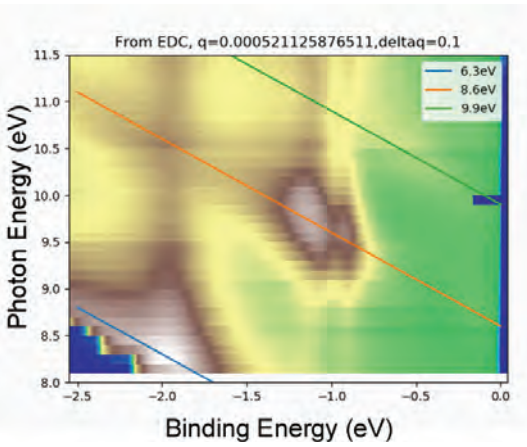


Fig. 3. Two-dimensional photoelectron intensity map.

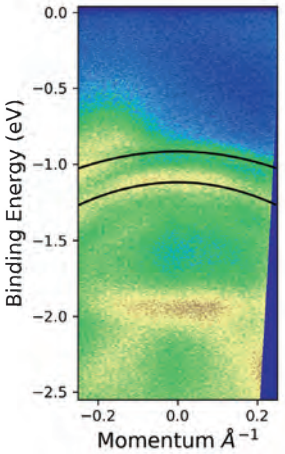


Fig. 4. ARPES map along the Γ-K line.

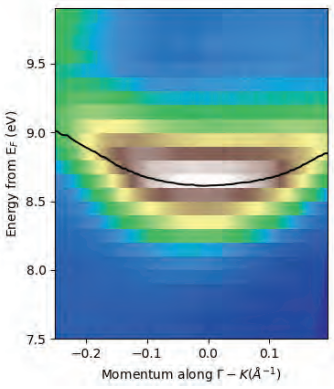


Fig.5 Dispersion of the excited band.

Department of Quantum Beam Physics (formerly Department of Accelerator Science)

Assistant Professor Akinori Irizawa

Outline

Particle accelerators and quantum beams generated from them are widely applied for not only basic science but also industrial usage. The division of accelerator science conducts THz-FEL including high brilliant electron beam in view of generating quantum beam and its usage. The newest generation radiation right source, FEL can change wavelength from its laser feature, and also its high power, coherency, pulsed, polarization characters yield many aspects of utilization in basic and applied fields. THz-FIR is just located between the photons and the radio waves, and the technical development is still in progress, so called “THz gap”, for both light source and detector. We are searching for the new scientific fields, controlling materials and its properties, developing THz-detection techniques, collaborating with world-wide researchers and laboratories.

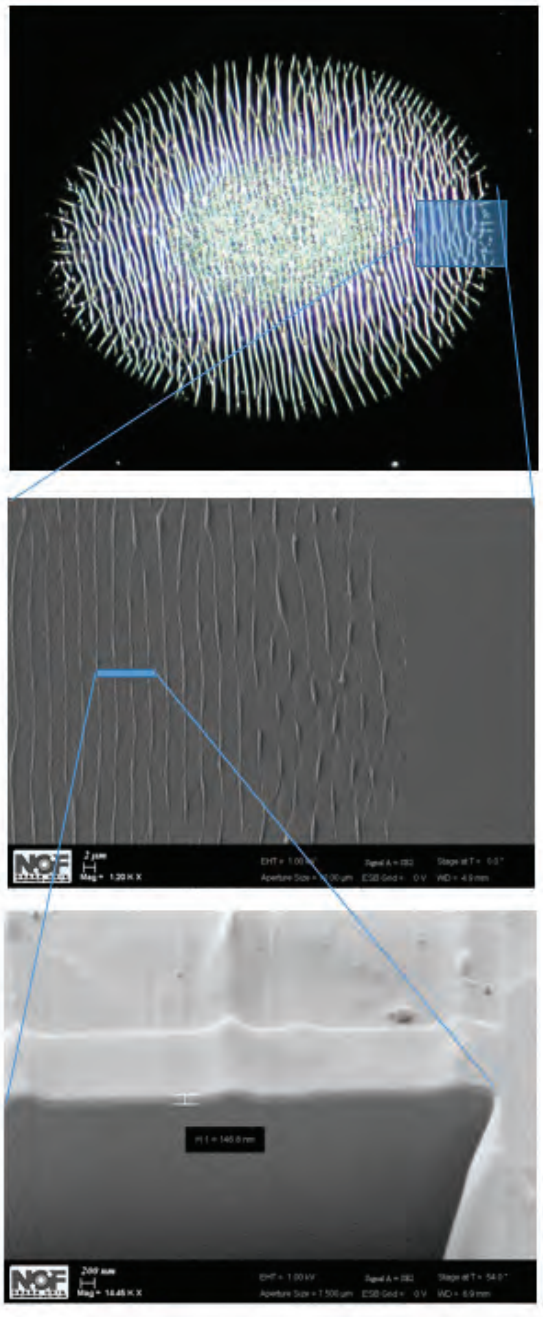


Fig. 1 Optical and SEM images of the LIPSS produced by THz-FEL irradiation (upper and middle) and its cross-section view by FIB (lower).

Research Projects

Irradiation experiments

For the purpose of development of IR laser

experiments, we are trying to execute several types of user experiments. Not only limited in ISIR, but also collaborated experiments with MIR-FEL facilities (KU-FEL in Kyoto University, FEL-TUS in Tokyo University of Science) are planned and now in progress in view of corporation through wide wavelength range of FEL. . The crystalline of amyloid compounds by irradiating of IR FEL has been studied using MIR-FELs and THz-FEL where the wavelength dependence of nonthermal process was discovered. These results are now submitted to an original paper. About THz-FEL in ISIR, the optics and control system are upgraded for the convenience of external users. The time-dependent experiments are possible by introducing high-speed detectors and adequate original programs. For responding to various procedure of irradiation experiments, XYZ stages and high-speed new oscilloscope are controlled by other original programs including pulse number control program. The new collaboration experiments about irradiation effect of film materials has been carried out by Executive Program between Japan and Italy. We also execute experiments about solid state physics which is one of our theme, and the new results about laser induced periodic surface structures induced by THz-FEL irradiation are found. These results have been reported in an original paper and several invited talks in international conferences. Figure 1 shows the cross-section view of LIPSS by FIB irradiation. The stripe of LIPSS comes out several hundred nm convexity shape by SEM observation. We are executing spectroscopic experiments for this microscopic structure to determine the physical properties right now.

Department of Beam Materials Science

Professor:	Takahiro KOZAWA
Associate Professor:	Yusa MUROYA
Assistant Professor:	Kazumasa OKAMOTO (2018.6.1 -)
Specially Assistant Professor:	Ayako NAKAJIMA (2018.8.1 -)
Specially Appointed Professor:	Kazuo KOBAYASHI
Graduate Students:	Satoshi ENOMOTO, Asuka KIMURA, Akihiro KONDA, Miou KARIYA, Teppei YAMADA, Yuta IKARI, Naoki MAEDA
Supporting Staff:	Mitsuru NISHISAKO (2018.4.1 - 2018.9.30), Kinuko WATANABE (2018.10.1 -)

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.

Research Projects

Radiation chemical study of metal oxide nanoparticles

Possessing the high catalytic activity and the high etching resistance, metal oxide nanoparticles are expected to utilize, for example, as a new additive (noble metal oxide nanoparticle) to mitigate corrosive environment in the water-cooled reactor, and as a new resist material (transition metal nanoparticle) in the next generation lithography technique etc. It was recently reported that Pt oxide nanoparticles can be prepared by gamma-ray irradiation upon the suspension without any additives of organic matters (i.e. reductants and dispersants). The fundamental process was studied by a pulse radiolysis and gamma radiolysis method. Both hydrated electron and OH radical were found to play important roles, especially the subsequent pair formation between the reduced- and the oxidized-radical (Fig.1) was pointed out to be a key precursor to the nanoparticle formation. Moreover, radiation-induced reactions of various carboxyl acids, ligands of the metal oxide resist, were systematically studied by ps- and ns- pulse radiolysis techniques, revealing that the reaction mechanism and the radiation sensitivity (electron/hole transfer, and dissociation of the carboxyl groups) are strongly affected by the molecular structure and the ionic form.

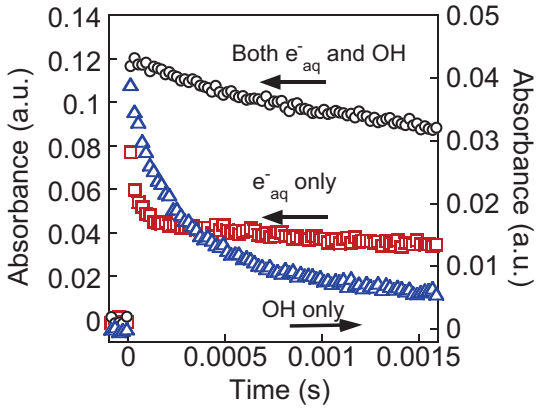


Fig.1. Time behaviors of radicals formed in the suspension of hexahydroxy platinic acid.

Radiation-induced reaction mechanism in phenyl silanes

Organic-inorganic hybrid materials are widely investigated because they have various

functions by mixing organic and inorganic regions in nano- and molecular-size. However the primary radiation chemical processes in this system have not been clarified. In this study, the primary radiation chemical process caused by pulse radiolysis was studied using a solution of polymer in phenylsilane as the hybrid model. The time-resolved transient absorptions was measured at ISIR, Osaka University. Neat liquid phenylsilane derivatives and polymer solutions (polystyrene and polyhydroxystyrene (PHS)) in phenylsilanes were used as the model samples. Fig. 2 shows the transient absorption spectra obtained in the polystyrene solution in trimethoxyphenylsilane (TMeOPhS). In comparison with the results of liquid TMeOPhS, these absorptions were identified as silyl radical, silylene, dimer radical cation, excimer absorption, respectively. The difference of the radiation-induced reaction mechanism between polystyrene and PHS was clarified.

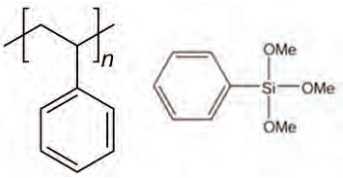


Fig.2. polystyrene/TMeOPhS

Relationship between electron beam irradiation and molecular weight distribution

Currently, lithography technology is required more improvement for miniaturization of electronic devices. In this study, we attempted to optimize the resist material for the improvement of lithography performance. It is hard that all indexes of resist performance are improved. We used 3 types of resist materials with the same chemical structure, ZEP520A (a famous main-chain-scission type resist) and two types of resist with different molecular weight distribution. Some measurements revealed that not only the molecular weight but also the molecular weight dispersion affects the resist performance. ZEP530A was strengthened a weak point caused by the small molecular weight part. The optimization of resist material and developer achieved greater resolution than conventional performance (Fig. 3). This study suggested that the resist material can be optimized by controlling the molecular weight distribution.

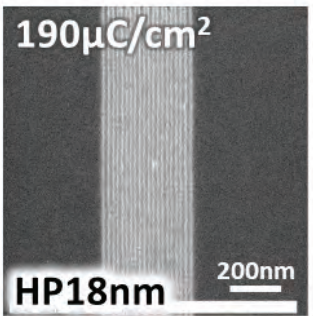


Fig.3. SEM image of L/S with HP 18 nm which achieved by the optimization of molecular weight distribution.

Oxygen Binding Properties of Hemoglobin from Radiotorelance *Ramaazzottius varieoratus*

Tardigrade species tolerate almost complete dehydration and exhibit extraordinary tolerance to various physical extremes such as radiotorelance. We present ligand binding properties of unprecedented globin protein Kumaglobin (KGB) from radiotorelance *Ramazzottius varieoratus* using pulse radiolysis. Fig. 4 shows the structure of KGB and high resemblance to well-characterized Mb. The unusual conformation of distal histidine is stabilized by a hydrogen bond with the carbonyl O atom of alanine. Hydrated electrons (e_{aq}^-) reduced the heme iron of KGB in step (i). Subsequently, the ferrous heme reacted with O_2 to form a ferrous-dioxygen intermediate in step (ii). The intermediate was found to decay with time range of seconds to form the ferric form in step (iii).

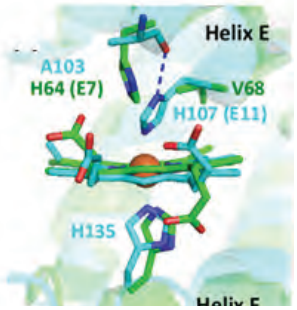


Fig.4. Structural comparison of heme of Kgb and Mb

$$Fe^{3+} \xrightarrow[(i)]{e_{aq}^-} Fe^{2+} \xrightarrow[(ii)]{O_2} Fe^{2+}\text{-}O_2 \xrightarrow[(iii)]{O_2^-} Fe^{3+}$$

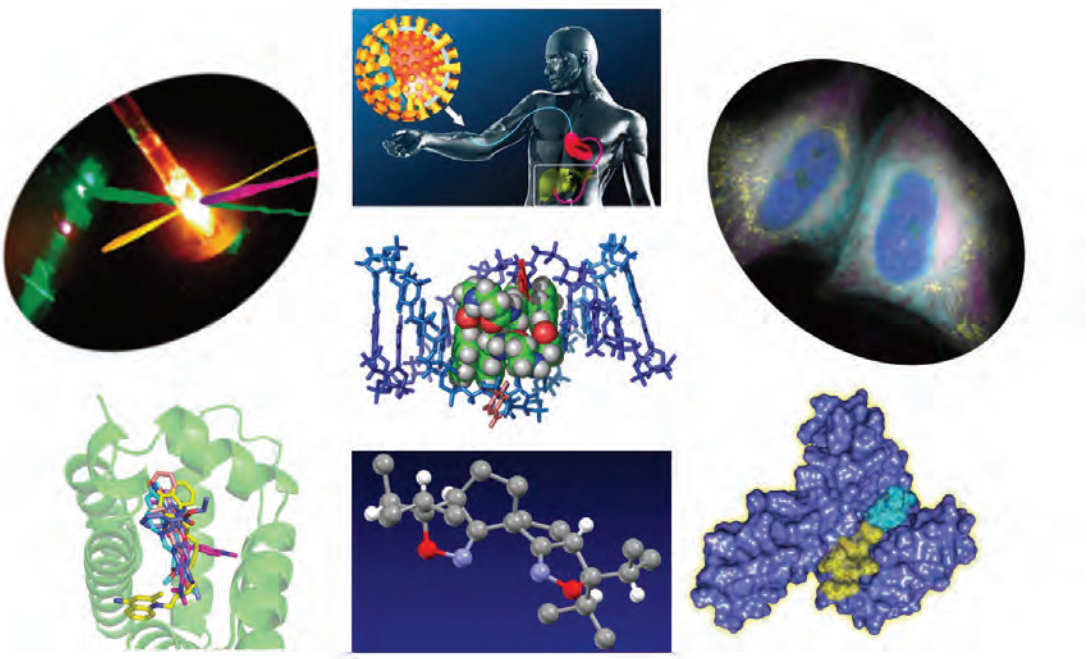
Division of Biological and Molecular Sciences

Outline

This Division consists of Biological Science Group and Molecular Science Group. The Biological Science Group of this departments has 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.

The Molecular Science Group 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.

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



Department of Molecular Excitation Chemistry

Associate Professors: Mamoru FUJITSUKA, Kiyohiko KAWAI
Yasuko OSAKADA (Institute for Advanced Co-Creation Studies)
Specially Appointed Assistant Professor:
Chao LU (-2018.9, Specially Appointed Researcher (-2019.3))
Guest Professors: Mikiji MIYATA, Akira SUGIMOTO
Guest Researchers: Xu Jing (-2018.7), Yan Aihua (-2018.9)
Graduate Students: Xiaowei SHI, Daming RUAN, Jie XU, Jiawei XUE, Yue WANG, Hiroki KAWAKAMI, Haruna KUBO, Bo ZHUANG, Xinxi LI, Shuya FAN, Zeyu FAN, Arisa TANAKA, Zuoyue LIU
Research Student: Zhang Ke (-2018.7)

Outlines

"Molecular excitation chemistry" based on photo- and radiation- induced chemistry of organic and inorganic compounds has been investigated from both basic and application points of view. The following research projects are underway with respect to developments of photo- and radiation-controlled chemistry and bioscience, functional materials, ultra-sensitive analytic and diagnostic methods.

1. Formation and reactivity of higher excited states and excited intermediates.
2. Single-molecule fluorescence measurements to study dynamic motions and reactions of DNA, RNA, and peptides
3. Kinetic analysis based on the control of fluorescence blinking
4. Nanocatalysts for light energy conversion
5. Application of vibrational spectroscopy to radiation chemistry

Research Projects

Chemistry of higher excited states and excited intermediates

We have studied photochemistry of various reaction intermediates for years, because novel reactions are possible due to their higher excitation energies, while systematic information on them is scarce. For this purpose, we have employed the multi-beam irradiation techniques such as pulse radiolysis-laser flash photolysis combined method and two-color two-laser photolysis. These studies have clarified various reaction processes of excited states of short-lived intermediates. Recently, we have systematically studied photoinduced electron transfer processes of excited radical ion species and showed relation to photo-induced carrier in crystalline materials. This year, we investigated electron transfer processes of the excited radical anion in strongly interacted chromophores in dyad molecules. For this purpose, a series of dyad molecules including aromatic imides and xanthene spacer were synthesized. Laser flash photolysis of the reduced dyads revealed fast electron transfer and back electron transfer generating vibrational-excited state. In addition, excited state properties of dications of cycloparaphenylenes (CPP) were examined. Transient absorption spectra due to S_1 state

of CPP^{2+} were confirmed. In addition, it was revealed that larger CPP^{2+} exhibited shorter excited state lifetime because of larger Franck-Condon factors due to smaller S_1-S_0 gap and smaller structural relaxation.

Single-molecule fluorescence measurement

By designing the patterns of fluorescence intensity fluctuation, so called blinking, to be affected by the microenvironment around the fluorescence molecule, we turned various fluorescent molecules into environment-sensitive probes. We developed the **r**edox reaction based **K**inetic **A**nalysis based on the **C**ontrol of fluorescence **B**linking (rKACB method), a general approach to investigating the dynamic motions and association kinetics of molecules at the single-molecule level. By attaching a fluorescent molecule to nucleic acids, we demonstrated that rKACB can be utilized to investigate the structures of nucleic acids (DNA & RNA). We discriminated nucleic acids structures, such as single strand, B-form DNA/DNA duplex, and A-like DNA/RNA duplex by monitoring the blinking patterns. rKACB is also adaptable to investigate antigen-antibody interactions at the single-molecule level.

Nanocatalysts for light energy conversion

In this year, visible light driven photocatalytic activity of a graphitic carbon nitride (g-C_3N_4) for H_2 evolution from H_2O was investigated. In the present study g-C_3N_4 nanosheet (g-C_3N_4-M_xU_y) was prepared from melamine (M) and urea (U) by changing their ratio. It was found that g-C_3N_4-M_1U_2 exhibited higher photocatalytic H_2 production rate and apparent quantum efficiency (AQE). Single particle emission spectroscopy revealed its longer carrier lifetime. Faster trapping rate was also confirmed from time-resolved diffuse reflectance spectroscopy. In addition, long-lived charge separated state was confirmed with Au/TiO_2 mesocrystal system. It was indicated that the hot electrons with energies lower than Schottky barrier height could directly transfer to the defect states via the charge transfer states.

Application of vibrational spectroscopy to radiation chemistry

We have tried to apply time-resolved resonance Raman spectroscopy to the pulse radiolysis in order to obtain information on molecular structure changes during pulse radiolysis. In this year, structural changes upon one-electron reduction of aromatic imides were investigated. It was revealed that the aromatic imides with larger π-electron systems exhibit smaller structural changes. In addition effect of substituent on structural change was also revealed. Namely, electron withdrawing group makes structural change smaller.

Department of Synthetic Organic Chemistry

Professor: Hiroaki SASAI
Associate Professor: Shinobu TAKIZAWA
Assistant Professor: Kazuhiro TAKENAKA (-15.12.2018), Makoto SAKO
Specially Appointed Professor: Hiromichi FUJIOKA
Specially Appointed Associate Professor: Kazuhiro TAKENAKA (16.12.2018-)
Specially Appointed Assistant Professor: Masaru KONDO
Graduate Students: Abhijit SEN (-30.9.2018), Miki KUSABA, Akimasa SUGIZAKI, Kento NAKAMURA, Md. Imrul KHALID, Ankit KUMAR (1.10.2018-), Hettiarachchige Dona Piyumi WATHSALA, Yuki ADACHI, Kousuke KATAOKA, Tomohiro TAKIISHI, Yuki TAMORI, Yuzhao JIANG, Yutaro HANATANI, Keigo HIGASHIDA, Tomohiro FURUKAWA, Naoki MATSUYAMA, Yoshitomo WAKABAYASHI, Linpeng ZHU, Hanseok PARK
International Student: Dinh Dat THANH (17.7.2018-24.8.2018), Lu Meng JIA (17.7.2018-24.8.2018)
Research Student: Chenyang LI (1.9.2018-31.12.2018), Tin Zar AYE (1.10.2018-), Yujia LIAN (1.10.2018-19.2.2019), Xinye ZHU (1.10.2018-31.10.2018), QingyuanTIAN (1.12.2018-)
Supporting Staff: Ayaka HONDA

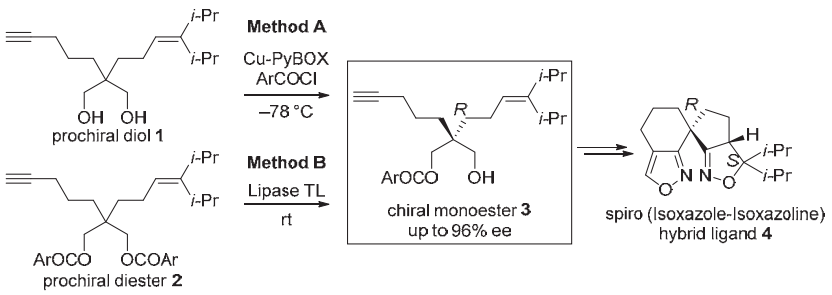
Outlines

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

Research Projects

Enantioselective Synthesis of Spiro (Isoxazole-Isoxazoline) Hybrid Ligand

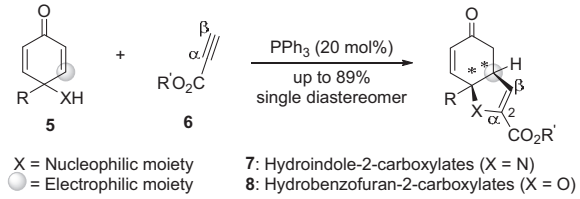
Our group have developed chiral (isoxazole–isoxazoline) hybrid ligands **4** as a robust chiral ligand for Pd-catalyzed enantioselective reactions. However, to obtain enantiomerically pure **4**, a resolution of the racemate **4** by chiral column chromatography was essential. This time, we succeeded enantioselective syntheses of **4** from key intermediate **3** which is prepared by an asymmetric desymmetrization of diol **1** or diester **2**. Thus, Cu(II)-PyBox complex-catalyzed asymmetric desymmetrization of **1** using ArCOCl provided **3** in up to 80% yield with 93% ee. In addition, enzymatic enantioselective hydrolytic desymmetrization of **2** using Lipase TL also afforded **3** in up to 90% yield with 96% ee. Finally, optically pure **4** was prepared from **3** after three transformations and single recrystallization.



Scheme 1 Enantioselective synthesis of spiro(isoxazole-isoxazoline) hybrid ligand.

Facile Synthesis of Hydroindole- and Hydrobenzofuran-2-carboxylates *via* Phosphine-catalyzed Dual Umpolung Domino Michael Reaction

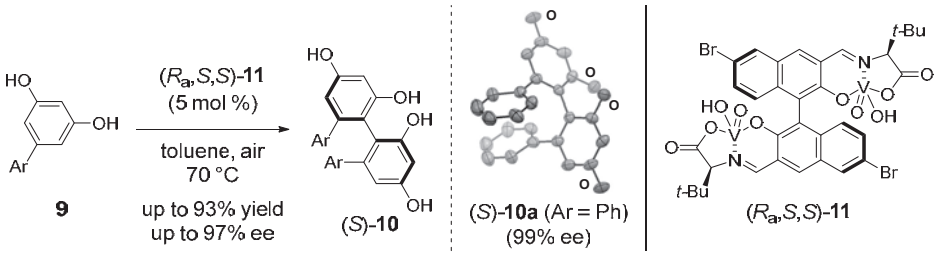
Hydroindoles and hydrobenzofurans having a carbonyl group at the 2-position are often found in natural products and bioactive compounds. Despite the importance of these skeletons, their syntheses have been challenging. Herein, we report the syntheses of hydroindoles **7** and hydrobenzofurans **8** *via* a dual umpolung domino Michael reaction of dienone **5** and alkynyl ester **6**. Thus, the phosphine-catalyzed reaction of **5** and **6** led to highly functionalized **7** or **8** as a single diastereomer in high yield (up to 89%). The obtained product could be easily transformed to a octahydroindole-2-carboxylic acid analogue.



Scheme 2 Facile Synthesis of hydroindole- and hydrobenzofuran-2-carboxylates.

Chiral Dinuclear Vanadium Complex-mediated Oxidative Coupling of Resorcinols

Axially chiral biphenols are one of the most attracted molecules in asymmetric chemistry and medicinal chemistry. Although many efforts have been made to develop their asymmetric syntheses, there are few reports on catalytic and enantioselective oxidative couplings of monocyclic phenols. Herein, we report the highly regio- and enantioselective oxidative coupling of resorcinols **9** catalyzed by dinuclear vanadium(V) complex (R_a,*S*,*S*)-**11**. The reaction of **9** with newly developed complex (R_a,*S*,*S*)-@ under air as the sole co-oxidant provided axially chiral biphenols **10** in up to 93% yield with 97% ee. In this reaction, the use of Cu or Fe catalyst, which is useful for oxidative coupling reaction of 2-naphthols, could not afford the desired product. Optically pure **10a** (Ar = Ph) was readily accessible by single recrystallization of the enantioenriched product. The absolute configuration of **10a** was definitely determined to be (*S*) by X-ray crystallographic analysis.



Scheme 3 Chiral vanadium(V) complex-catalyzed enantioselective oxidative coupling of resorcinols.

Department of Regulatory Bioorganic Chemistry

Professor: Kazuhiko NAKATANI
Associate Professor: Chikara DOHNO
Assistant Professor: Asako MURATA, Tomonori Shibata
Specially Appointed Assistant Professors: Takeshi YAMADA
Postdoctral Fellow: Bimolendu DAS
Guest Researcher: Sanjukta MUKHERJEE
Graduate Students: Jun MATSUMOTO, Yihuan LU, Koichi MIYAGAWA, Russell KOYEAN, Ryo ENOMOTO, Arisa KAWAKITA, Ryo MINAMI, Eitaro MURAKAMI, Yuki YAGI, Tatsumasa OKAMOTO, Junya OKINISHI, Shotaro KOBAYASHI, Yusuke TAKASHIMA, Qingwen CHEN, Shuhei SAKURABAYASHI, Lu NI
Research Assistants: Maki KIMURA, Ayako SUGAI, Yasue HARADA
Supporting Staff: Yuriko YAGUCHI

Outlines

We have studied on ‘‘Chemical Biology’’ and ‘‘Nano-Technology’’ based on synthetic organic chemistry. For chemical biology, we focused our attention on 1) molecular design of synthetic ligands for specific sequence and structure of DNA/RNA, including trinucleotide repeat, and 2) in vitro selection of RNA aptamer binding specific nucleic acid structure. 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.

Research Projects

A mismatch binding small molecule that dimerize only on CGG repeat DNA

Fragile X syndrome is a neurodegenerative disease, caused by excessive elongation of 5'-CGG-3 'repetitive sequences in FMR1 gene. We previously reported a small molecule **NCD** that binds strongly to the GG mismatch in the CGG repeat. In this study, a new DNA binding molecule **NCD-CC** consisting of NCD and a linker with two thiol moieties was developed. **NCD-CC** only undergoes intramolecular cyclization in the absence of CGG repeats, but forms a disulfide dimer that exhibits tighter binding than **NCD** itself only in the presence of target CGG repeats. The concept of this study is expected to be widely applied for repeat disorders in general as well as fragile X syndrome.

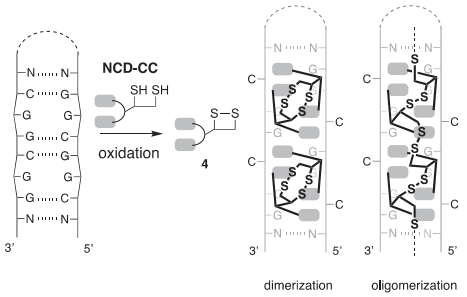


Fig. 1 Dimerization of NCD-CC on CGG repeat DNA

A dimeric 2,9-diamino-1,10-phenanthroline derivative improves alternative splicing in myotonic dystrophy type 1 cell and mouse models

Expanded r(CUG) repeats are the cause of the neurological disorder myotonic dystrophy type 1 (DM1). The pathological features of DM1 include the formation of ribonuclear foci containing expanded r(CUG) repeats, which sequester MBNL1 protein and lead to the misregulation of alternative pre-mRNA splicing. Small molecules that bind to the r(CUG) repeats and improve the alternative splicing have therapeutic potential in the treatment of DM1. We synthesized a novel r(CUG) binding ligand, **DDAP**, that is a covalent dimeric molecule of 2,9-diaminoalkyl-1,10-phenanthroline. **DDAP** can interfere with the binding of MBNL1 to r(CUG) repeats. Studies using a DM1 cell model and a DM1 mouse model revealed that **DDAP** was partially effective in the recovery of the pre-mRNA splicing defects.

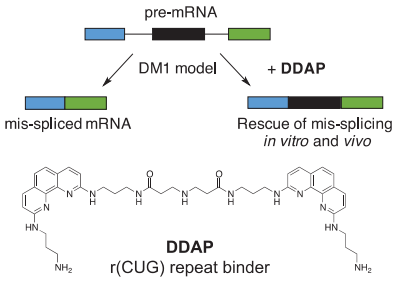


Fig. 2 Improvement of alternative splicing by DDAP

Bicyclic and tricyclic C-C mismatch binding ligands that bind to CCG trinucleotide repeats

Fragile XE syndrome is caused by the expansion of CCG trinucleotide repeats (TNRs) of 5'-untranslated region in FMR2 gene. The expanded TNRs are known to form various non-canonical DNA structures, which may be involved in repeat instability. Small molecules that bind to the non-canonical DNA structures of the expanded TNRs have potentials to modulate the repeat instability and can be a research tool for the study of TNR instability. In this study, we evaluated the binding of C-C mismatch binding ligands (**Am-ND** and **Am-BzND**) to CCG TNRs. The CCG TNRs adopt hairpin structures containing CCG/CCG motif. We confirmed the binding of **Am-ND** and **Am-BzND** to CCG TNRs by T_m measurements, CD spectra and surface plasmon resonance assay. The CD spectra of CCG TNRs in the presence of **Am-BzND** showed marked spectral change, indicating that the binding of **Am-BzND** to CCG TNRs induced large conformational change.

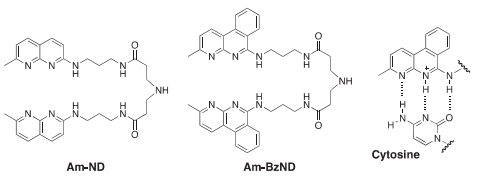


Fig. 3 Chemical structure of **Am-ND** and **Am-BzND** and hydrogen bonding between **Am-BzND** and cytosine

Regulation of ribosomal frameshifting by synthetic small molecules

Programmed –1 ribosomal frameshifting (−1PRF) is a recoding mechanism to make alternative proteins from a single mRNA transcript. − 1PRF is stimulated by two cis-acting signals in mRNA, a seven-nucleotide slippery sequence (XXXYYYZ) and a downstream pseudoknot structure. The pseudoknot impedes the movement of the ribosome along the mRNA and stalls the ribosome precisely on the slippery sequence, which stimulates a backward shift by one nucleotide. The ribosome resumes decoding by unfolding the pseudoknot structure to translate a –1 frame. In this study, we engineered the frameshifting pseudoknot to respond to our rationally designed small molecules NCTn. We demonstrate that NCTn can stabilize the pseudoknot structure in mRNA by binding their target sequence CGG/CGG and activate –1PRF both in vitro and in human cells.

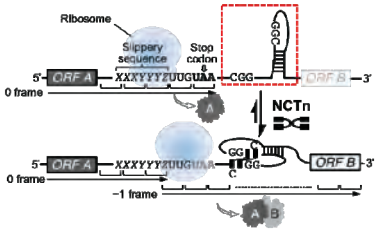


Fig. 4 Ribosomal frameshifting by small molecules

Department of Organic Fine Chemicals

Assistant Professor: Yusuke HIGUCHI
Specially Appointed Researcher: Hajime NITTA
Technical Assistant: Hiroyo MATSUMURA

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 molecules that potentially modulate protein-protein interactions. We also develop a screening system for a sphingosine-1-phosphate efflux protein, SPNS2.

Research Projects

Rationally Designed Semisynthetic Natural Product Analogues for Stabilization of 14‐3‐3 Protein‐Protein Interactions

The natural product family of fusicoccanes are stabilizers of 14‐3‐3 mediated protein‐protein interactions (PPIs), some of which possess antitumor activity. In this study, the first use of molecular dynamics (MD) to rationally design PPI stabilizers with increased potency is presented. Synthesis of a focused library, with subsequent characterization by fluorescence polarization, mutational studies, and X‐ray crystallography confirmed the power of the MD‐based design approach, revealing the potential for an additional hydrogen bond with the 14‐3‐3 protein to lead to significantly increased potency (Figure 1) Additionally, these compounds exert their action in a cellular environment with increased potency. The newly found polar interaction could provide an anchoring point for new small‐molecule PPI stabilizers. These results facilitate the development of fusicoccanes towards drugs or tool compounds, as well as allowing the study of the fundamental principles behind PPI stabilization. [Original Paper 3]

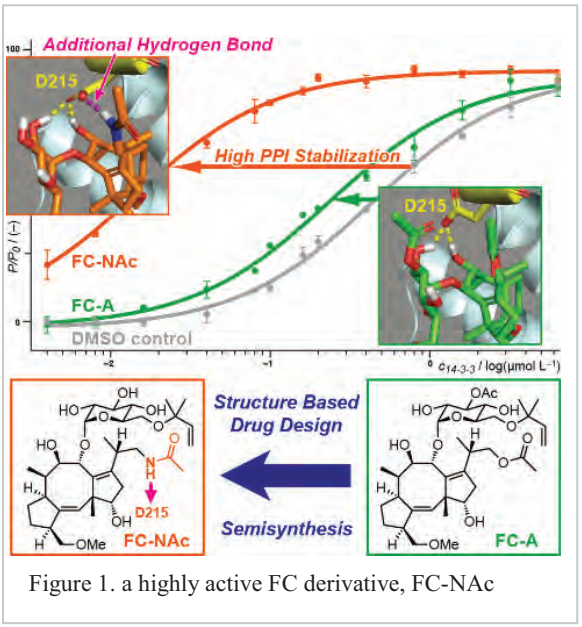


Figure 1. a highly active FC derivative, FC-NAc

Department of Biomolecular Science and Reaction

Professor: Shun'ichi KURODA
Specially Appointed Associate Professors: Syuji HINUMA (1.4.2018-)
Associate Professor: Toshihide OKAJIMA, Yoh WADA
Specially Appointed Associate Professors: Kazuki OKAMOTO
Assistant Professors: Kenji TATEMATSU, Masaharu SOMIYA
Specially Appointed Researchers: Yumi YUKAWA, Minami TAKAI
Research Students: Qiushi LIU (-31.3.2019), Fei TENG, Hao LI, Toshinori OOZEKI, Kazuyo FUJITA, Masahiro NAGAMORI (-31.3.2019), Kanako SAKAEDA (-31.3.2019), Yuusuke KOBAYASHI (-31.3.2019), Satoshi KANAGAWA (-31.3.2019), Yasushi SASAKI (-31.3.2019), Yuki YAMADA (-31.3.2019), Miyo NAKAMURA (-31.3.2019), Takuya YUKUTAKE (1.4.2018-)
Supporting Staffs: Mayuko MURAI

Outlines

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

Research Projects

Identification of novel heparin-binding domain in envelope protein of hepatitis B virus

Hepatitis B virus specifically infects to human hepatic cells by utilizing two different cellular receptors such as sodium taurocholate cotransporting polypeptide (NTCP) and heparan sulfate proteoglycan (HSPG). NTCP-binding domain in the HBV envelope protein was recently discovered, whereas HSPG-binding domain was not fully understood. We synthesized various peptides based on the pre-S1 sequence and conjugated on the liposome (Fig. 1). Then, we compared the

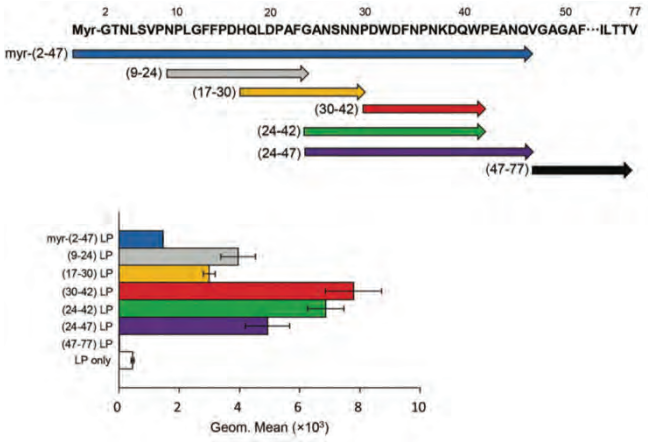


Fig.1 Cellular uptake of heparin-binding protein-displaying liposome.

cellular binding and uptake of peptide-conjugated liposomes in human hepatic cell HepG2. When the peptide corresponding to from 30 to 42 amino acid sequence of pre-S1 was conjugated on the liposomes, the cellular uptake of liposomes was significantly enhanced, suggesting that this domain may contribute to the cellular uptake of HBV by HSPG-dependent manner. Furthermore, the cellular uptake of pre-S1 (30-42) peptide-liposomes was significantly reduced in the presence of heparin. These results indicated that pre-S1 (30-42) is useful to deliver drugs in the liposomes by binding to the HPSG on cell surface.

Membrane Dynamics and Mechanism of Endocytosis

Endocytosis is a cellular function by which living cells actively modulate components of cell surface, extracellular milieu, as well. This fundamental biological process connects the internal and external environments constituting a major path delivering foreign materials into cytoplasm inside the cells, therefore it is highly pertinent issue to drug delivery systems and also to virus/bacterial infection. However, precise roles of endocytic dynamics, especially in multicellular context, have remained to be elucidated.

Like in the other membrane dynamics, the late stages of endocytosis around late endosomes are regulated by a small GTP-binding protein Rab7. We developed a genetically modified mouse in which the Rab7 locus could be deleted by spatially and temporally regulated manner. Most recently our colleagues and we found that the rab7 regulates the oriented movement of the late endosomes [refs, Sato et al 2018; Matsumoto et al, 2018]. We have shown that the rab7 function is required for at the very early stage of embryogenesis. The rab7-deficient embryos are unable to develop beyond the gastrulation due to lack of proper organization of mesodermal tissues. This defect in embryogenesis is however, not associated to the loss of rab7 in epiblast itself from which the mesoderm delivers. Deletion of the *rab7* function only in visceral endoderm (VE) surrounding the epiblast was sufficient to cause abnormal mesoderm patterning. VE is highly active in endocytosis and delivering nutrients and signals from maternal circulation to embryo proper. We found that VE internalizes Dkk1, an antagonist for Wnt signaling, from the extracellular space to endocytic compartments in VE cells, whereas the rab7-deficient VE fails to do so, exhibiting an accumulation of DKK1 between VE and embryo proper and attenuation of the Wnt signaling in embryos. These findings suggest that the rab7-dependent endocytosis regulates tissue patterning and morphogenesis by promoting the canonical Wnt signaling by cancelling its antagonism in the early embryogenesis.

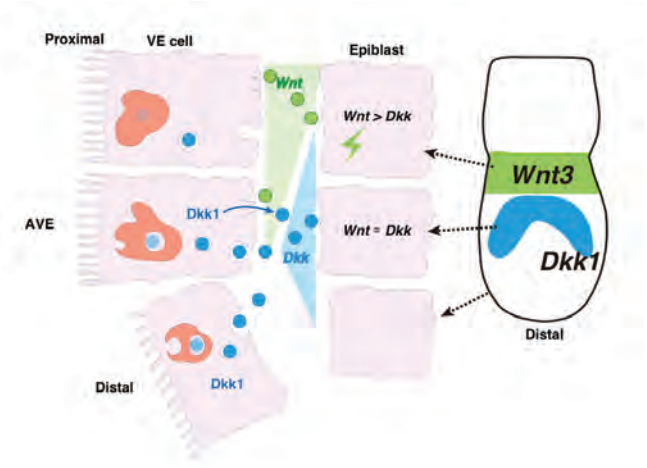


Fig.2 Endocytic pathway is essential for proper spatiotemporal patterning of the canonical Wnt signaling through endocytic cancellation of the antagonist Dkk1 from the extracellular space between visceral endoderm (VE) cells and epiblast.

Department of Biomolecular Science and Regulation

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Assistant Professors: Seiji YAMASAKI, Mitsuko HAYASHI-NISHINO
Specially Appointed Assistant Professor: Martijn ZWAMA
Postdoctoral Fellows: Shoko NISHI, Katsuhiko HAYASHI, Iwao NISHIMURA
Graduate Students: Ami YAMAGISHI, Kaori NAKAO
Under Graduate Student: Kazushi UCHIDA, Naoki KOGA, Tsunami TOKUMITSU, Sohei NAKANO, Ken WISE
Guest Professor: Yoshimi MATSUMOTO
Supporting Staffs: Aiko FUKUSHIMA, Iwao NISHIMURA, Sumie MATSUOKA, Chiharu TOTTORI

Outlines

Xenobiotic transporters are widely distributed in living organisms and play important roles in their self-defense mechanisms. Transporters cause a serious chemotherapeutic problem named multidrug resistance in pathogenic bacteria and cancer cells. Recent discoveries also support the notion that some xenobiotic transporters have shown to have important roles in bacterial virulence and signal transduction. We are interested in understanding roles xenobiotic transporters in multidrug resistance and physiological functions. Our knowledge should promote the development of novel inhibitors or strategies that could counteract the contribution of xenobiotic transporters to drug resistance and virulence.

Research Projects

Gut Instinct: Bile Acid-Triggered Bacterial Adaptation Characterized

When bacteria enter the digestive tracts of their hosts, including humans, they encounter a highly acidic environment. Bacteria have evolved elegant mechanisms to survive and colonize this habitat, such as highly resistant and impermeable outer membranes and systems to pump out any toxins that make it beyond that barrier. However, the molecular mechanisms behind many of these processes have remained unclear.

As part of an international effort, a research team centered at ISIR of Osaka University has revealed how *Salmonella* bacteria use a protein

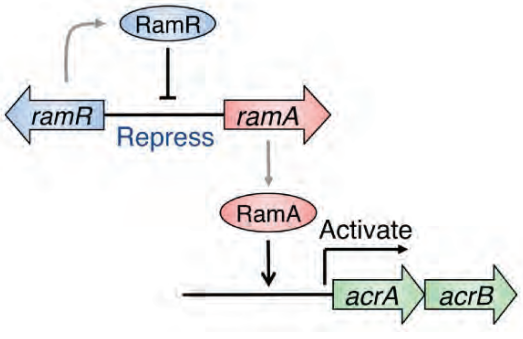


Figure 1: Model for the gene regulatory pathway by RamR. RamR represses the *ramA* gene, which encodes a protein that activates *acrAB* drug efflux pump genes. RamR binds to the region between the *ramR* and *ramA* genes, while RamA binds to the upstream region of *acrAB*.

called RamR to sense the presence of bile acids in their surroundings. This induces a cascade of events that help the bacteria to adapt to the difficult conditions in the gut.

In this work, reported in the journal *Scientific Reports*, the team first analyzed a regular strain of *Salmonella* and one in which RamR had been deleted. As it was already known that RamR represses the expression of the gene RamA, which is linked to the export of substances from bacterial cells (Figure 1), we compared RamA expression in the two sets of bacteria upon exposure to different types of bile acid. The results showed that two particular bile acids common in the gut caused dramatic increases of RamA expression in the regular *Salmonella*, but not in the RamR mutant.

We already knew that *Salmonella* starts to express many genes when reaching the gut, but these findings clearly showed that RamR is a key part of its adaptation. We then used surface plasmon resonance analysis to show that RamR binds directly to the primary bile acids cholic acid and chenodeoxycholic acid.

To obtain more details about this binding and its downstream effects, we then determined the crystal structures of RamR when bound to each of these acids. In these complexes, they identified the formation of hydrogen bonds and the associated uncoiling of an alpha-helix domain in RamR, both of which are novel binding mechanisms for this protein (Figure 2).

When RamR is bound in this way, it loses some DNA binding affinity and can no longer repress its RamA target. This leaves the RamA protein free to activate the AcrAB-TolC efflux system, which pumps damaging substances out of bacterial cells and helps them to survive in the small intestine and gallbladder."

These findings about RamR suggest that it could be a good target for developing new treatments against infections of gut bacteria or for rebalancing the bacterial population in the gut to ensure better intestinal function.

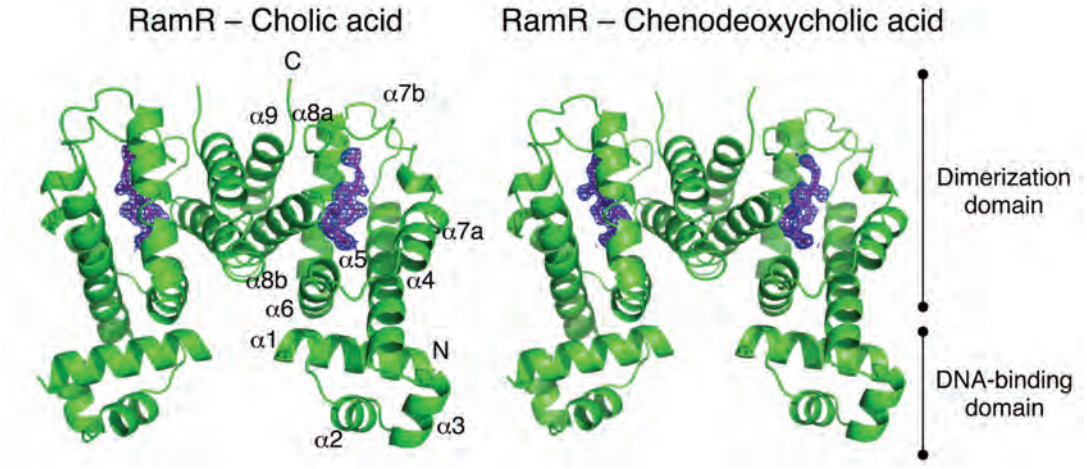


Figure 2: Full structure of the RamR dimer with two molecules of cholic or chenodeoxycholic acid. Both compounds were completely enclosed in the binding pocket of RamR. Both cholic and chenodeoxycholic acids form four hydrogen bounds with RamR.

The article "Crystal structure of the multidrug resistance regulator RamR complexed with bile acids" is published in *Scientific Reports* at DOI: https://doi.org/10.1038/s41598-018-36025-8.

Department of Biomolecular Science and Engineering

Professor: Takeharu NAGAI
Associate Professor: Tomoki MATSUDA
Assistant Professors: Mitsuru HATTORI, Kenji OSABE (16/10/2018-)
Specially Appointed Associate Professor: Tetsuichi WAZAWA
Specially Appointed Assistant Professors: Megumi IWANO (-15/9/2018), Tetsuyuki ENTANI
Specially Appointed Researchers: Tomomi KAKU, Takahito ONISHI, Kai LU, Takashi KANADOME
JSPS Fellowship Researcher: Michael SHANNON (-31/1/2019)
Visiting Researcher: Syo SATO
Graduate Students: Yemima Dani RIANI (-30/9/2018), Hajime SHINODA, MD. Nadim HOSSAIN, Quang TRAN, Israt FARHANA, Taichi KIMURA, Masanori TSUJI, Yoshimasa IKE, Syusaku UTO, Yuhei OGAMI, Eunike Priscilla TANIO, Nae SUGIURA, Zhai LE
Under Graduate Students: Kousuke NOGUCHI, Yukino ITO, Ryosuke NAKATANI, Yoshihiro YONEOKA
Research Student: Xue PENG (1/10/2018-), Chaochen KANG (1/10/2018-)
Supporting Staffs: Kazuyo SAKAI (1/10/2018-), Yuko MORIMOTO (1/10/2018-), Hiroko INOUE

Outlines

When looking at the phenomena of life, it is often fund that the appearance of a small number of elements (proteins, protein complexes, or cells), which are rarely found, becomes a nucleus and causes a discontinuous change in the ork of the whole multi-element system. However, the mechanisms by which they occur are poorly understood due to limitations and/or lack of development of analytical techniques. In our research field, we are developing biomolecule visualization technology based on genetic engineering as a means to solve these problems. In addition to live visualization of the behavior of individual molecules and cells by releasing intracellular molecular spies to various parts of cells and tissues, techniques are being developed to visualize the flow of intracellular signals, such as changes in the state of proteins responsible for intracellular signal transduction and intracellular ion concentration as well as to manipulate them. By making full use of these technologies, we are also promoting research that will open up a new field of study called “singularity biology” which will approach life phenomena caused by a small number of rarely found cells. Furthermore, with the aim of realizing a next-generation ultra-energy-saving society, we are developing plants that emit light in multiple colors with high luminosity.

Research Projects

Development of low affinity Ca^{2+} sensor using bioluminescent protein

In this study, we developed a low-affinity cyan bioluminescent Ca^{2+} sensor CeNL (Ca^{2+}), which can perform imaging in the endoplasmic reticulum (ER) with high Ca^{2+} concentration by replacing the fluorescent protein of FRET acceptor with a different color and introducing mutations into the Ca^{2+} sensing domain in GeNL(Ca^{2+}), a conventional

bioluminescent Ca^{2+} sensor [1,2]. We also developed an orange bioluminescent Ca^{2+} sensor, OeNL(Ca^{2+}), which has an intermediate affinity between the cytosol and endoplasmic reticulum (Figure 1). By multicolor bioluminescence imaging using high affinity GeNL(Ca^{2+}), medium affinity OeNL(Ca^{2+}) and low affinity CeNL(Ca^{2+}), changes in Ca^{2+} concentration in the nucleus, cytoplasm and ER with different Ca^{2+} concentration ranges were successfully observed in single cells (Figure 2). Multi-color, multi- Ca^{2+}-range bioluminescence imaging with these sensors is expected to contribute to the elucidation of Ca^{2+}-mediated communication between organelles.

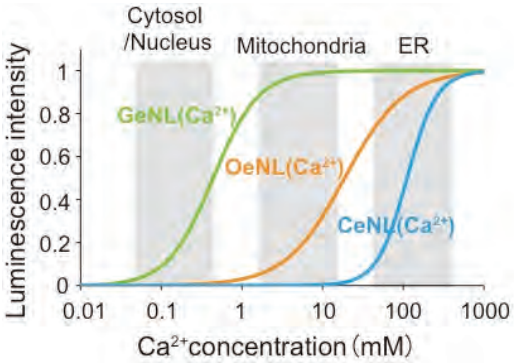


Fig.1 Ca^{2+} titration curves of eNL (Ca^{2+}) with different Ca^{2+} affinities and emission wavelengths.

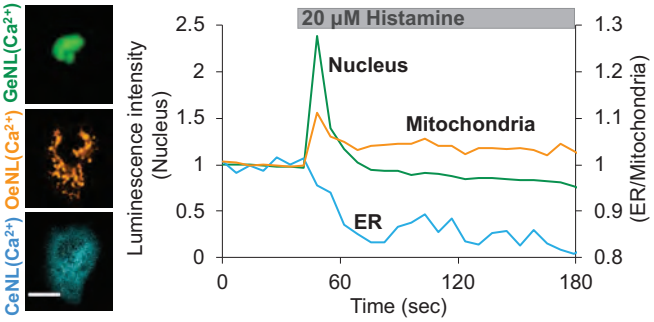


Fig.2 (Left) An eNL (Ca^{2+}) affinity-color mutant localized in each intracellular organelle. Scale bar: 10 μm. (Right) signal changes in each organelle.

Monomeric green fluorescent protein that inactivates proteins and cells by light irradiation

A green mutant SuperNova Green (SNG) was developed based on the existing photosensitized red fluorescent protein SuperNova (SNR) [3]. SNG showed that superoxide and its derivatives were mainly produced among reactive oxygen species by blue light irradiation, and no significant production was observed for singlet oxygen. We also showed that photosensitization by light stimulation using SNG caused functional destruction of PH domain of phospholipase C and induction of cell death in HeLa cells. Furthermore, in order to demonstrate the potential application of the spatiotemporal control of two components, we successfully induced functional disruption or cell death in individual proteins or cells when combined with SNR, which produces reactive oxygen species by green light irradiation (Figure 3). SNG opens up possibilities for the application of photosensitized fluorescent proteins, and it is hoped that the spatiotemporal destruction of multiple components will lead to the elucidation of new physiological mechanisms for various phenomena.

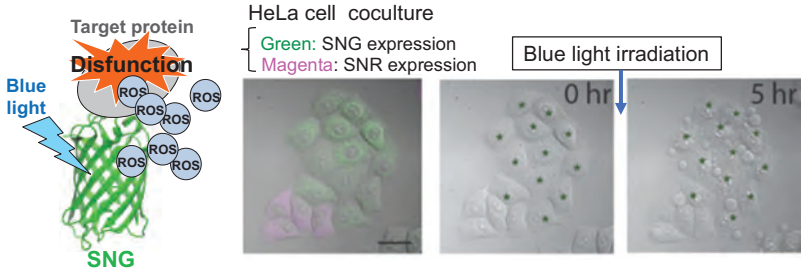


Fig.3 (Left) Schematic diagram of the disruption of SNG protein function wavelengths. (Right) blue light irradiation (~ 4W/cm^2, 2 min) to the SNG/SNR-expressing HeLa cell co-culture system induced SNG-expressing cell death specifically. Scale bar 20 μm

[1] Suzuki et al., Five colour variants of bright luminescent protein for real-time multicolour bioimaging, Nat. Commun., 7, 13718, 2016

[2] Tiwari et al., A fast- and positively photoswitchable fluorescent protein for ultralow-laser-power RESOLFT nanoscopy Nat. Methods, 12, 515-518, 2015

[3] Lu-Walther et al., Nonlinear structured illumination using a fluorescent protein activating at the readout wavelength PLoS ONE, 11, e0165148, 2016

Division of Next Industry Generation

Outline

This research division was established in October 2006 and is composed of two research departments. The goal of this division is to provide advances in science and technology via close relationships with industry, which will lead to create a novel industry in the 21st century.

The departments are:

-Department of New 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 Translational Datability

Professor:	Yasushi SAKURAI
Associate Professor:	Yasuko MATSUBARA
Phd Students:	Takato HONDA (Special Research Student), Koki KAWABATA
Secretary:	Yukako MIYATAKE (1.7. 2019-)

Outlines

In recent years, with the rapid global spread of IoT devices, there has been a growing demand for new, high-quality services created by managing and analyzing various kinds of IoT big data streams. Two major goals of this project are to develop fundamental technologies for the real-time modeling and forecasting of IoT big data streams, and to industrialize social optimization service. We will also focus on transferring technology to industry. Our overall aim is to contribute to revitalization and innovation as regards industrial activity in Japan by applying our advanced time-series big data analysis technologies to various societal challenges.

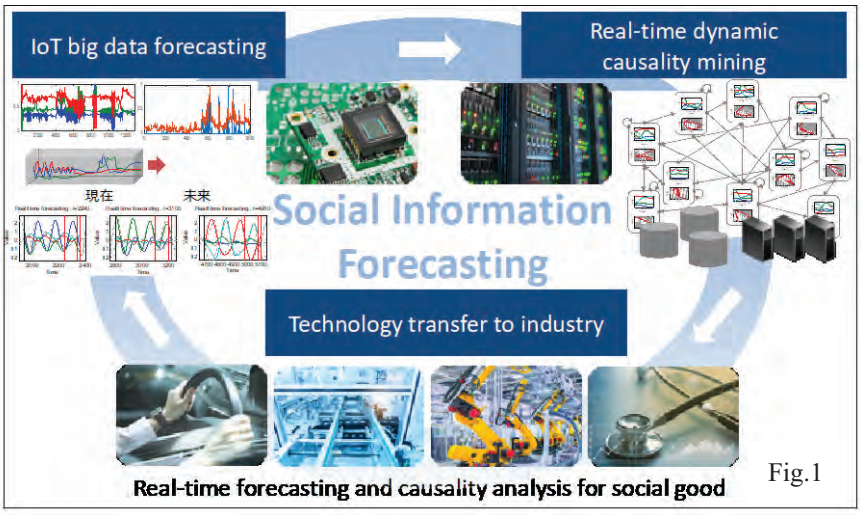
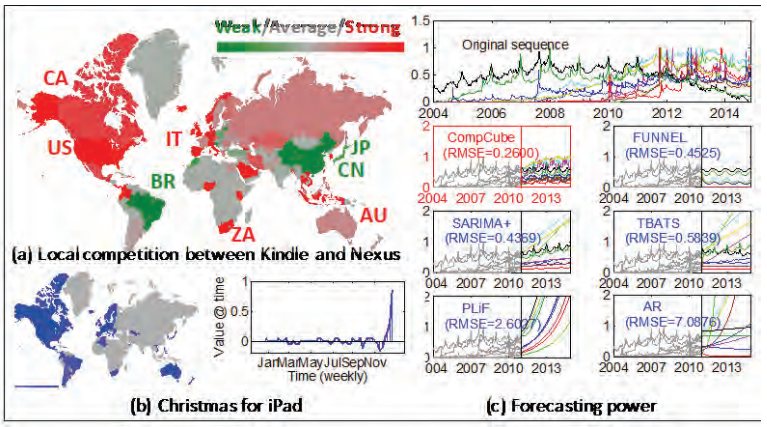


Fig.1

Research projects

Non-linear tensor analysis for complex time-stamped data

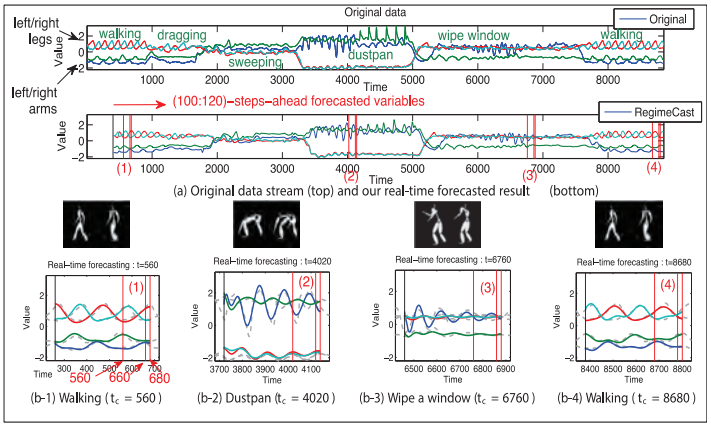
We have developed a new, powerful, multi-aspect modeling technique that can capture important patterns and latent interactions in a large collection of complex time-stamped data. CompCube (WWW2016) is a unifying non-linear, multi-aspect analytical model that provides a compact and powerful representation of complex time-stamped events: (a) basic trends and non-linear dynamics of co-evolving activities, (b) latent interaction, (c) seasonality, and (d) anomalies and unrepeated local events. Thanks to its concise but effective summarization, it can also forecast long-range future activities.



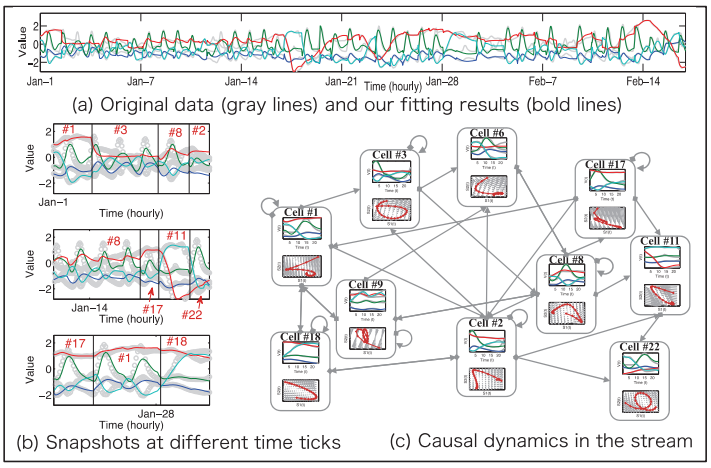
In real-world applications, such as advanced driver-assistance services and smart manufacturing systems, a large amount of time-stamped data is generated by cameras, sensors, wireless tools and other IoT devices. For example, automobile data includes basic information (e.g., vehicle type, driver's ID), numerical and continuous data streams generated by IoT devices (e.g., velocity, acceleration rate, yaw rate), and also a set of time-stamped discrete events (e.g., turn indicators, brakes, and hybrid controllers). We intend to extend this state-of-the-art technique, and develop powerful and practical technologies for the real-time modeling and forecasting of IoT big data streams.

Real-time forecasting and dynamical causality analysis for IoT data streams

In practice, real-life IoT data streams contain various types of distinct, dynamic evolving patterns of different durations. For example, assume that we have multiple automobile sensors (e.g., accelerometers) that generate multi-dimensional co-evolving event entries every millisecond. We would like to forecast future events, efficiently and effectively (e.g., to prevent traffic accidents). The ideal algorithm should identify any sudden discontinuity in an event stream, and immediately recognize the current dynamical patterns and trends, so that it can forecast future events adaptively at any time. We introduced RegimeCast (KDD 2016), which is an adaptive and effective algorithm for forecasting co-evolving data streams. Our method can identify important dynamical patterns and forecast long-range future events, incrementally and automatically.



In practice, real-world IoT data streams contain various types of distinct, dynamic evolving patterns (e.g., social user behavior, environmental conditions and the operational status of buildings and factories), and these activities are closely related to various kinds of natural and social phenomena. We have introduced OrbitMap (KDD 2019) to capture the dynamics of time evolution. In this project, given such a large collection of IoT data streams, we would like to find "dynamic causality" (i.e., a time-evolving cause-effect relationship) between multiple natural and social phenomena. The figure shows our experimental results on environmental sensor streams. (a) Our model fits the original data very well, and (b) it automatically identifies typical time-evolving patterns and their cut points; (c) It also reveals latent dynamical interactions (namely, dynamical causal chains) between time-evolving patterns. Based on this approach, we will develop a new technology, namely, real-time dynamic causality analysis, which can automatically and efficiently identify current important dynamical patterns and cause-effect relationships, so that we can detect signs of potential accidents or trouble (e.g., emergency braking and equipment failures in smart factories).



Department of New Industry Generation System

Specially Appointed Professor: Mototsugu OGURA

Outlines

On July 3rd 7th imec Handai Interantional Symposium was held at imec Leuven, Belgium,with professor Jo De Boeck,CTO&executive vice president imec, and professor Katsuaki Suganuma, director ISIR.

The pre-award meeting, for 1st medical department & ISIR workshop held on January 26th, was held between professor Kaneda, director of medical department, professor Suganuma, director of ISIR, professor Matsumoto, where COI collaborative topics were introduced, then periodical workshop was decided to be continued constructively.

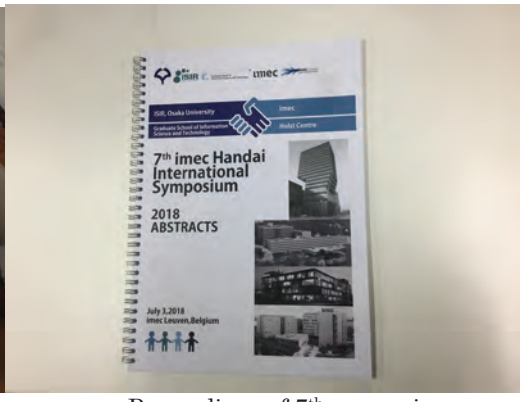
In pararell, in Osaka univ. COI(Center of Innovation) program, the collaboration agreement were currently contracted between 29 companies and 17 research academia, then " Fostering of super-Nipponjin by human power activation" development has been going well under one roof followed by 7th Handai COI symposium(open) held at Iino Hole, Tokyo on October 2, by Wearable EXPO 2019 at Tokyo Big Sight during January 16 to 18, where wearable devices demonstarted were quite popular for implementation, and by 2018 annual meeting(closed) as the final year of phase 2 period.

Research Projects

- **7th imec HandaiInternational conference were held at imec Leuven, Belgium on July 3rd last year.**

Coincidently, the world soccer game between Belgium and Japan was held in the evening of the previous day, then quite exciting in the city.This conference was composed of two kerynote speech by professor Jo De Boeck, CTO&executive vice president and professor Katsuaki Suganuma, director of ISIR, and 4 oral session/17 presentation. Topics of informal processing, quantum devices, flexible, organic electronics and bioelectrinics , life science were presented mutually, and tight collaboration friendship were shared and being established towards our future.

Friendly meeting with imec executives



Proceedings of 7th symposium

Dinner of Osaka Univ. participants

Main buildings of imec

Group photo in 7th imec Handai International Symposium

Department of Intellectual Property Research

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

Outlines

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

We have continued a consignment study [(1) Developmental study for new element technologies to enable the value adding of natural materials] and have gained a new external grant of consignment study [(2) Development of the vitality states of plants] and a new research grant [the Japanese Society of Eucommia / 14th research grant (project members)]. These empirical studies were carried out.

Research Projects

University-Industry Collaboration of New Business Fields

We have conducted the following university-industry collaboration projects.

-New element technologies to enable the value adding of natural materials
-Symposium on functional foods

Intellectual Property Seminar

The intellectual property seminar was held at ISIR on Sep.13, 2018. Prof. Hiroki Naito of Osaka Institute of Technology gave a lecture entitled “Strategies for using intellectual property in the IoT era”

New Element Technologies to Enable the Value Adding of Natural Materials

In order to develop applicable technologies for resolving social and environmental problems, researches of the promotion of plant growth, a development of the methods for analyzing plant vitalities, and an exploratory research of functional food components by using microorganisms, were carried out.

Fig.1 Practical tests of new hydroponic-cultivation system

Fig.2 Symposium on functional foods

-New hydroponic-cultivation system using scrap glass was developed, and the technology was practically tested for various plants.
-The elemental technologies for nondestructive and quantitative verification were developed by combining the water content and physical characteristics of plants.
-The research on the new methods for generating new functional components from Eucommia was carried out by using microbial enzymes.
-An academic symposium was held on Nov. 16, 2018 to introduce the achievements of academia-industry collaboration in functional-food field.

Categorization of water in rivers, lakes and reservoirs using Oxygen and Hydrogen Isotopic Ratios

As a useful methodology development for tracing the source of water, which is the base element that makes up natural materials, an empirical analysis regarding categorization of water using "the existence ratio of hydrogen and oxygen isotopes contained in natural water" and specific aquatic environmental samples was performed. The water isotope ratio of water existing on the surface of the Earth varies depending on various factors such as changes in evaporation speed due to changes in isolation, and fluctuation of rainfalls, so the oxygen and hydrogen stable isotope ratio comparison analysis that utilizes this characteristic to categorize the source of water in rivers, lakes and reservoirs is being recognized globally as has not been established as a method. However, by using this method, it is possible to indirectly contribute to the production improvement of vegetation by categorizing water that flow into farmlands, lakes and reservoirs.

In particular, we have conducted water samples analysis research based on lake water samples from Laguna de Bay in the Philippines, one of the largest landside lake in Asia. Our research results were first time in the world to map the categories of waters around the vast Laguna de Bay only by the stable isotope ratio sample data, and was able to clarify that the Laguna de Bay, which is almost closed (waters flow in from surrounding rivers, but there is only one river that lets these waters flow out), is strongly influenced by rain water and evaporative concentration.

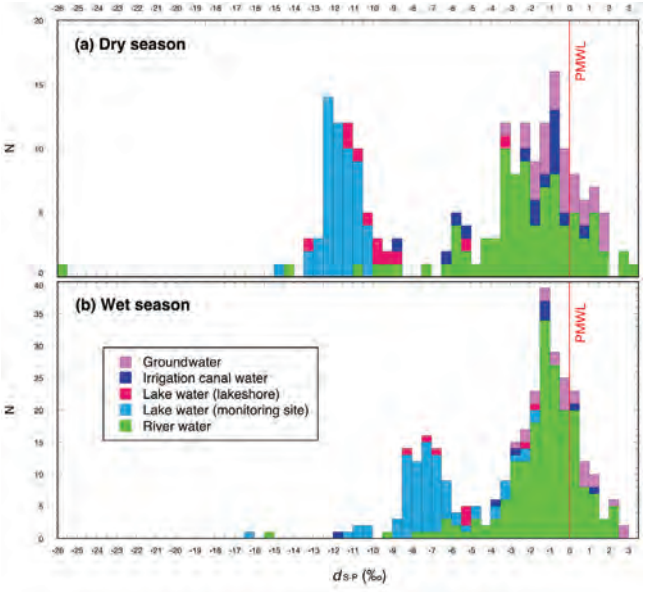


Fig3. Water categories analysis results in Laguna de Bay, Philippines

Laboratory of Cell Membrane Structural Biology

Specially Appointed Professor: Akihito YAMAGUCHI
Specially Appointed Associate Professor: Ryosuke NAKASHIMA
Supporting Staff: Kimie KITAGAWA

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.

Research Projects

Multiple entry pathways within the efflux transporter AcrB contribute to multidrug recognition.

AcrB has multiple entry pathways, the membrane surface entrance channel 1 (CH1) and periplasmic entrance channel 2 (CH2), and two multisite drug-binding pocket named the proximal binding pocket (PBP) and the distal binding pocket (DBP). From these channel, drugs can move to a voluminous multisite drug binding pocket within the AcrB monomer, from where the drugs are extruded through a top-open funnel. A glycine-rich swinging loop is located between the PBP and DBP. This loop acts as a swinging valve during the translocation of drugs from the PBP to the DBP by a peristaltic motion. In this year, we reported an additional third channel (CH3) open to the central cavity within the AcrB trimer. The importance of CH1 and CH2 is revealed by site-directed mutagenesis studies, while there was yet no experimental evidence for CH3. It therefore appeared that RND-type exporters have multiple drug-binding pockets as well as multiple drug translocation pathways. However, the significance of the existence of multiple entrances had not been clearly established. We provide evidence for a specific entry channel from the central cavity and show that this channel (CH3) is directly connected to the DBP and bypasses the PBP and the switch-loop. We show that CH3-preferring drugs can be characterized by their chemical structure and are transported non-competitively with the other CH1 and CH2-preferring drugs (Nature Communications, 9(124), 1-9, 2018).

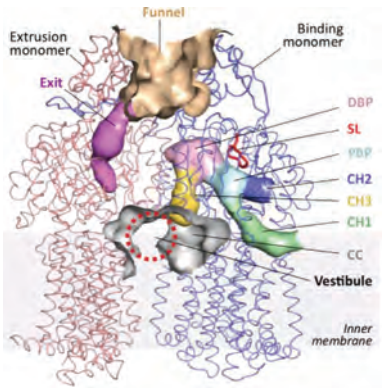


Figure 1. The three main supposed channels for AcrB.

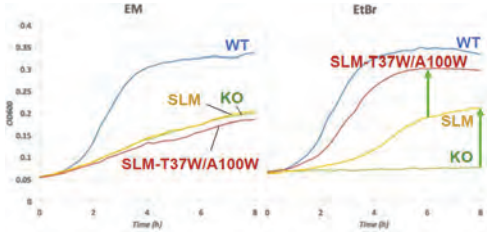


Figure 2. The effect of drugs on the export activity of the switch-loop mutant (SLM).

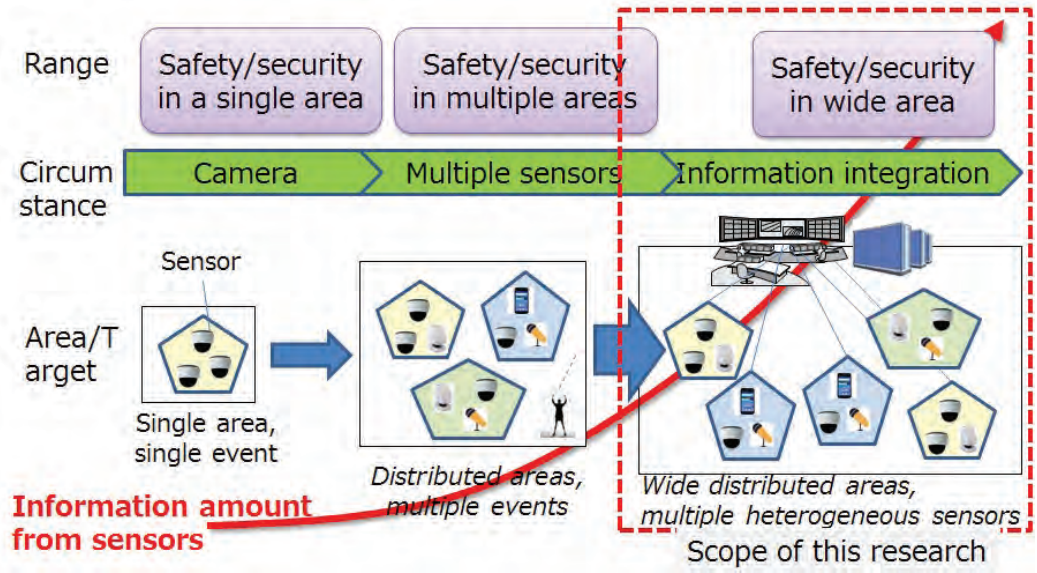
Mitsubishi Electric Collaborative Research Division for Wide-area Security Technology

Outline

The studies in this division focus on security technology to enhance safety and security in wide areas such as city. Some of our major research projects are generation and visualization of multi-modal sensor data space by integrating massive camera and sensor data, person matching for cross-camera tracking robust against observation views and occlusion situation, attribute-based high-speed person retrieval for efficient forensics, establishment of physical security level for understanding and predicting security risk.

Current Research Programs

- Generation and visualization of multi-modal sensor data
- People density estimation based on staying detection
- Cross-view person matching
- Occlusion handling for person matching
- Attribute-based high-speed person retrieval
- Establishment of physical security level



Security technology to enhance safety and security in various areas ranging from a single area at an event level to a wide area at a city level

Division of SCREEN Single-Molecule Analysis

Outline

Development of methodology of identifying molecules and/or detecting / monitoring molecular behaviors at the single-molecular level is an important research issue for research field and also for application-fields. The object of this division is to establish a high-throughput single-molecule electrical measurement and analysis methodology by using silicon-based nano-devices, which are fabricated by cutting-edge nanotechnology, and to develop application technology of this single-molecule sensing technology for various social needs. For that purpose, we aim to develop the manufacturing process technology of semiconductor devices which is quality-controlled, measuring equipment adapted to device performance, accompanying measurement, analysis system and so on.

Research Projects

1. Development of device production technology for single-molecular measurement.

The key to semiconductor based devices for one molecule measurement is to keep clean in device and sensing condition. In this fiscal year, we investigate the process of the device and worked to minimize the contamination route. Furthermore, we reviewed the material of the flow path cover on device, and improved the design of the microchannel structure on the cover by the developed fabrication technology. Contamination due to the material, which occurs at the time of sample introduction until now, can be reduced significantly, and it succeeded in reducing the yield and the necessary minimum capacity of measurement at the time of measurement by this.

2. Development of measurement system for high-sensitive current measurement.

One of the key technologies for single-molecule sensing is the development of an amplifier for high-speed and high-resolution current measurement. In this fiscal year, we developed low-capacitance feedback resistors with adjustable capacitance, and developed an amplifier with even lower noise. As a result, it became a noise level of <1 pA, and succeeded in improvement of S / N. In addition, we performed the electrode shape and its optimization for electrophoresis, and found the best structure as a result of investigation on the reduction of contamination and its effect.

3. Development of single-molecule analysis system

High quality of single-molecule identification and quantification is key for application. It is necessary to analyze a large amount of obtained single molecule measurement data quickly and automatically. In this fiscal year, we concentrated on acquiring a large amount of single molecule measurement data from our fabricated devices. First, several kinds of molecules including modified nucleic-acid molecules can be measured, and their database for obtained signals were constructed. Second, we newly developed a program and launched their data-server that quickly and automatically analyzed large amounts of data. Based on this data infrastructure, we supply the service of database information to the collaborative laboratory, which try to design the newly artificial molecules that improve the accuracy for this system, and try

to elucidate the action mechanism for some of drugs. In addition, as a part of commercialization based on this single molecule analysis technology, we plan to evaluate the possibility of single molecule ultra-high memory density memory using biopolymer from the next fiscal year.

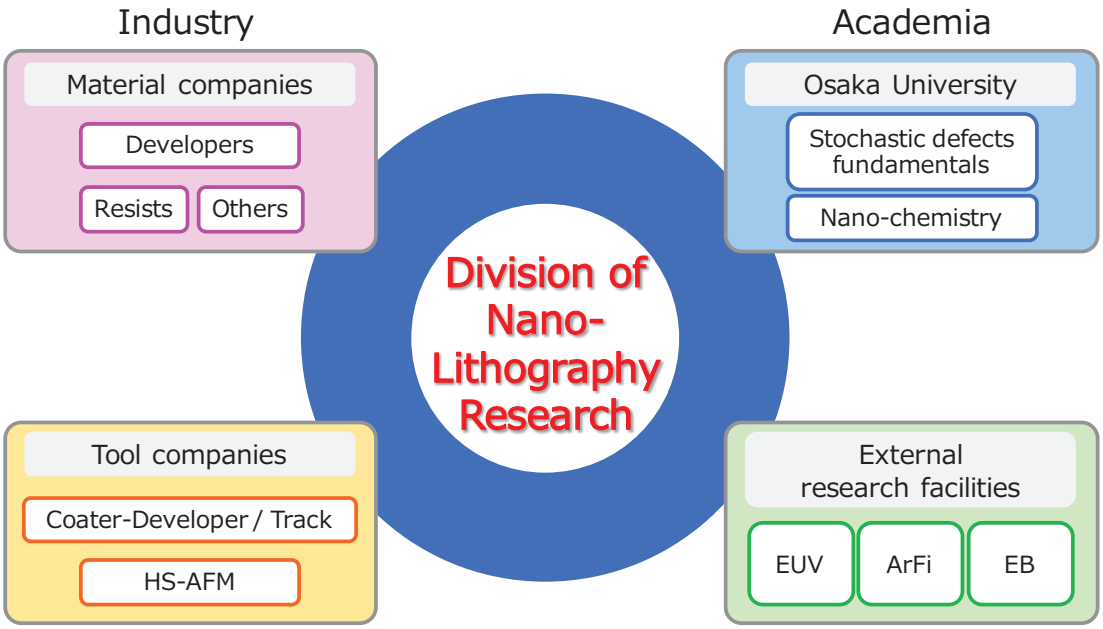
Division of Nano-Lithography Research

Outline

Photoreactive materials (referred to as “resists”) and related processes play a significant role in the miniaturization of semiconductor devices. In semiconductor lithography patterning, various types of polymers are used. However, present patterning targets are reaching sizes that are as small as the basic units of the materials utilized. For this reason, the research of next generation resist materials and processes are required.

Objective

The main goal of this research is to contribute to the advancement of patterning technologies, through the extensive search of next generation materials. Furthermore, fundamental research of related resist processes, especially focusing on the real-time characterization of resist dissolution during the development process.



Lithography research carried out through effective application of novel measurement/analysis techniques and strong industry/academia/government collaborations.

Activities of Centers

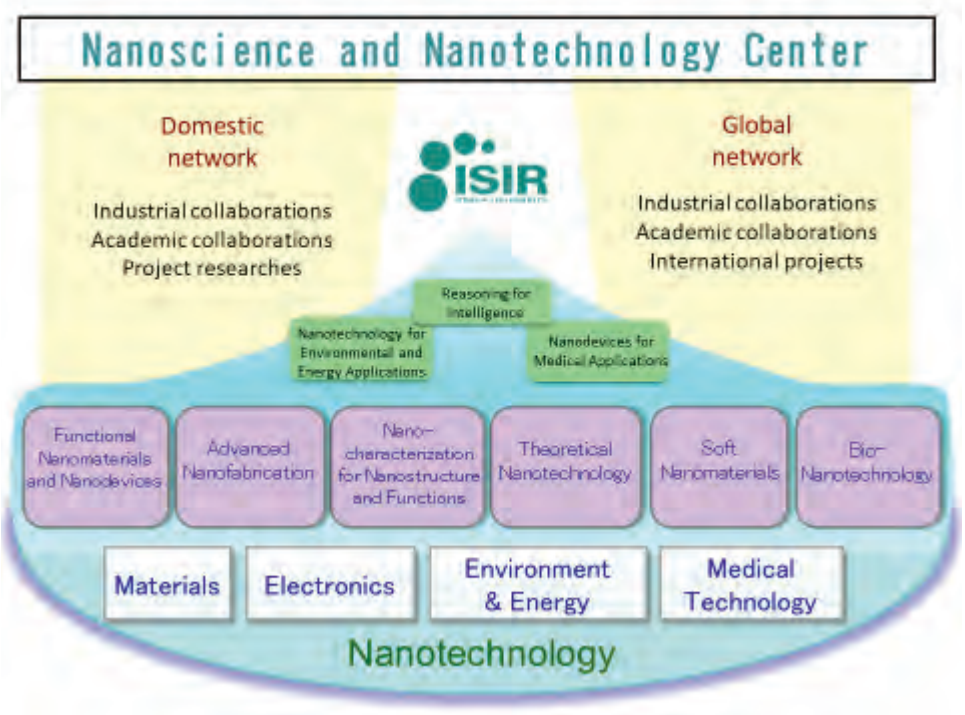
Nanoscience and Nanotechnology Center

Director, Professor: Tamio OGUCHI
Supporting Staff: Yuka UMEMOTO

Outlines

Nanoscience and Nanotechnology Center was founded in the Institute of Scientific and Industrial Research (ISIR) in April 2002 as the first nanotechnology center in Japan for developing bottom-up nanotechnology, top-down nanotechnology, and their collaborated applications in industrial fields. Following the reorganization of ISIR in 2009, the Center was enhanced and strengthened by building up a new structure centering on 6 full-time departments.

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



Department of Functional Nanomaterials and Nanodevices

Professor: Hidekazu TANAKA
Associate Professor: Teruo KANKI
Assistant Professor: Azusa HATTORI, Mahito YAMAMOTO
Guest Professor: Yoshito TOBE
JSPS Research Fellow: Alexis BOROWIAK (28.9. 2016 - 27.9.2018)
Guest Research Fellow: Rupali RAKSHIT (1.1.2018 – 31.12.2018)
Specially Appointed Assistant Professor: Rupali RAKSHIT (1.1.2019 – 31.5.2019)
Graduate Students: Masahi CHIKANARI, Yoshihide TSUJI, Daiki KAWAMOTO, Yuto ANZAI, Keita MURAOKA, Shingo GENCHI, Fumiya ENDO, Takashi YAMANAKA
Under Graduate Students: Toshiya SUZUKI, Shin NONAKA
Research Students: Boyuan YU (1.10.2018 – 31.3.2019)
Supporting Staff: Saeko TONDA, Natsuko SAKAKI, 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.

Research Projects

Effective Resistance Modulation in VO_2 by Gating through Hexagonal Boron Nitrides.

The strongly correlated electron system of VO_2 exhibits an ultrafast metal-insulator transition (MIT) under external stimuli such as heat, light, and strain. If the MIT in VO_2 can be controlled by an electric field, a field effect transistor (FET) could be demonstrated with ultrafast and ultralow power consumption switching properties. Previously, VO_2 FETs have been fabricated with conventional gate oxides such as SiO_2. In such VO_2 FETs, however, the resistance modulation under gating is extremely small, presumably due to the electron scattering from the roughness and the electron traps at the interface. Here, to enhance the resistance modulation in VO_2 FETs, we employ, as a gate insulator, a layered material of hexagonal

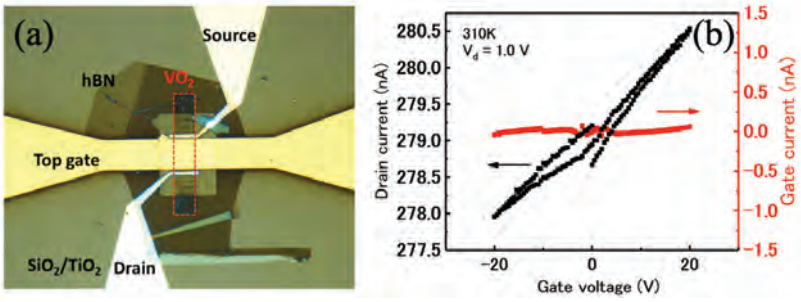


Fig.1 (a) Optical microscope image of VO_2 contact with 2D h-BN gate insulator, (b) Their electrical resistance modulation against gate bias voltage.

boron nitride (hBN) which is atomically flat and has much fewer electron trap sites than the other gate oxides have. Fig. 1 shows the device fabricated and their gate bias modulation of the drain current in a VO_2 FET under gating through hBN. We observe the resistance of VO_2 is modulated by up-to 4.4% at a gate voltage of 30 V, which is 10 times larger than in previously reported VO_2 FETs with oxide gate Insulators. This is likely because with hBN the interface carrier scattering is strongly suppressed. Our results pave the way for the realization of "a phase-transition FET" based on VO_2 and hBN.

Enhancement of Resistive Modulation in Nano-convex VO_2 FET.

We have developed nano-fabrication processes for preparing a phase-change field-effect-transistor (FET) using VO_2 nano-channels and have demonstrated its operation. It was found that the resistance modulation ratio increases with decreasing channel size. On the other hand, when channel length of the conventional top gate FET is further shortened, gate electric fields are not effectively applied to the channel in the geometry, which was found from the result of the electric field simulation using the finite element method. We proposed a new geometry channel structure, which is a convex shape as shown on Fig.2 (a). This geometry enables us to effectively apply electric fields to nano channels due to converged electric field at channel, leading to 22 times higher resistance modulation than that of the thin film-based FET.

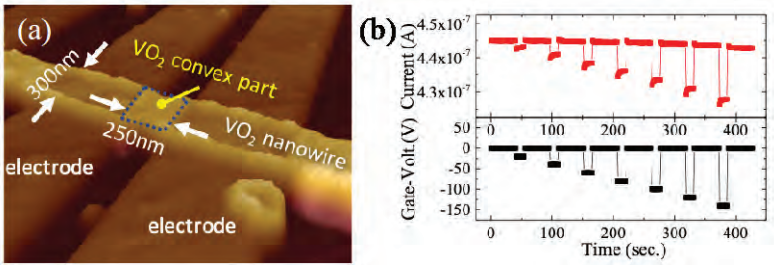


Fig. 2(a) an AFM image of the VO_2 convex channel. (b) Resistance modulation of the VO_2 -FET with convex channel. The inset shows

Correlation between Ni Valence and Resistance Modulation on a Correlated Oxide Chemical Transistor.

The resistance modulation under various gate voltage (Vg) application conditions was systematically studied for a chemical field effect transistor (FET) composed of a $SmNiO_3$ (SNO) film channel and an ionic liquid gate insulator. The channel resistance of the SNO chemical FET changed nonlinearly over a wide range for different temperatures, Vg magnitudes, and Vg application durations. The correlation between the modulated resistance and the Ni valence state was quantitatively revealed using X-ray photoelectron spectroscopy. A model describing the resistance change with the Vg application conditions was proposed by considering the kinetics of the reduction reaction on the SNO channel. This model enables the resistance to be predicted for given Vg application conditions and selective resistance modulation over a wide range of resistances has been demonstrated.

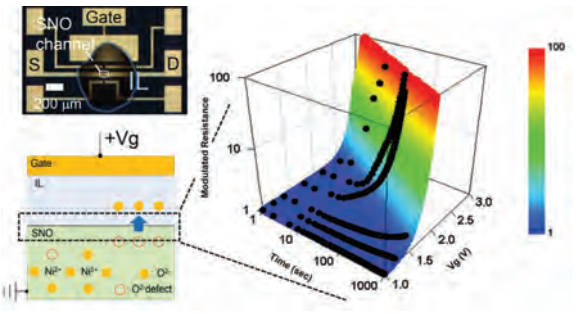


Fig. 3 Optical microscope image of $SmNiO_3$ ionic liquid gate FET and their electrical modulation by gate bias voltage.

Department of Advanced Nanofabrication

Professor:	Yoichi YOSHIDA
Associate Professor:	Jinfeng YANG
Assistant Professors:	Takafumi KONDOH (-15.1.2019), Koichi KAN
Specially Appointed Professor:	Seiichi TAGAWA (-31.3.2019)
Specially Appointed Associate Professor:	Shigeki KAWAKAMI
Specially Appointed Researcher:	Masao GOHDO (-31.3.2019), Kimiaki TANIHATA
Invited Professors:	Shunichi GONDA, Kazumichi NAKAGAWA, Shigehiro NISHIJIMA
Invited Associate Professors:	Akihiro OHSHIMA
Guest Associate Professor:	Hiromi SHIBATA
Under Graduate Students:	Kazuki ARAKI
Supporting Staff:	Yukie TAKAHASHI

Outlines

Our research target is fundamental physicochemical processes induced by electron beam irradiation to materials for the sake of realizing an advanced nanofabrication. To reveal the foundation of the processes, a femto/atto-second pulse radiolysis measurement system and technique has been developing including generation and measurement methods of attosecond electron beam. In addition to the time-resolved spectroscopy, time-resolved electron diffraction and electron microscopic method and apparatus have been developed and studied. Utilizing our ultra-short electron beam, we are exploring novel interaction of the high-density electron beam and materials. Our research is lying to interdisciplinary fields of radiation chemistry, accelerator science and electron microscopy.

Research Projects

Spatio-temporal Measurement of Terahertz Electric Field from Coherent Transition Radiation

Generation of femtosecond electron bunches has been investigated for a light source based on electron bunches and improvement of time resolution in time-resolved measurements. Spatio-temporal measurement of terahertz (THz) electric field of coherent transition radiation (CTR) was conducted using a photoconductive antenna (PCA) with radial microstructures. CTR was generated by electron bunches (35 MeV and <1 nC/pulse). The PCA was moved for spatial resolution of CTR measurement. An optical delay for a femtosecond laser enabled temporal resolution. This method would be also applied to THz pulse radiolysis based on probe pulse of CTR.

Early stage processes of ionizing radiation induced reaction in CCl_4

Halomethanes have been used as solvents to observe solute cation radicals induced by ionizing radiation. Among halomethanes, dichloromethane and 1,2-dichloroethane were widely used for this purpose. Although, carbon tetrafluoride is known that cation radical formation of solute is much less efficient comparing with other halomethanes, but CCl_4 has the most simplest molecular structure. Thus, we started investigation of early stage processes of ionizing radiation induced reaction in halomethanes with CCl_4. Reactivity of transients induced by ionizing radiation were examined by scavenging reaction with CH_2Cl_2 and $CHCl_3$, and found the scavengers react with transient observed at 340 nm by playing hydrogen abstraction reaction. The fs-pulse radiolysis showed decay and rise signal observed at 340 nm. The decay component seems to be corresponding to the rise signal observed at 480 nm. Newly found rising component at 340 nm is the transient which played hydrogen abstraction reaction with $CHCl_3$ and CH_2Cl_2.

Development of Femtosecond Time-resolved Electron Microscopy

Ultrafast electron microscopy (UEM) with femtosecond temporal resolution is a “dream machine” that has been long envisioned for the study of ultrafast structural dynamics in materials. For this purpose, we are developing an UEM with relativistic femtosecond electron pulses generated by a radio-frequency (rf) acceleration-based photoemission gun. In this year, we have constructed a new relativistic-energy UEM lens system including the new stigmator coils, apertures and sample controlling system. In the new UEM, we succeeded to observe TEM images of gold nanoparticles with a 3.1-MeV and 100-fs pulsed electron beam generated by the rf gun.

Department of Nanocharacterization for Nanostructures and Functions

Professor: Seiji TAKEDA
Associate Professor: Hideto YOSHIDA
Assistant Professor: Naoto KAMIUCHI, Ryotaro ASO
Graduate Students: Takehiro TAMAOKA, Tatsuya MIZOBUCHI, Kengo YOSHIMOTO, Ryota SAWADA, Kento HATA
Supporting Staff: Akira DOI

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. In particular, 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. Using ETEM, we study nanomaterials and nanodevices at the atomic scale when they actually exhibit their functions.

Research Projects

Thermal stability of Au nanorods

Au nanorods attracted a lot of scientific attention due to their tunable optical properties, catalytic activity, and bio-compatibility. Au nanorods exhibit a transverse and a longitudinal localized surface plasmon resonances. The longitudinal localized surface plasmon resonances can be tuned from the near-infrared to the visible part of the electromagnetic spectrum by decreasing the aspect ratio of the Au nanorods. Therefore, understanding the thermal stability of Au nanorods is important since a heat-induced deformation of the Au nanorods leads to a decrease in aspect ratio and consequently affects their optical properties. We investigated the thermal stability of Au nanorods in different environments by ETEM.

Figure 1 shows the TEM images of a Au nanorod supported on a SiN film. The surface of Au nanorod is covered with a 2 nm thick carbon layer. Figure 2 shows the deformation of Au nanorods by heating under a pure O_2 and a mixture of CO and O_2. In the case of O_2 (Fig. 2 (a)), slight deformation of the Au nanorods was observed at 200 °C along with a reduced thickness of the carbon layer surrounding it. At 400 °C the carbon layer was completely gone and the Au particles

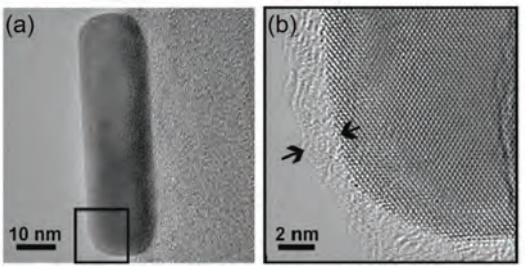


Fig.1 (a) A TEM image of a Au nanorod. (b) An enlarged image of the rectangular area in (a).

deformed losing their anisotropic character. In the presence of CO/O_2 (Fig. 2(b)), the observed deformation process was clearly slower, leading to a change in the Au nanorod aspect ratio from 3.5 to 2.2 after heating at 400 °C for 60 min. The difference in the deformation rate appeared to be independent of the relative pressure of O_2, but rather related to the presence of CO which seemed to promote deposition of carbonaceous species and thus replenishing the carbon layer that was being removed by oxidation.

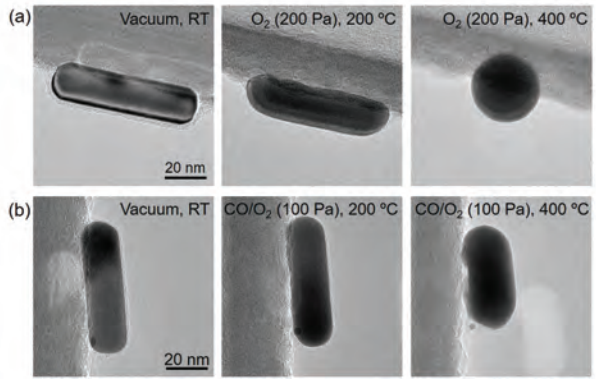


Fig. 2 Deformation of Au nanorods after 1 h heating at 200°C and 400°C under (a) a pure O_2 (200 Pa) and under (b) a mixture of 50 Pa CO and 50 Pa O_2.

Suppression of oxidation of Pd surface by prolonged H_2 exposure

Understanding atomic-scale reaction processes at gas-metal interfaces is important in research fields such as catalysis and gas sensing. We observed the phase transition of Pd surface in both oxidizing and reducing environments by ETEM. The surface of as–prepared Pd foil was covered by hydrocarbon contamination. The contamination was eliminated by intensive electron irradiation in O_2. After the elimination, the Pd surface was covered with PdO. After exhaustion of O_2, the PdO film still remained, but after introduction of H_2, the PdO was immediately and completely reduced to Pd. The duration of H_2 exposure was about 10 minutes. Next, we exhausted H_2 and then introduced O_2. After exposure to O_2 in 305 seconds, we observed oxidation happening in both step edges and terraces (Fig. 3 (a)-(c)). Then, the oxidation proceeded on the Pd surface (Fig. 3 (d)), and finally, the Pd surface was completely covered with the PdO film (Fig. 3 (e)). In the hydrogenation-oxidation sequence, we also studied the effect of the duration of the H_2 exposure. We found that there is a dependence of hydrogen exposure on the oxidation of Pd. After short H_2 exposure (10 minutes), Pd can be oxidized as shown in Fig. 3. However, after long exposure (over 90 minutes), the oxidation of the Pd surface was not possible. We confirmed that the formation of the bulk β-phase hydride did not occur even after long exposure. Therefore, we concluded that the formation of surface hydride and/or the formation of the bulk α-phase hydride act as a barrier that prevents further oxidation.

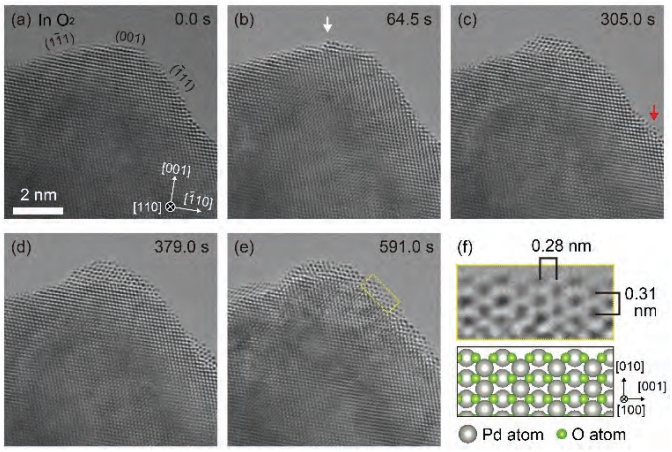


Fig. 3 (a-e) Oxidation processes of the Pd surface in O_2 after 10 minutes exposure to H_2. (f) The enlarged ETEM image of yellow rectangle region in (e) and schematic illustration of PdO.

Department of Theoretical Nanotechnology

Professor: Tamio OGUCHI
Associate Professor: Koun SHIRAI
Assistant Professors: Kunihiko YAMAUCHI, Hiroyoshi MOMIDA
Specially Appointed Associate Professor: Tetsuya FUKUSHIMA
Guest Professors: Mitsuhiro MOTOKAWA, Takeo JO, Shigemasa SUGA
Specially Appointed Researcher: Takayoshi FUJIMURA
Visiting Researcher: Tomoki YAMASHITA, Hitoshi FUJII
Joint Research Collaborator: Yukihiro MAKINO, Sonju KOU
Graduate Students: Masayuki FUKUICHI, Hiroshi KATSUMOTO, Motoyuki HAMAGUCHI, Fumiaki KURODA, Huyen Thi Ngoc VU, Huu Duc LUONG, Thao Thi Phuong NGUYEN, Masahito KUMAKURA, Hung Ba TRAN, Shinichi KANEHIRA, Yousuke KANDA, Takao KOSAKA, Takuro HIRAIWA, Shogo YAMASHITA, Keiya HIRAOKA, Tatsuya TAKAHASHI, Takafumi HAYASHI, Ryuta MATSUMIYA
Undergraduate Students: Ryoma SHIMAZU, Ryosuke NAKAGAWA
Supporting Staff: Chiaki KURIBAYASHI, Mika ASADA

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.

Research Projects

Sparse Modeling of Chemical Bonding in Binary Semiconductors

Chemical bonding is empirically interpreted in terms of the mechanism of ionic, covalent, and metallic bonding and van Alkel-Ketelaar's triangle is well known to classify the chemical bonding for typical material systems. Each binary compound is placed in the triangle with the sum and difference of electronegativity of constituent atoms, classifying its chemical bonding. Recently energy difference ΔE=E(RS)–E(ZB) between rock-salt (RS) and zinc-blende (ZB) crystal structures evaluated by first-principles calculations has been quantified to sparse

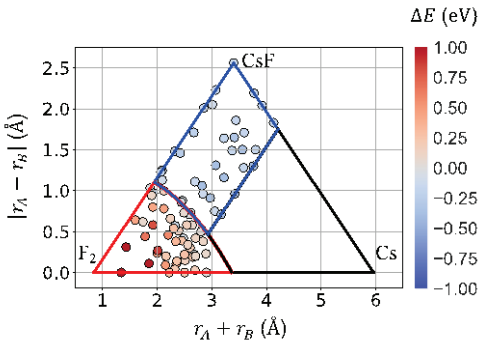


Fig. 1 Energy difference between rock-salt (RS) and zinc-blende (ZB) structures of binary semiconductors expressed in 2D map of empirical atomic radius of constituent atoms

models. However, since several explanatory valuables are used in model descriptors and complicated operations are applied, models constructed seem to be not easily understandable. In this study, the linearly independent descriptor generation (LIDG) method that we have recently developed and exhaustive search method are adopted to construct interpretable sparse models for the same target valuables ΔE as before. As results, sparse models with empirical atomic radius are successfully made and a new triangle map with the sum and difference of atomic radius of constituent atoms is proposed. In the new triangle map, stable areas of RS and ZB structures are separately expressed, representing ionic and covalent bonding regions, respectively. In addition, it is speculated that an empty region in the map might correspond to a metallic bond region that has not been considered in this study.

Defect Control of Boron by Utilizing Hydrogen

Boron crystal is known to have considerable amount of intrinsic defects, and it was believed that removing the defects is impossible. A recent experiment shows that hydrogenated α-tetragonal boron, which was obtained at high pressure, is transformed to defectless δ-orthorhombic boron on dehydrogenation by annealing. Our calculations revealed the mechanism for the obtaining defectless structure. It is a consequence of the ingenious conspiracy by the hydrogen-assisted migration of B atom and the order-disorder transition of α-tetragonal boron.

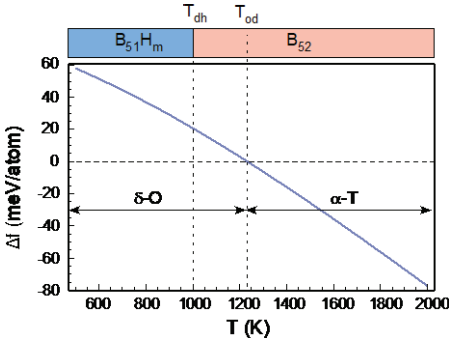


Fig. 2 Phase diagram of hydrogenated α-tetragonal boron

Bandstructure Calculation for Topological Matter

Topological matters have attracted much attention recently and developed its research in a wide region of material sciences. In this study, we collaborate with an experimental group of angle-resolved photoemission spectroscopy (ARPES) research in Tohoku University to understand the electronic structure of various topological matters. Recently, we have calculated the bandstructure of topological semimetals, ZrGeS, ZrGeSe, ZrGeTe and compared it with experimental results. It unveiled the existence of an exotic surface state that is called Dirac node arc in those materials.

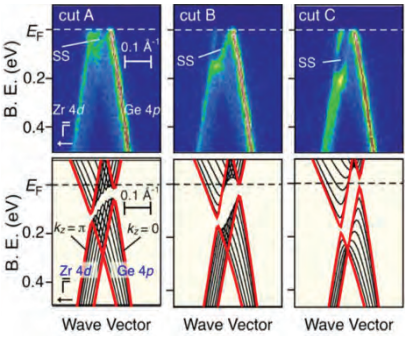


Fig. 3 Band structures by ARPES (upper) and first principles (lower)

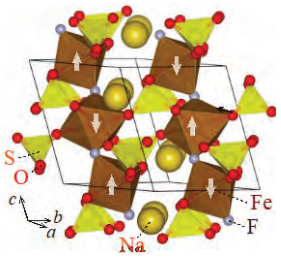


Fig. 4 Crystal structure of $NaFeSO_4F$

Electrode Properties of Li/Na-ion Battery Materials

Li-ion batteries have been widely utilized in several devices, and $LiCoO_2$ cathode and Li-C anode are typically used. Recently, Na-ion batteries have been developed aiming to reduce materials cost. We study several types of electrode materials including Li_2MnTiO_4 cathode, $NaFeSO_4F$ cathode (Fig. 4) and SnS anode using the first-principles calculations. Voltage-capacity curves and x-ray absorption spectra are theoretically clarified for each material.

Department of Soft Nanomaterials

Associate Professor: Yutaka IE
Specially Appointed Researcher: Shreyam CHATTERGEE (-30.6.2018)
Graduate Students: Keitaro YAMAMOTO, Yota KISHIMOTO, Taishi SAKAI, Tomoya HAMADA
Supporting Staff: Yoshimi FUJIKI
Technical Assistant Staff: Takuji SEO

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 carrier mobility, and (2) functionalized molecular wires and metal-electrode-anchoring units applicable to molecular electronic devices.

Research Projects

Development of Organic Photovoltaic Materials

Organic photovoltaics (OPVs) have been intensively investigated over the last decade. To develop n-type semiconductors based on π-conjugated system, the use of strong electron-accepting unit is essential. However, the effective electron-accepting unit is still limited. Naphtho[1,2-*c*:5,6-*c*']bis[1,2,5]thiadiazole (NTz) has been known to

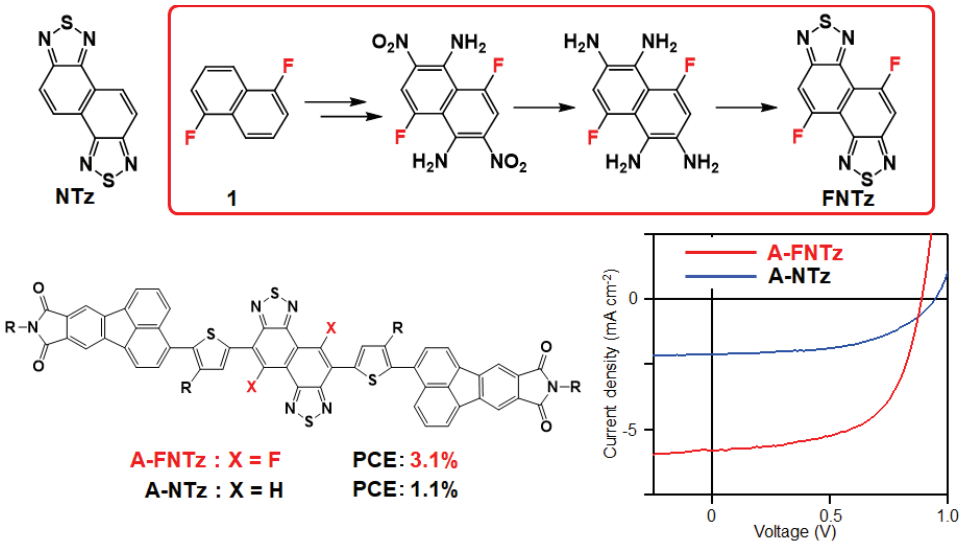


Fig. 1 Chemical structures and OPV characteristics.

function effectively as an electron-accepting unit of both p-type and n-type OPV materials. Since the chemical modification of NTz toward stronger electron-accepting character is a straightforward direction to enhance the device performance, we designed fluorinated NTz (FNTz) as a new electron-accepting unit (Fig. 1). Synthesis of FNTz is accomplished by the sequential introduction of amino functional groups into 1,5-difluoronapthalene. We also synthesized n-type organic semiconductor (A-FNTz). OPVs based on A-FNTz in combination with poly(3-hexylthiophene) as a p-type material exhibited a significant improvement of power conversion efficiency (PCE) compared to the corresponding A-NTz-based devices and reached a high PCE of up to 3.12%. This result demonstrates the potential of FNTz for an electron-accepting unit in organic semiconductors. [Original Paper 4]

Development of Organic Field-Effect Transistor Materials

Oligothiophenes bearing quinoidal structures have been investigated as n-type semiconductors in organic field-effect transistors (OFETs). One of unique feature of the quinoidal systems is an equilibrium between quinoidal and biradicaloid electronic structures. We focused on the utilization of benzene-annelation for the stabilization of the quinoidal electronic structure against biradicaloid structure and thus designed BTTN (Fig. 2). Furthermore, in order to increase the electron-accepting character of BTTN, fluorine substituents were introduced to the *β*-positions of the quinoidal terthiophene (BTTN-F). Based on the results of ^{1}H NMR measurements, the reduced contribution of biradicaloid structure by the benzene annulation was observed. Cyclic voltammetry measurements revealed that the lowest unoccupied molecular orbital energy levels of these compounds lie below –4.0 eV. OFET devices based on these compounds showed typical n-type characteristics [Original Paper 6].

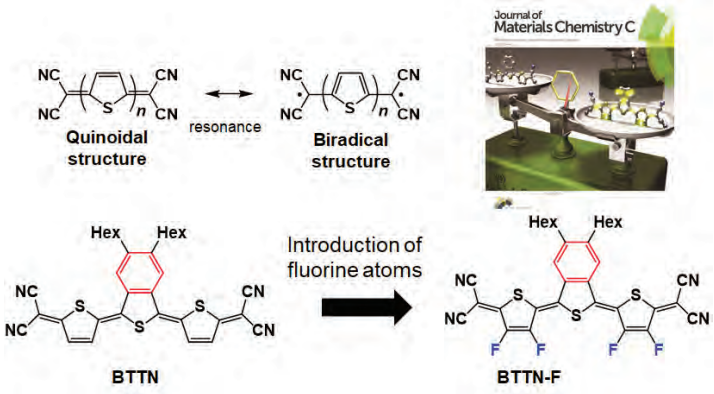


Fig. 2 Chemical structures.

Development of Novel Antiaromatic Compound

While the majority of organic semiconductors are based on fused [4*n*+2]π-electron aromatic molecules, the utilization of a [4*n*]π-electron antiaromatic character has emerged as a useful strategy to create new molecules with unusual electronic structures. Although a 16π-electron segment (BDA) has been recognized as an effective antiaromatic framework, its-based antiaromatic compounds are still limited. To unveil the antiaromatic character of the BDA framework, we developed compound 2 and revealed that that antiaromaticity appeared in the BDA framework (Fig. 3) [Original Paper 1].

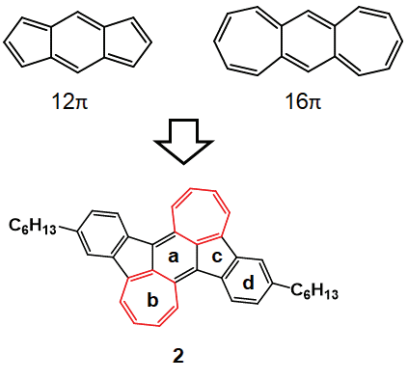


Fig. 3 Chemical structures.

Department of Bio-Nanotechnology

Professor: Masateru TANIGUCHI
Associate Professor: Makusu TSUTSUI
Assistant Professor: Hiroyuki TANAKA, Yuki KOMOTO(1.11.2018-)
Specially Appointed Professor: Tomoji KAWAI
Specially Appointed Assistant Professor: Wataru TONOMURA(-31.5.2018), Akihide ARIMA
Specially Appointed Researcher: Sanae MURAYAMA, Yuko ESAKI, Hiroko DEGUCHI, Yukari KUBO, Yayoi TSUMOTO
Graduate Students: Bo LIU, Tomoki HAYASHIDA, Leong IAT WAI, Shohei KISHIMOTO(1.10.2018-)
Under Graduate Students: Takuto Kanda
Supporting Staff: Noriko FUJIBAYASHI

Outlines

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

Research Projects

Direct observation of anticancer drug incorporated into DNA by single molecule quantum sequencer

Fluorothymine is widely used as an anticancer agent for treating refractory digestive tract cancer such as metastatic colorectal cancer. It was thought that fluorothymine replaced the thymine in DNA to inhibit the growth of cancer cells. However, there is no method to determine at which position in the DNA the fluorothymine is incorporated, and an unknown part remains as an anticancer agent mechanism. In particular, the elucidation of the mechanism of fluorothymine is a source of generating new anticancer agents, and the development of a method for directly observing the behavior of fluorothymine in DNA has been a major issue. In collaboration with the research group

at Osaka University School of Medicine, we succeeded in determining the base sequence of DNA and the location of fluorothymine using a single-molecule quantum sequencer method that can identify one molecule by tunneling current. This is expected to enable elucidation of the mechanism of the anticancer drug. Furthermore, it is possible to determine with high accuracy which position of the nucleotide sequence in the DNA in cancer cells treated with this anticancer agent fluorothymine is incorporated to change the function of the gene with high accuracy. Clarify the mechanism that is effective and lead to the development of new drugs.

Influenza diagnosis using molecular recognition solid-state nanopore sensors

Conventionally, recognition molecules used in virus test kits are based on one-to-one antigen-antibody reaction. While this enables convenient diagnosis of infectious diseases through its excellent molecular selectivity, the recognition molecule could only be used for detecting only one kind of analyte.

In contrast, here we used peptide engineering to synthesize peptide probes compatible with the nanopore sensor for multiplex analysis of single-viruses. This peptide molecule is very different from the concept of conventional immunochromatography technology, and was designed to show weak interaction with surface proteins on influenza virus. We adsorbed the molecule probe on wall surface of a Au nanopore. Using this peptide-decorated nanopore for single-virus detections via ionic current measurements, we observed significant extension in the transit time of viruses through the nanopore reflecting the strength of molecular interactions between the virus and the peptide probe. In addition, the application of pattern recognition technology based on machine learning to ion current signal analysis demonstrated that this device can be used for influenza typing. This device concept is in principle applicable to all target substances from DNA to bacteria by merely changing the pore size, and therefore can be used as a useful tool for a range of bioanalytical applications including viral screening and DNA sequencing.

Recognition of neurotransmitters by using of MCBJ method

Single-molecule measurement by using of MCBJ method enable to observe only single molecule directly. It is much paid attention to single-molecule measurement as new detection technique of various molecules. Our group have reported DNA and RNA sequencer and detection of amino acids with MCBJ methods. Here, we demonstrated recognition of neurotransmitters as new detection targets bio-molecule with MCBJ methods. Conductance measurements of three neurotransmitters, dopamine, noradrenaline and serotonin were performed. The three neurotransmitters were not distinguishable by single-molecule conductance determined by typical analysis method which make the conductance histograms. However, we succeed in discrimination of the neurotransmitters with applying of machine learning analysis for single pulse signals. Single-molecule signals obtained by measurement of mixtures were classified with machine learning. The mixtures were recognized from the determined mixing ratio. This result is important progress in single-molecule research because quantitative analysis is difficult due to its low selectivity with conventional analysis method. Our machine learning analysis method has potential to capture the behavior difference caused to difference of molecular structures or intramolecular interaction. The result is significant in not only application of sensors but also basic studies in the field of single-molecule measurement.

Department of Nanotechnology for Environmental and Energy Applications

Professor: Takahiro KOZAWA

Outlines

To address the urgent issues of environment and energy, we are developing the process and material technologies, by utilizing the facilities for nanofabrication available at the Nanoscience and Nanotechnology Center.

Research Projects

Reaction mechanisms of photodecomposable quencher

With the reduction of feature sizes in semiconductor devices, it is expected to apply ionizing radiations to the high-volume production of semiconductor devices. In the next-generation lithography, the extreme ultraviolet radiation, the wavelength of which is 13.5 nm, will be used. A highly sensitive resist called a chemically amplified resist has been used as a patterning material. In this type of resists, the energy for the decomposition of sensitizers is first deposited, using the high-quality and highly expensive beam. Then, the chemical reactions for the solubility change of the resist are induced by providing low-quality and low-cost thermal energy. This mechanism enables highly resolved and sensitive patterning. However, the fluctuation of line edge, called a line edge roughness (LER), is a significant problem because the chemical reaction is a stochastic process. A photodecomposable quencher is a promising material for suppressing LER. In this project, the mechanism of LER suppression through the use of photodecomposalbe quenchers was clarifed, using the simulation on the basis of sensitization and reaction mechanisms.

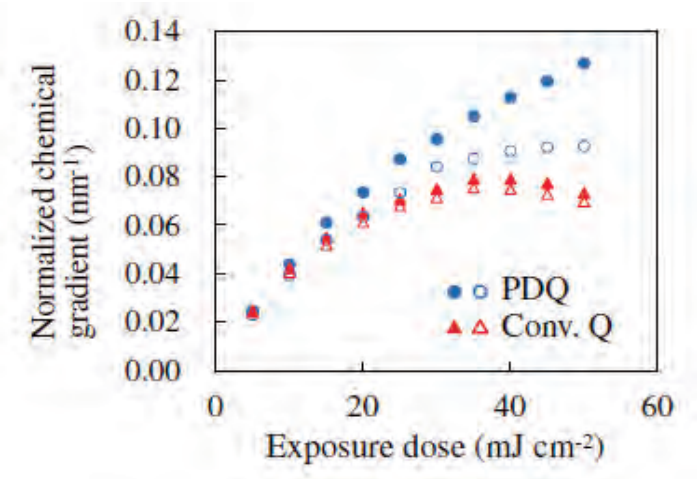


Fig. 1 Relationship between exposure dose (sensitivity) and chemical gradient (an indicator of LER).

Department of Nano-Intelligent Systems

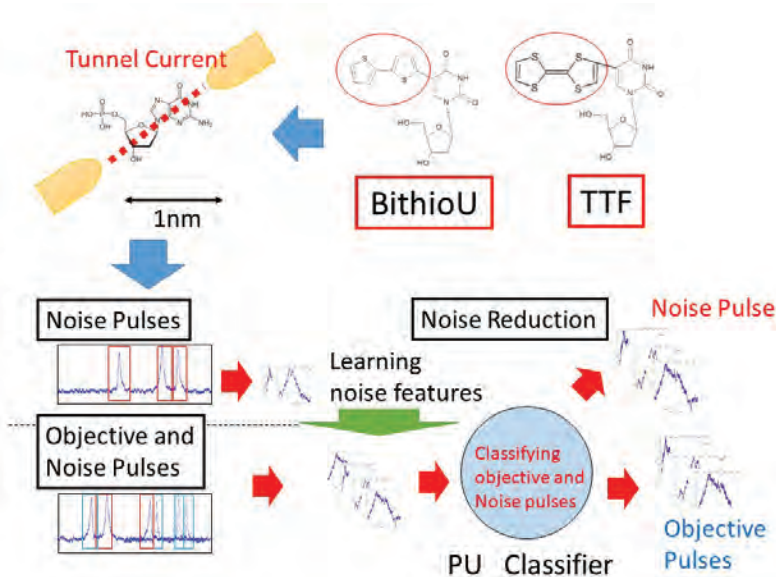
Professor: Takashi WASHIO

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 continued the development of a machine learning method for an accurate monomer molecule classification using a nano-gap device. This is a joint work with the department of bio-nanotechnology. The classification of individual molecule is a promising technology for many important applications including RNA and DNA sequencing and cancer gene detection.

Research Projects

Subsequent to the last year's study, we sought a principle and a method to reduce noise pulses from measured pulses using machine learning based pattern recognition for the individual molecule classification. Because the objective pulses and the noise pulses cannot be separately acquired while the noise pulses can be independently collected easily in many problems, we are developing a method to learn a PU classifier from the labeled noise pulse data and the unlabeled pulse mixture data. In this year, we particularly developed a highly robust pattern recognition method for the noise reduction based on maximum likelihood principle. We measured the mixture of Di thiophene uracil derivative (BithioU) and TTF uracil derivative (TTF) by the nano-gap with noise pulses, and confirmed the highly robust noise reduction against the large changes of SN ratio by using our developed method.



Department of Nanodevices for Medical Applications

Professor: Shun'ichi KURODA

Outlines

We are developing bio-industrially useful technologies on the basis of the analysis of intermolecular reactions found in various biological phenomena. In particular, we focus on an *in vivo* pinpoint drug delivery system with nanocarrier (bio-nanocapsule) by mimicking the function of viruses. In addition, we apply such bio-nanocapsules to an oriented immobilization technology for various biomolecules to achieve highly sensitive biosensor devices.

Research Projects

Analysis of the early infection machinery of hepatitis B virus by using bio-nanocapsule

Hepatitis B virus (HBV) is considered to interact first with heparan sulfate proteoglycan (HSPG) *via* an antigen loop of HBV envelope S protein. Then, it is rapidly migrated to the sodium taurocholate cotransporter polypeptide (NTCP) *via* the myristoylated N-terminal sequence of the pre-S1 region, and it finally enters the cell by endocytosis. However, the machinery of HBV migration from HSPG to NTCP has not been clarified. In the past, it was difficult to obtain a large amount of HBV, therefore biochemical analysis of HBV infection mechanism was difficult. In the last decade, we have established a human hepatic cell-specific DDS nanocarrier by using recombinant yeast-derived L protein particle (denoted as Bio-nanocapsule (BNC)). The human hepatic cell-specific binding and cellular uptake of BNC are similar to HBV. The cellular uptake pathway of HBV therefore was investigated by using this BNC. It was suggested that cellular uptake of both myristoylated BNC (myr-BNC) and HBV depend on NTCP, because Myr-BNC bound to NTCP *in vitro* and competitively inhibited HBV infection. Thus, myr-BNC would be a useful biomimic of HBV for the elucidation of early infection machinery of HBV. However, the cell entry rate of Myr-BNC and HBV was the same as that of BNC in HepG2 cells overexpressing NTCP. In addition, the cellular uptake of these particles was not dependent on NTCP but mainly on HSPG. These results suggest that cytosolic NTCP plays an important role in endosomal escape, while NTCP on the cell surface may not be involved in cellular uptake of HBV.

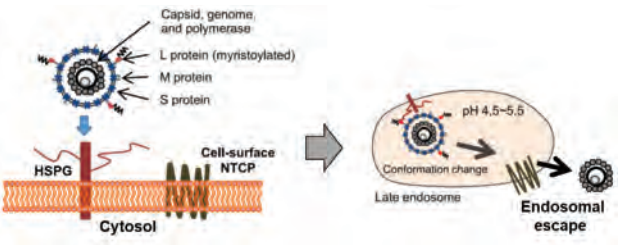


Fig.1 Model of early infection machinery for hepatitis B virus and bio-nanocapsule L in human hepatocytes.

Department of Nanosystem Design

Visiting Professor: Fumitoshi KAKIUCHI (1.4.2018-31.3.2019)

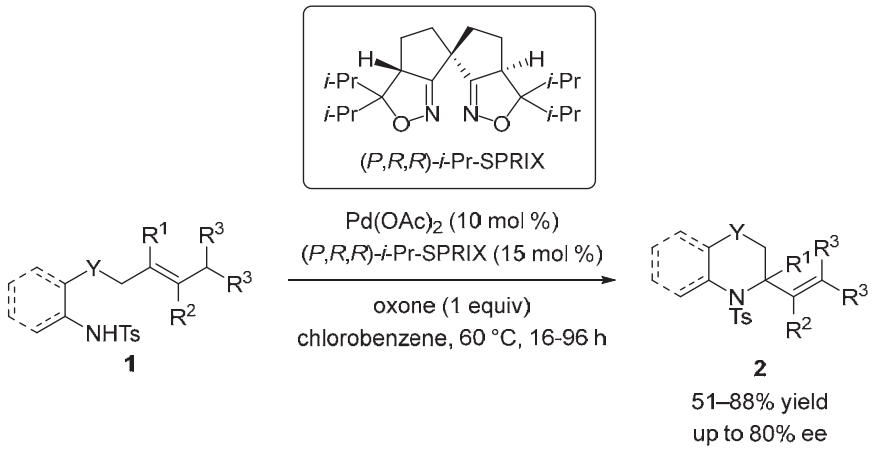
Outlines

Optically active *N*-heterocyclic compounds are broadly found in pharmaceutical and natural products. While various synthetic protocols have been developed for the synthesis of such heterocyclic compounds, Pd-catalyzed asymmetric oxidative C–N bond-forming reaction, frequently referred to as the aza-Wacker-type cyclization, is a highly useful and straight-forward method. Although a number of examples have been reported for the aza-Wacker-type cyclization, the enantioselective version is limited to the 5-membered ring formation.

Research Projects

Enantioselective Synthesis of Nitrogen Heterocycles *via* aza-Wacker-type Reaction Catalyzed by Pd-SPRIX Complex

In 2012, Stahl and his co-worker reported a 6-membered ring forming aza-Wacker-type reaction of alkenyl tosylamides **1**. Previously we successfully developed a methodology for the synthesis of 6-membered oxygen heterocylcles *via* Wacker-type cyclization by utilizing a spiro-type chiral ligand, SPRIX. We conceived that the unique property of SPRIX enabled 6-membered nitrogen heterocycles to be constructed enantioselectively. After optimization of reaction parameters, aza-Wacker-type cyclization of substrates **1** was found to proceed smoothly in the presence of Pd-(*P*,*R*,*R*)-*i*-Pr-SPRIX catalyst and oxone as the oxidant to furnish desired several heterocycles **2** such as morpholines, piperazines, piperidines, and their benzo-fused derivatives in up to 88% yield with 80% ee.



Scheme 1. Enantioselective Aza-Wacker-Type Cyclization Promoted by Pd-SPRIX Catalyst

Department of Nanosystem Design

Guest Professor: Shigeki TAKEUCHI (1.4.2018 - 31.3.2019)

Outlines

In order to realize quantum information science using photons, such as quantum computer, quantum metrology, and quantum network, it is important to develop photonic quantum devices for the controlling the nature of the photons. For this purpose, we have studied about nanophotonics devices coupled with single light emitters. In this year, we worked on the development of a nanofiber Bragg cavity (NFBC) with high *Q* factor, which is a microcavity embedded in an optical nanofiber, by using a helium focused ion beam (FIB) system in nanotechnology open facility of Osaka University.

Research Projects

We have fabricated NFBCs using a helium focused ion beam (FIB) system (ZEISS "ORION NanoFab"). In our previous studies, we succeeded in the improvement of *Q* factor from 250 to 450 when the NFBC was fabricated with same fabrication parameters with the gallium FIB system. In this year, we fabricated the NFBCs with increased grating periods to improve the *Q* factor.

Figure 1 shows the measured transmission spectrum of the NFBC with 320 grating periods. A sharp resonant peak is appeared in the stop band. The wavelength and the linewidth of the peak are 701.8 nm and 0.45 nm, respectively. These agree with the *Q* factor of 1560.

To further improve the *Q* factor, we fabricated the NFBC with 640 grating periods. We observed a sharp resonant peak with the linewidth of 0.17 nm, which corresponds to the resolution limit of our spectrometer. The estimated *Q* value from this linewidth is 4170. Taking into account the resolution of the spectrometer, however, the actual *Q* value would be higher than this value [1].

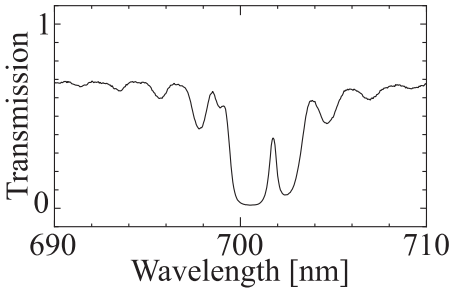


Figure1. Transmission spectrum of the fabricated NFBC

We will develop hybrid devices of the high *Q* NFBC and a single light emitter toward the realization of photonic quantum devices.

In addition, as a related result, we also realized a "nano optical fiber microscope" using a thin tapered optical fiber [2]. This result will pave the way to a new optical measurement method that can scan high-low differences on the nanometer order and changes in physical properties over a wide range.

[1] Hideaki Takashima, Atsushi Fukuda, Hironaga Maruya, Toshiyuki Tashima, Andreas W. Schell, and Shigeki Takeuchi, Fabrication of a nanofiber Bragg cavity with high quality factor using a focused helium ion beam, Optics Express, 27, 6792-6800 (2019). [2] Hironaga Maruya, Yasuko Oe, Hideaki Takashima, Azusa N. Hattori, Hidekazu Tanaka, and Shigeki Takeuchi, Non-contact detection of nanoscale structures using optical nanofiber, Optics Express, 27, 367-276 (2019)

Department of Nanosystem Design

Guest Associate Professor: Yuta Nishina (1.4.2018 - 31.3.2019)

Outlines

Rapid increase in the global usage of consumer electronic products has accelerated the consumption of non-renewable resources and generated a large amount of electronic-waste (e-waste). E-waste has been threatening human health and environment, especially in developing countries. From this point of view, there is a growing need to develop green electronic devices, which are originating from natural resources and are human/environment-friendly. Wood-derived nanocellulose paper has recently received major attention as a promising substrate for green electronics due to its renewability and biodegradability. However, the use of metal or petroleum-based non-renewable electric components is still required, because nanocellulose is electrically insulative (more than 10^{14} Ω).

In this study, we conducted the conversion of electrically insulative nanocellulose to conductor by a carbonization strategy for bio fuel cell applications, by collaboration with Assoc. Prof. Hirotaka Koga (Department of Functionalized Natural Materials).

Research Projects

Carbonized nanocellulose paper for glucose-based enzymatic biofuel cell applications

The carbonized nanocellulose paper had an isolated nanofiber structure with high specific surface areas up to 730 m^2 g^{-1} (Fig. 1a). When the carbonized nanocellulose paper was applied as an electrode for glucose-based enzymatic biofuel cell, much higher current was detected as compared with that of conventional graphite sheet and glassy carbon (Fig. 1b). The high performance of the carbonized nanocellulose paper electrode was possibly derived from its interconnected nanoporous structures (Fig. 1a), which would allow the efficient transport of enzyme (FAD-GDH).

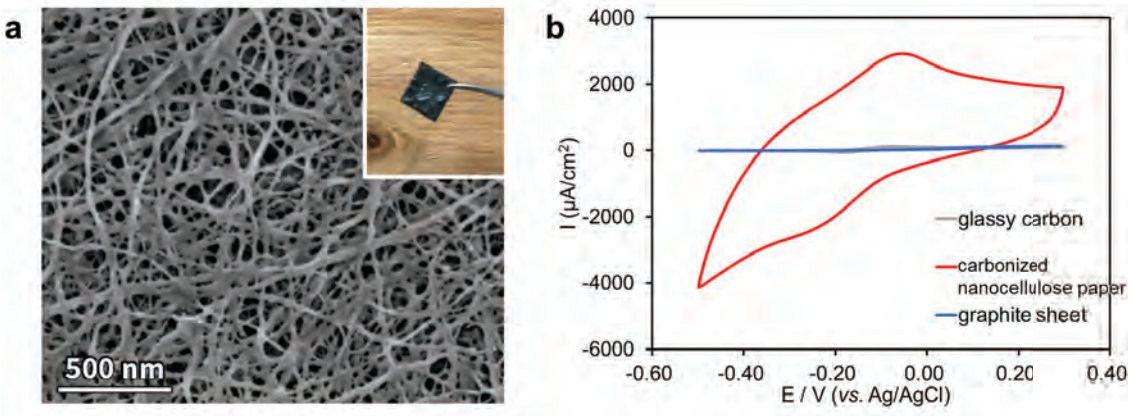


Fig. 1 (a)Optical and FE-SEM images of carbonized nanocellulose paper, (b)cyclic voltammetry curves of the carbonized nanocellulose paper, glassy carbon, and graphite sheet as a glucose-based enzymatic biofuel cell electrode.

Department of Nanosystem Design

Guest Associate Professor: Kazuki Nagashima (1.4.2018 - 31.3.2019)

Outlines

Recent progress towards the Internet of Things (IoT) and the concept of a “trillion sensor universe” have highlighted the importance of molecular sensor devices for medical diagnostics, environmental monitoring, industrial safety, and other applications. There is a growing demand for a large number of widely distributed sensor devices, which are preferably disposable, for achieving the proposed trillion sensor society.

In this study, the paper-based disposable molecular sensor was developed by using an oxide nanowire sensor, a nanocellulose paper substrate, and pencil-drawn graphite electrodes, by collaboration with Assoc. Prof. Hirotaka Koga (Department of Functionalized Natural Materials).

Research Projects

Disposable paper sensor

The paper-based disposable molecular sensor device was constructed from a wood-derived biodegradable nanocellulose paper substrate, a nanowire sensor based on zinc oxide (ZnO), and a low-cost graphite electrode (Fig. 1). The ZnO nanowire/nanocellulose composite structure was embedded into the surface of a nanocellulose paper substrate via a two-step papermaking process. This structure provided mechanically-robust and efficiently-bridged networks for the nanowire sensor, and allows reliable electrical contact with electrodes. The as-fabricated paper sensor device with pencil-drawn graphite electrodes exhibited efficient performance for resistance change-based molecular sensing of NO_2 as a model gas, which was comparable to that of conventional precious metal electrode-based sensors. Furthermore, we demonstrated cut-and-paste usability and easy disposal of the sensor device, which featured uniform sensing performance over its whole surface area. This strategy can be extended to various oxide nanowires, and will break new ground in the creation of abundant, ubiquitous, and disposable molecular sensors for future sensor society.

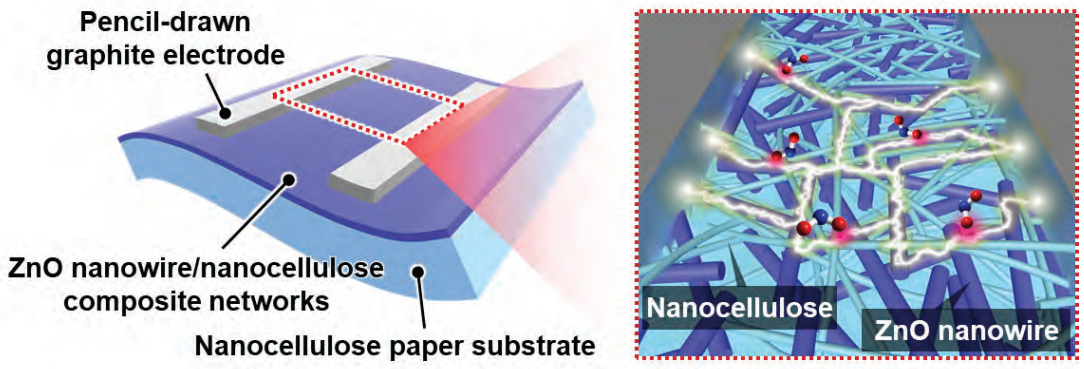


Fig. 1 Schematic of the paper sensor consisting of nanopaper and ZnO nanowires.

Department of Nanosystem Design

Guest Researcher: Kazumasa OKAMOTO (1.4. 2018-31.5. 2018)

Outlines

Lithography using quantum beams is widely used not only for mass production of semiconductor devices, but also as one-off nano/ micro processing. Along with the recent development of extreme ultraviolet (EUV) lithography, not only chemically amplified resists but also metal-containing resists are being developed. Therefore, we have tried to enhance the performance of chemically amplified resists and selectively patterning of metal oxide crystals.

Research Projects

Sensitivities of the chemically amplified resist upon adding diphenyl sulfone with a methoxy group at the para position (DMS) was measured after electron beam (EB) exposure. Further, 125 keV EB lithography patterning of line and space (L&S) was similarly performed, and the pattern line width and LWR (Line Width Roughness) after development were measured by a scanning electron microscope (SEM). In addition, nanosecond pulse radiolysis using 26 MeV EB was performed at Research Laboratory for Quantum Beam Science. The radiation-induced reaction was analyzed. As a result of the SEM, the sensitivity was enhanced upon adding DMS, and the resolution of space patterns was also improved. In addition, DMS enhances the acid yield because electron transfer from DTS radical anion to acid generator occurs after the EB irradiation.

It is possible to prepare oxide micro-nanocrystals of various metals in neutral water conditions upon irradiations of ultraviolet light and gamma-ray by “Submerged Photo-Synthesis of Crystallites (SPSC)” method. SPSC proceeds without additives such as catalysts, etc. and under room temperature and atmospheric pressure. In former works, oxide nanobumps (concave and convex shape) are formed on the metal surface in liquid plasma, and the SPSC method is performed, thus the position of nanobump formation is random. We tried to metal oxide patterning using SPSC method using lithography. ZnO pattern was formed by 125 kV electron beam lithography using zinc naphthenate as a resist. The sensitivity was about 50 $mCcm^{-2}$. 100 nm-thick Cu nano-patterns were formed by a lift-off method combining EB lithography using ZEP520A resist and Cu deposition. The SPSC method using 365 nm ultraviolet light was preliminary carried out. As a result, ZnO crystals were aligned with the Cu pattern.

Department of Nanosystem Design

Guest Researcher: Satoshi TSUKUDA (1.4.2018-31.3. 2019)

Outlines

Polymer gels are commonly used as a template and reducing agent for the synthesis of metallic NPs and exhibit a volume phase transition by absorption of a large amount of water or in response to external stimuli. We have reported selective formation of Au nanoparticles on Poly(vinylpyrrolidone) (PVP) gel film by photoreduction reaction. The Au NP and PVP gel hybrids exhibit visible optical absorption based on localized surface plasmon resonance (LSPR) of the Au NPs. The absorption peak wavelength shifts reversibly with cycles between in air and water because the distance between Au NPs alters in response to PVP gel volume change during swelling and drying cycles. poly(N-isopropylacrylamide) (PNIPA), are known to exhibit a volume transition at lower critical solution temperature (LCST) because PNIPAM polymers exhibit a conformation transition in water by releasing structured water molecules around the polymer chains. Here, we report solution synthesis of hybrids combining both Au NPs and PNIPAM gel film. The shift of the absorption peak of the LSPR of Au NPs was also demonstrated, utilizing the change of interparticle distance of Au NPs accompanying the volume change of the swelling and shrinkage of gels responding to the temperature.

Research Projects

PNIPAM was dissolved in 2-propanol at 1.0 wt %. N, N-methylenebis(acrylamide) was added to solution as the cross-linking agent at 15 wt % against dissolved PNIPAM. PNIPAM films were prepared on Si substrate by spin-coating. The films were exposed to EB to fabricate gel film. Furthermore, for fabricating Au NPs on PNIPAM films, the samples were immersed in HAuCl4-containing MeOH solutions. After immersing the samples for 10 min, the solutions were irradiated by UV light. Au NPs were selectively formed on PNIPAM gel film by the photoreduction of Au ions. The Au NPs were preferentially and rapidly formed on PNIPAM gel because the films, which consisted of 3-D gel networks, serve as a reduction site and affected particle formation. The Au NP and PNIPAM gel hybrids exhibit visible optical absorption based on localized surface plasmon resonance (LSPR) of the Au NPs. In water, the LSPR peak from Au NPs on PNIPAM films is blue-shifted compared to the dry conditions. This result are good agreement with trend of the Au/PVP hybrid films. The absorption peak wavelength blue-shifted at 40 ºC because the distance between Au NPs alters due to shrinkage of PNIPAM gel caused by increase of the temperature more than LCST.

Department of Nanosystem Design

Guest Researcher: Hiroki YAMAMOTO (1.4. 2018-31. 3.2019)

Outlines

The requirements for next generation resist materials in extreme ultraviolet (EUV) lithography are very challenging. Therefore, the development of new resist materials and processes has been expected to meet strict requirements. Recently, metal sensitizers containing metal elements of high EUV absorbance have gained growing attention due to significant sensitivity improvement. However, the role of metal sensitizers for sensitivity improvement has been still unclear because of the absence of the fundamental study of the metal sensitizer. In this study, we investigated the patterning performances of the resists containing metal sensitizer were investigated using electron beam (EB) lithography system. These results indicate metal sensitizers are promising method for the improvement of resist performance.

Research Projects

The resist NXE1631, without sensitizer, will be called A_0. Two different loadings of sensitizer A were added. A_{Low} contains 7.5 wt% sensitizer A loading and A_{High} has 11.3 wt% sensitizer A loading. Propylene glycol monomethyl ether acetate (PGMEA) was used as a casting solvent. In order to examine the cause of sensitivity improvement of the resist, the patterning properties were investigated by a 125 kV EB exposure tool (ELIONIX, ELS-F125). Figure 1 shows SEM micrographs of line and space patterns of A_0, A_{Low}, and A_{High} after PEB at 90 ˚C for 60 s. The area dose of electron beam exposure were required from 140 μC/cm^2 (A_0) to 60 μC/cm^2 (A_{High}). We observed a dose reduction of 43% for A_{Low} and 57% for A_{High}. Similar trend with EUV patterning was observed from 125 kV EB patterning results. In both A_0 and A_{Low}, clear line and space patterns could be obtained with resolutions of half-pitch 40 nm. At high sensitizer loading, we observed a clear degradation of the pattern quality. Nevertheless, the addition of a metal sensitizer does not necessarily lead to pattern degradation as shown in A_{Low} where the line width roughness was reduced compared to A_0. Our result indicates that an optimized loading of sensitizer can lead to a simultaneous reduction of dose and roughness, at identical resolution ［Original Paper 1］. Thus, the sensitizer plays their role, with significant dose reduction. Perhaps, the presence of metal sensitizer helps achieving higher pattern formation efficiency.

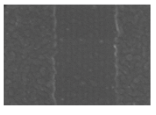
Sample	A_0	A_{Low}	A_{high}
Picture HP 40nm			
Dose-to-size (μC/cm²)	140	80	60
LWR (nm)	3.1	2.3	NA

Figure 1. SEM micrographs of line and space patterns of A_0, A_{Low}, and A_{High} after PEB at 90 ºC for 60 s.

1. H. Yamamoto, Y. Vesters, J. Jiang, D. De Simone, G. Vandenberghe, and T. Kozawa, J. Photopolym. Sci. Technol., 31 (6) 747-751 (2018).

Department of Nanosystem Design

Guest Researcher: Masayuki TOYODA (1.10. 2018- 31.3. 2019)

Outlines

Electromagnetic materials have greater potential to realize novel electronics devices that are faster, less energy consuming, and more efficient than conventional electronic device materials. This is because electromagnetic materials can have several advantages such as the fast operation speed, non-volatility, and high-density recording, which are currently realized by combining semiconductors and magnets in the conventional electronics. The electromagnetic materials are, however, still rare in number and the physical origin of the electromagnetic responses are not completely revealed. Therefore, in this research project, we theoretically investigate the microscopic mechanism behind the electromagnetic effect in transition-metal oxides that exhibit multipole-type alignment of localized spins by using the first-principles electronic structure calculations. We also try to predict and confirm the electronic and magnetic properties of selected materials via close collaboration with experimental researches.

Research Projects

A-cation control of magnetoelectric order in $A(TiO)Cu_4(PO_4)_4$

In this project, we revealed the microscopic mechanism behind the magnetic exchange interaction in a group of transition-metal oxides $A(TiO)Cu_4(PO_4)_4$. This group of materials have a characteristic crystalline structure called *square cupolas*, in which square plaquettes of CuO_4 are connected with an angle between the neighboring ones. The localized spins at Cu sites shows antiferromagnetic ordering due to the super-exchange interaction. They also show non-collinear canting because of the magnetic anisotropy and anisotropic magnetic exchange interaction due to the non-flat feature of the square cupola structures. This canting result in quadrupole-type alignment of the spin component on the *ab* plane, which then leads to electromagnetic effect. When *A*-cation is alkaline-earth metals such as Sr and Ba, however, the material does not exhibit macroscopic electric polarization because the exchange interaction along *c* axis becomes antiferromagnetic and thus the local electric polarization induced by the electromagnetic response cancels each other. In our study, we found that when *A*-cation is group-IV element such as Sn and Pb, the 5*s* or 6*s* electrons of the *A*-cation mediate the ferromagnetic exchange interaction along the *c* axis and, therefore, the materials could exhibit macroscopic electric polarization from the analysis of the density-of-states and the charge-density distribution in real space. Based on this insight, our collaborator synthesized single crystals of $Pb(TiO)Cu_4(PO_4)_4$ and successfully measured its macroscopic electric polarization induced by the magnetoelectric effect.

Department of Nanosystem Design

Guest Professor: Jun TERAO (1.16.2019-31.3.2019)

Outlines

Conjugated porphyrin tubes with defined axis lengths and cavity sizes were successfully synthesized by a two-step amine template method, i.e., template-assisted cyclization and tubulation. During the tubulation, structural parameters of templates, such as numbers of coordination points and distances between the coordination points, played important roles in controlling the axis lengths and tubulation rates. The porphyrin tubes exhibited an extended effective conjugation because of the rigid tubular structure.

Research Projects

Two-Step Template Method for Synthesis of Axis-Length-Controlled Porphyrin Tubes

This is the first example of synthesizing covalently linked porphyrin tubes with a defined axle lengths via one-dimensional accumulation of ring shaped square porphyrin dimers. In the presence of the templates, a defined number of the square porphyrin dimers coordinated with the templates selectively. Therefore, the intermolecular reactions among the accumulated square porphyrin dimers on the templates afforded porphyrin tubes with controlled axle lengths. Kinetic analyses revealed that the lengths of the alkyl linker ($-(CH_2)_n-$) between two coordination points for porphyrin rings affected the reaction rate of the tubulation. An appropriate distance between reaction points on the complexes between the template (n = 6) and square porphyrin dimers accelerated the tubulation. The tubular structures suppressed the rotation of the oligomeric porphyrins around the diyne bonds, which fixed multiple porphyrin planes with high coplanarity. Accordingly, porphyrin tubes have the longer effective conjugation lengths than the butadiyne linked linear porphyrin oligomers.

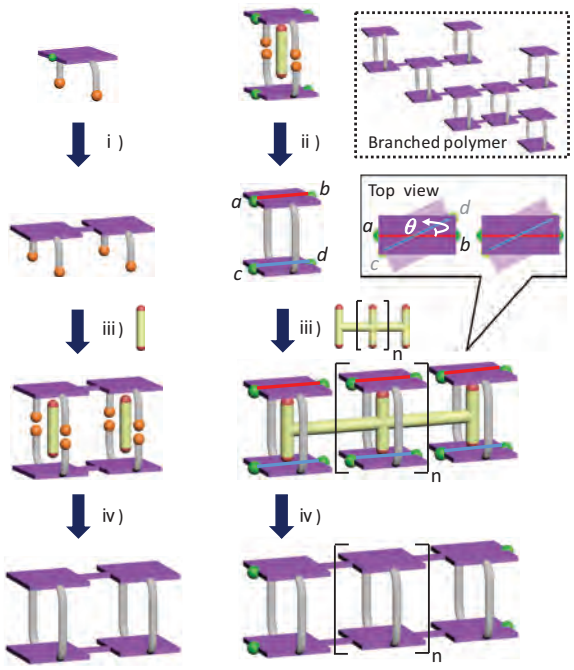


Figure 1. Template synthesis of porphyrin tubes (left: previous method, right: this method); (i) dimerization, (ii) template-assisted cyclization, (iii) complexation, and (iv) template-assisted tubulation.

Department of Nanotechnology for Industrial Applications

Guest Professor: Akther A.K.M. Hossain (17.12. 2018-15.2.2019)

Outlines

"Spintronic devices" are one of the most important next generation energy saving devices, and research on ferromagnetic and ferroelectric heterostructures becomes very important such as La,$SrMnO_3$, Fe_3O_4, $BiFeO_3$ and so on. Especially, translon metal oxides exhibit ferromagnet with very high Curie temperature above room temperature, ferroelectrics with very large spontaneous polarization. However, in these materials, nano-fabrication technique is not developed owing to their hardness, so it is highly desired to develop new nano-fabrication technique to realize T bit / $inch^2$ scale highly integration.

Research Projects

In this research project, we prepared a multiferroic (ferroelectric-ferromagnetic) oxide nanocomposite material. By sintering (Li,Ni,Mn,Bi, Dy, Fe)O sample, nanocomposite composed of spinel type (Li,Ni,Mn)Fe_2O_4 and perovskite type (Bi,Dy)FeO_3 are spontaiously obtaind. X-ray diffraction measementn and scanning electron microscope observatin comfimed formation of crystalline nano-composite systen. Spinel Fe oxides exhibits ferromagnet with very high Curie temperature above room temperature, and perovskite Fe oxide shows ferroelectrics with very large spontaneous polarization, so the system is expected to be nano-scale integrated multiferroic system.

Nanofabrication Shop

Director, Professor: Hidekazu TANAKA
Technical Staff: Shouichi SAKAKIHARA

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.

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 128 fabrication requests from 14 laboratories in 2018. Figure 1 shows the transit of requests since 2005. Though there are abrupt changes in the number of requests which accompanied the increase and decrease of the major client, we wish to aim at the number of 100 requests from 10 laboratories.

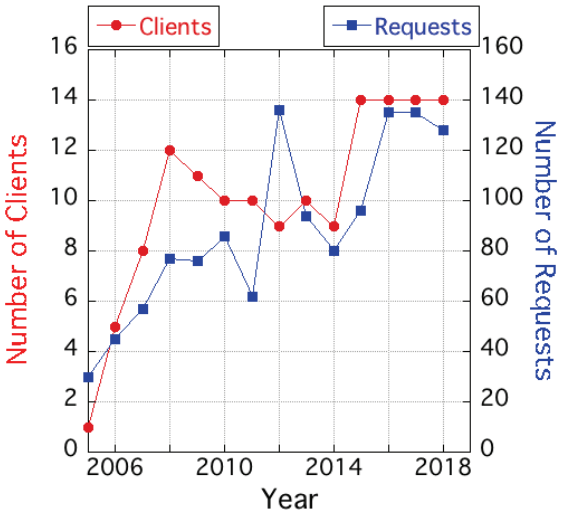


Figure 1 The transit of requests since 2005.

It received the request of the printed circuit board manufacture in 2018 for the first time. Using a glass epoxy board to which a copper plate of 40 micrometers in thickness was stuck as a material, a wiring of several to 0.05 millimeters was produced by photolithography and wet etching. Figure 2 shows a photograph of the finished product. The positive novolac resist, which is the most commonly used resist, was etched for a long-time wet etching. Thus, we used a negative epoxy resist. However, since peeling from the substrate occurs when etching proceeds, photolithography is required twice. The line of 50 micrometer width was thinned, but there was no problem because it did not affect the function of the circuit.

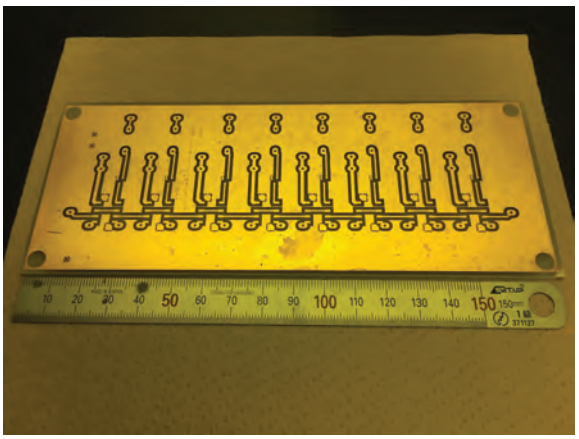


Figure 2 The printed circuit board fabricated twice with photolithography and wet etching.

Participation in “nanotech 2019”

We demonstrated some samples and devices, showed a panel introducing our activity in the booth of Nanotechnology Center in the international nanotechnology exhibition and conference “nanotech 2019” which was held on 30th of January to 1st of February in 2019.

Advanced Nanotechnology Instrument Laboratory

Director, Professor: Hidekazu TANAKA
Specially Appointed Technical Staff: Michiko SAKUMA

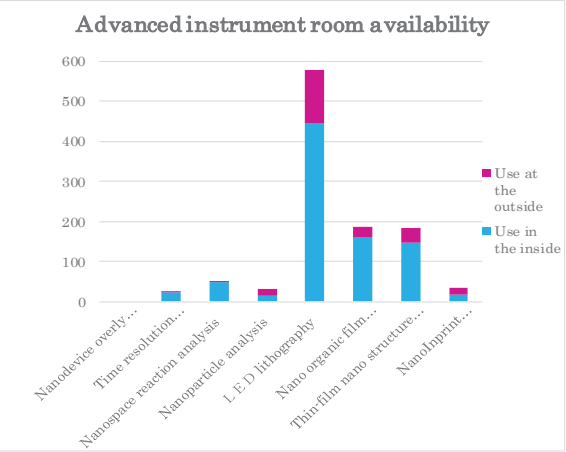
Outlines

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

Research Projects

Advanced Instrument Laboratory assisted nano/micro-fabrication researches using Nanoimprint lithography, LED mask-less lithography system, and assisted investigation of thin film properties using Thin-film nano structure analysis, Nano organic film evaluation, Nanospace reaction analysis, and so on.

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



Nanotechnology Open Facilities

Director, Professor:	Seiji TAKEDA (-30.6. 2018)
	Hidehiro YASUDA (1.7. 2018-)
Professors:	Tamio OGUCHI (1.4. 2018-)
	Hidekazu TANAKA
	Masateru TANIGUCHI
Specially Appointed Professors:	Hirotarou MORI
Specially Appointed Assistant Professors:	Akira KITAJIMA
	Kimihiro NORIZAWA
Specially Appointed Researchers:	Miki KASHIWAKURA
	Kouji HIGUCHI (-31.7. 2018)
	Takashi TANIGUCHI (-15.3. 2019)
	Kazumi KONDA
	Masanobu YAMAZAKI
Technical Supporting Staff:	Yoshimi MAEGAWA
Supporting Staff:	Keiko ENMI (1.10. 2018-)
	Kyoko SHIMOMITSU (1.12. 2018-)
	Yukiko Watsuji

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 160 research themes in 2018.

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 equipment 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.

Research Projects

Bring-up Nanotechnology Open Facilities

The 160 research themes (except for non-publish the fruits) have been supported in the program in 2018. 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) Equipment utilization without assistance, (c) Technical substitution, (d) Collaborative research with NOF staff and (e) Using equipment with NOF operators.

Break-through toward Multi-platform Nanotechnology R&D

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

Fusion between Top-down and Bottom-up Nanotechnologies

For top-down and bottom-up nanotechnologies, lots of useful equipment such as 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:	Takahiro KOZAWA
Associate Professor:	Takeyuki SUZUKI
Assistant Professor:	Da-Yang ZHOU, Kaori ASANO
Assistant Professor:	Kazuhiro TAKENAKA, Makoto SAKO,
(concurrent)	Naoto KAMIUCHI, Tomoyo GOTO, Mitsuko NISHINO
Technical Staff:	Tsuyoshi MATSUZAKI, Hitoshi HANEOKA,
	Yosuke MURAKAMI, Tsunayoshi TAKEHARA
Technical assistant Staff:	Takeshi ISHIBASHI
Support Staff:	Etsuko MORI

Outlines

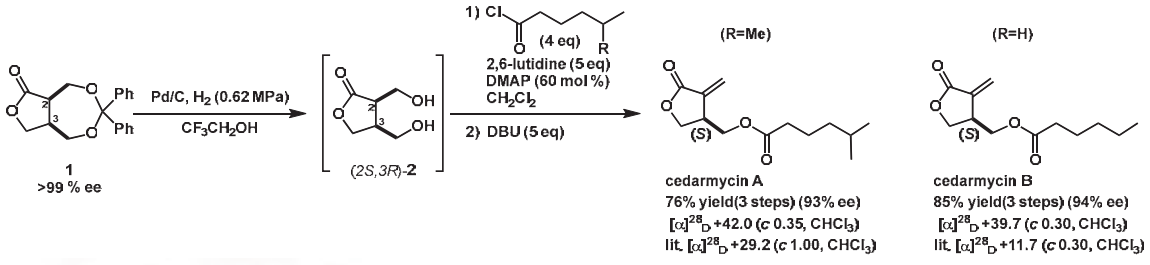
The Comprehensive Analysis Center was founded in 2009, whose project includes (1) analysis of samples provided from other research sections in ISIR and (2) original research for developing novel synthetic methods using a molecular catalyst.

Research Projects

Determination of the absolute configuration of cedarmycins

Tishchenko reaction is known as the synthetic method of the dimeric ester from the corresponding aldehydes. Recently we have succeeded in the asymmetric synthesis of cedarmycins using the asymmetric Tishchenko-type reaction for the first time.

This time we applied this method for the synthesis of the natural products. Cedarmycins A and B are antibiotic compounds isolated from the cultured broth of the actinomycete Streptomyces sp. TP-A0456 by Furumai. The absolute configuration of the lactone **1** was determined by the single crystal X-ray analysis. After deprotection of diphenylmethylidene acetal, the resulting diol **2** were converted to the diester, and one-pot elimination gave cedarmycins. Thus the absolute configuration of natural cedarmycins has *S* form.



Catalytic asymmetric synthesis of cedarmycins using asymmetric Tishchenko-type reaction

Research Laboratory for Quantum Beam Science

Professor, Director:	Yoichi YOSHIDA
Associate Professor:	Yoshihide HONDA
Assistant Professor:	Sachiko TOJO
Specially Appointed Professor:	Goro ISOYAMA
Specially Appointed Researcher:	Akira TOKUCHI
Technical Staff:	Kazuya FURUKAWA, Yuhei OKADA
Supporting Staff:	Nanami FUJITA (1.5.2018-)
(Concurrent members)	
Professors	Yoichi YOSHIDA, Takahiro KOZAWA
Associate Professors:	Mamoru FUJITSUKA, Kiyohiko KAWAI, Jinfeng YANG, Yusa MUROYA, Yasuko OSAKADA
Assistant Professors:	Takafumi KONDO(-15.1.2019), Akinori IRIZAWA, Koichi KAN, Kazumasa OKAMOTO (1.6.2018-)
Specially Appointed Professor:	Kazuo KOBAYASHI

Outline

The Research Laboratory for Quantum Beam Science (RLQBS) has 3 electron linacs, i.e. a 40 MeV L-band linac, a 150 MeV S-band linac, an RF-Gun S-band linac, and three ^{60}Co γ-ray sources as the representative facilities for joint use. These are opened to the users in Osaka University. Based on quantum beam science, frontier beam science relating to environmental material science, new energy sources and advanced medical technology as well as fundamental beam science are promoted with the above concurrent members. The management including operation, maintenance and the safety control of radiation related facilities are also conducted with the aid of concurrent members.

Current Research Projects

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

The results of operation for all linacs: total score 3,434 hours, 273 days, 38 themes.

L-band linac was operated for 218 days except for maintenance use, 2,820 hours (Fig.1). The major issues of this year are described below. **Electron-Gun:** Due to a serious increase of dark current, the cathode used for one year and four months was replaced. A new DC high voltage power supply was equipped in the injector instead of a step-up transformer soaked in PCB-contaminated oil. **Cooling System:** The cooling tower water was going to be supplied directly to the second heat exchanger by bypassing the first heat exchanger to save the lifetime of refrigerator of the first heat exchanging system as well as the running cost, since the temperature of cooling tower water was well stable except summer season. This procedure successfully contributed to a stable operation and to a cost-cut of electricity by about 20 kW. **RF system:** The circuits relating to the semiconductor switches in failure was repaired after diagnosing each contained board and finding damages on the 9 boards. **Beam sharing:** A new beam-sharing trial was carried out. Although a flat-top operation of the magnetic field at a rate of 5 Hz was not achieved even under the magnetic feedback control, the stability

Fig. 1. Results of L-band linac

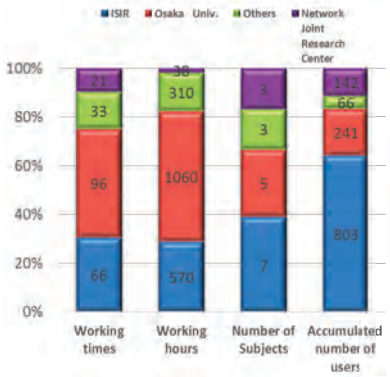


Fig. 2. Results of Co-60 facility

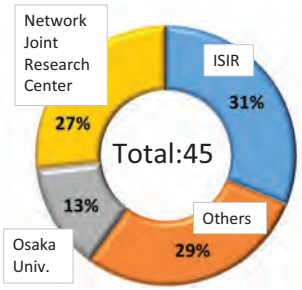


Fig. 3 Accepted subjects

of the magnetic field in the bending magnet was evaluated to be about 0.7% at the fixed timing in the time-varying region, and the beam current stability was about 0.2% in the second irradiation room, showing that the present beam sharing system would be applicable to the pulse radiolysis experiments.

RF-gun S-band linac was operated for 117 days, 1,152 hours.

150 MeV S-band linac was not operated. Several condensers in the circuits of klystron and modulator were replaced due to potential contamination of PCB. During this procedure, several leakages of SF6 gas were detected. In particular, the leakage on the RF-power splitter including phase shifter and tuner seems difficult to repair or purchase again due to high price. The difficult situation would be averted by increasing a gas-filling frequency at present. The linac is able to be operated.

Cobalt-60 facility was used in 216 times, 1,976 hours, for 18 subjects (Fig.2). The annual maintenance was made in March.

Management (Joint use & Radiation safety management)

Accepted subjects were 45 in total (Fig.3). Specially programmed academic meeting was held on Dec. 17 2018 and the annual debrief session was held on March 8 2019. Visitors were more than 76. The training concerning radiation safety management was carried out for the registrants on May 11 2018. The inspection conducted every two years by Institute for Radiation Science in Osaka Univ. was carried out on Dec. 13 and no problems were pointed out.

Formation and structures of methionine dimer radical cation by during Pulse Radiolysis Resonance Raman Spectroscopy

We have developed the nanosecond time-resolved resonance Raman spectroscopy (ns-TR3) during pulse radiolysis. The oxidation of N-acetyl-methionine (Met) with hydroxyl radical (OH•) in aqueous solution lead to the formation of intermolecular σ-dimer radical cation ($Met_2^{\cdot+}$) with two-center three-electron bond between two sulfur atoms (2c-3e S∴S). The ns-TR3 spectrum of $Met_2^{\cdot+}$ shows a peak at 267 cm^{-1} (2c-3e S∴S stretching). This is the first report on the ns-TR3 direct measurement of 2c-3e S∴S of σ-dimer radical cation in amino acid systems.

Production of slow positron beam based on electron linac

A new designed moderator was fabricated and equipped in the vacuum vessel. A VXI bus controller in failure was repaired. Some leakages in the vacuum vessels of positron transport line are repaired, the present vacuum pressure is kept about 10^{-7} Pa.

Center for Collaborative Research Education and Training

Director:	Professor Akira OIWA
Head of Educational Affaires Board:	Professor Masateru TANIGUCHI
Board Members:	Professor Takashi WASHIO
	Associate Professor Shinichiro TANAKA
	Associate Professor Kiyohiko KAWAI
Head of International Affaires Board:	Professor Hiroaki SASAI
Board Members:	Professor Hikaru KOBAYASHI
	Assistant Professor Teppei ARAKI
	Associate Professor Hideto YOSHIDA

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 kinds 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 Collaborative Research Center

Outlines

ISIR has promoted international collaboration with various universities and institutions all over the world based on the agreements on the academic exchange programs with the institutions and universities and by establishing the ISIR Branches in the foreign countries and so on. To further promote and to continuously support such international exchange and collaborations, International Collaborative Research Center was founded in April 2009. The center consists of several collaborative laboratories, which are established between ISIR and the universities / institutions in the foreign countries. Currently nine 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

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.

CU-ICT lab.

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

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

SMU-EMGRL lab.

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

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

UU-CTMD lab.

Department of Physics and Astronomy, Uppsala University (UU), and ISIR have established a cooperative research laboratory between both institutions.

1. Theoretical and computational material design.

HKU-MID lab.

School of Biological Sciences, The University of Hong Kong (HKU), and ISIR have established a cooperative research laboratory between both institutions.

1. Research on overcoming microbial infection and multidrug resistant bacteria

Dynamic Alliance for Open Innovation Bridging Human, Environment and Materials

Outline

Based on the former successes of multi-party alliance projects (FY2010-FY2015), "Dynamic Alliance for Open Innovation Bridging Human, Environment and Materials" (Five-star Alliance) was started in FY2016 to attempt strategic development of next generation Materials, Devices, and System for bridging human, environmental and materials as a cooperative research project with five outstanding university institutes, ISRI (Osaka University), Research Institute for Electronic Science (RIES: Hokkaido University), Institute of Multidisciplinary Research for Advanced Materials (IMRAM: Tohoku University), Laboratory for Chemistry and Life Science, Institute of Innovative Research (CLS: Tokyo Institute of Technology), and Institute for Materials Chemistry and Engineering (IMCE: Kyushu University).

This Five-star Alliance consists of three research groups; "Electronics Materials and Devices (G1)", "Environment and Energy Materials, Device and Systems (G2)", and "Biological Functions Materials, Devices and Systems (G3)". In addition, various types of multidisciplinary collaborative researches are carried out through the newly-established "Quantum-beam" and "Time-resolved" Materials and Properties Analysis sub-research groups. In addition, the alliance has strong correlation with the "Network Joint Research Center (NJRC) for Materials and Devices"; these two projects are promoted to the inextricably. Through the significant cooperative researches as well as under the promotion programs for young scientist and students, the dynamic alliance project aims to realize innovation that links human, environment and materials and devices.

The alliance was being run under the Steering Committee of five Institutes and CORE Collaboration Center. (Member from ISIR: Prof. K. Suganuma (Director of Operations), Prof. T. Sekino (Chair), Prof. H. Tanaka, and Specially Appointed Prof. H. Asahi (Coordinator)). The group members of ISIR in FY2018 are as follows.

(G1) Electronics materials and devices group (11 members)
Prof. T. Sekitani (Sub-leader), Prof. A. Oiwa, Prof. T. Oguchi, Prof. T. Kozawa, Prof. H. Tanaka, Prof. Y. Yoshida, Prof. T. Washio, Assoc. Prof. M. Nogi, Assoc. Prof. Y. Ie, Assoc. Prof. K. Inoue, Assoc. Prof. J. Kanasaki

(G2) Environment and energy materials, device and systems group (7 members)
Prof. H. Kobayashi, Prof. K. Suganuma, Prof. T. Sekino, Prof. S. Takeda, Prof. T. Majima, Assoc. Prof. S. Tanaka (Sub-leader), Assoc. Prof. Y. Honda, Assoc. Prof. M. Fujitsuka

(G3) Biological functions materials, devices and systems group (12 members)
Prof. K. Nishino (Sub-leader), Prof. S. Kuroda, Prof. K. Komatani, Prof. H. Sasai, Prof. M. Taniguchi, Prof. K. Nakatani, Prof. T. Nagai, Prof. M. Numao, Specially Appointed Prof. A. Yamaguchi, Assoc. Prof. Y. Makihara, Assoc. Prof. T. Suzuki, Assoc. Prof. K. Kawai

Activities of Facilities

Workshop

Director:	Professor Masateru TANIGUCHI
Mechanical workshop workers:	Technical Staff Masayoshi OHNISHI
	Technical Staff Yuki MATSUSHITA
Glass workshop workers:	Technical Staff Hiroaki MATSUKAWA
	Technical Staff Noriyuki OGAWA

Outlines

Workshop 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 Mechanical workshop and the Glass workshop, plays an important role in activities of the institute and contributes to them by making and providing such experimental apparatuses.

The Mechanical workshop performs design and trial manufacture of experimental apparatuses for science and engineering as well as production of experimental tools made of various metals and resin. Requests of experimental apparatuses for vacuum or cryogenic 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. We have a gate-type machining center, NC lathe with milling and a 5 axis-milling machine. We design using 3D CAD and produce prototypes using 3D printers. We can answer to advanced and difficult requests from researchers.

The Glass workshop 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. We have introduce CNC cylindrical grinder machine and we can answer to advanced and difficult requests from researchers.

Activities

This year, we renewed our website. The purpose is to deliver information about what processing techniques are available and what kind of equipment can be produced in workshop. We will build a better support system by exchanging technology with researchers. (Fig.1)

Number of fabrication request jobs

Mechanical workshop: 186jobs
Glass workshop: 78jobs
Total 264 requests from 36 laboratories and joint research company.

Fig. 1 New workshop website

Anechoic Laboratory

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

Outlines

Anechoic Laboratory was reorganized in 2017 from Electronic Processing Laboratory. The aim of this laboratory is to contribute to various studies in the Institute of Scientific and Industrial Research. This laboratory has an anechoic chamber that can be used for acoustic measurement, psychological experiments, etc. The anechoic chamber measures 4.0x7.2 meters (4.0 meters in height) and the sound pressure level in it is below 30dB. The level has been kept as of February 2019.

In the fiscal year of 2018, the internal regulations for using the laboratory was enacted. Maintenance around the anechoic chamber was also advanced, e.g., measurement of acoustic environment performance in the anechoic chamber, and floor maintenance and air conditioning repair in the front room of the anechoic chamber. There were inquiries from outside the university through the website of the anechoic laboratory, which was created last year. The laboratory was also used for a tour of visitors from outside the university.

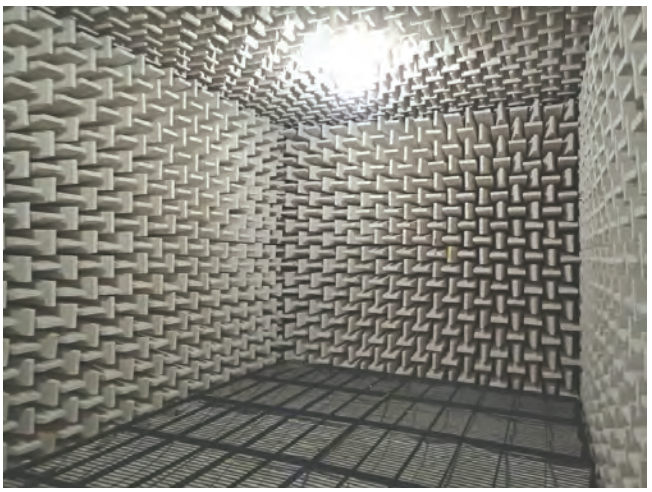


Fig.1 Inside of the anechoic chamber

Library

Professor: Tamio OGUCHI
Librarian: Itsumi KOMURA
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, 2019)

	Number of books	Journals	Newspapers
Japanese	5,126	161 titles	5 titles
Foreign	19,738	493 titles	1 title

Facilities Management Office

Professor: Takahiro KOZAWA
Staff: Kayoko OHASHI

Outlines

Facilities Management Office works for the following matters:

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

Research Projects

On 2018, the following 16researchers used Nanotech Open Laboratory.

Research Representative	Department
Assistant Professor. Takao ONO	Institute of Scientific and Industrial Research
Specially Appointed Professor. Akihito YAMAGUCHI	Institute of Scientific and Industrial Research
Professor. Takahiro KOZAWA	Institute of Scientific and Industrial Research
Professor. Takeharu NAGAI	Institute of Scientific and Industrial Research
Invited Professor. Tetsuro MAJIMA	Institute of Scientific and Industrial Research
Specially Appointed Associate Professor. Shigeki KAWAKAMI	Institute of Scientific and Industrial Research
Specially Appointed Professor. Toshiro ITANI	Institute of Scientific and Industrial Research
Professor. Hidekazu TANAKA	Nanotechnology Open Facilities
Professor. Masateru TANIGUCHI	Nanotechnology Open Facilities
Professor. Yusuke MORI	Graduate School of Engineering
Associate Professor. Yukio TAKAHASHI	Graduate School of Engineering
Associate Professor. Tsuyoshi KONISHI	Graduate School of Engineering
Professor. Makoto YASUDA	Graduate School of Engineering
Researcher Yoshi NISHITANI	Graduate School of Medicine
Invited Professor.Kazuyuki YOSHIZAKI	Graduate School of Information Science and Technology
Professor. Takashi NAKANO	Research Center for Nuclear Physics

Office of Information Network

Professor, Director:	Akira OIWA
Professor:	Masayuki NUMAO
Professor:	Toru SEKINO
Professor:	Hiroaki SASAI
Professor:	Yoichi YOSHIDA
Associate Professor:	Koji KOZAKI
Associate Professor:	Kenji TATEMATSU
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 2.

And we have offered poster printing services for ISIR researchers. Total number of poster printing was 383.

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: Shun'ichi KURODA
Professors: Takashi WASHIO, Masaya NOGI
Kunihiko NISHINO, Hidekazu TANAKA
Specially Appointed Professor: Hirokazu SHIMIZU
Specially Appointed Assistant Professor: Hisaaki KATO

Outlines

The Academia Industry Relations Office (AIR Office) of the Institute of Scientific and Industrial Research (ISIR), is dedicated to reinforcing collaboration between ISIR and the industrial community, thereby combining and developing research potential of the two sectors and promoting activities for new industrial creation and innovation. The AIR Office organizes a variety of activities to inform the industry community of the ISIR's research activities efficiently through the interaction with the industry community such as SANKEN Techno Salon and various industry-university cooperation events. The major activities of AIR Office are: 1) A network development between ISIR and Industry, 2) Responding to inquiries from industry, 3) A liaison between academia and industrial research activities, 4) Creation of complementary opportunities for science and technology progress. AIR Office will make proposals for new business opportunity between academia and industry. New venture business activities and novel industrial products are the vision of AIR Office.

Activities

Promotion of Industry-University Cooperation

1) "SANKEN Techno-Salon"

Held times	Date	Theme	Participants
1	May12, 2018	Microorganism Biotechnology	66
2	Aug. 4, 2018	Image Recognition Technology	80
3	Feb.8, 2019	Active female researcher / entrepreneurs	82
special Ⅰ	Nov.9, 2018	Future society developed by AI / IoT	133
special Ⅱ	Feb.16, 2019	Toward the Expo 2025 Osaka! - Designing a Future Society for the Realization of Society 5.0 -	113

2) "SANKEN Zakkubaran Talk"
6 seminars

3) Publication of a booklet for introduction of ISIR's research activities to industry sectors
https://www.sanken.osaka-u.ac.jp/labs/air/research1.html

4) Publicity of ISIR's technologies at exhibitions etc.
5 exhibitions and one lecture-meeting

Use of Company Research Park

Area Occupancy rate: 95% Number of Use: 25 companies [new use: 4 companies]

Support for New Industry Creation Study Groups

6 study groups (Total number of sessions: 22)

Public Relations Office

Director, Professor:	Akira OIWA
Professors:	Takashi WASHIO (-30.9.2018), Tamio OCUGHI (-30.9.2018), Masaya NOGI, Kunihiko NISHINO, Kazunori KOMATANI (1.10.2018-), Hidekazu TANAKA (1.10.2018-)
Associate Professors:	Shinobu TAKIZAWA (-30.9.2018), Yutaka Ie (-30.9.2018), Kouichi SUDOH, Yusa MUROYA, Koun SHIRAI, Kiyohiko KAWAI (1.10.2018-)
Assistant Professors:	Haruki KIYAMA, (-30.9.2018), Akinori IRIZAWA (-30.9.2018), Masaharu SOMIYA (1.4.2018-), Satoshi HARA (1.10.2018-), Kojiro UETANI (1.10.2018-), Koichi KAN (1.10.2018-)
Staff:	Atsumi ITO
Technical Staff:	Yuka OKUMURA

Outlines

The Public Relations Office was opened in 2006 to provide various information on SANKEN for the public widely, and was strengthened in 2012 by the merge with the Public Relations 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 regular press conference had been started in 2013 in the collaboration with other offices of SANKEN.

Activities

The number of visitors in ICHO Festival:	786
The number of visits and visitors:	17 visits and 416 visitors
Press release:	31(The number of coverages 447)
Regular press conference:	18
The number of SANKEN HP updates	448

Publications (Sanken Introduction Brochure, Annual report, Memoirs, Newsletter)
Exhibit at “Let’s play with Osaka University” (citizen participation type event)

Planning Office

Vice Director :	Yoshinobu ISHIKURA
Staff :	Aya NISHIDA

Outlines

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

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

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

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

Technical Division

Director:	Masayoshi OHNISHI
Group Leaders:	Masayoshi OHNISHI (concurrent), Senjin AIHARA
Chiefs:	Shouichi SAKAKIHARA, Tsuyoshi MATSUZAKI, Yuka OKUMURA, Hitoshi HANEOKA
Staff:	Yuki MATSUSHITA, Kazuya FURUKAWA, Yosuke MURAKAMI, Yuhei OKADA, Tsunayoshi TAKEHARA, Hiroaki MATSUKAWA, Noriyuki OGAWA

Outlines

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

Making experimental apparatuses and samples by machines; Analysis of samples; Machine operation; Maintenance and development of experimental facilities; Network and server management; Creating and updating websites; Public relations activities.

In addition, we take some technical trainings and give the researchers and the students some guidance of expert technical instruction. Furthermore we are in charge of the following matters:

- Activities of safety and security (e.g. holding the safety seminars, radiation protection management, the ISIR in-house fire brigade team, PCB management, and management of medicine and gas control systems)
- Outreach activities (e.g. craft lecture for children “MONODUKURI”)
- Support some symposiums (e.g. Recording and live-streaming etc.)

Activities

New technical staff was assigned the Comprehensive Analysis Center.

We held the following events

- The Safety and security seminar. (35 participants).
- The craft lecture for the children (60 participants).
- The joint technical report meeting with Institute for Protein Research, Osaka Univ. (27 participants).
- Accept the technical training of the Technical Division, School of Science, Osaka Univ.
- Accept the visit from the Technical Division, School of Engineering, Faculty, Kobe Univ.

In addition, we went 50 business trips and technical trainings. Especially we participated in The Alliance Technical Support Symposium held in Tohoku Univ. and interacted with technical staff of 5 institutes of national universities. Furthermore we issued the own annual report FY 2017.

Licenses

Total 79 licenses.

List of Achievements

Department of Quantum System Electronics

Original Papers

[1]Single-electron charge sensing in self-assembled quantum dots, Haruki Kiyama, Alexander Korsch, Naomi Nagai, Yasushi Kanai, Kazuhiko Matsumoto, Kazuhiko Hirakawa, Akira Oiwa: SCIENTIFIC REPORTS, 8 (2018) 13188.

[2]Photogeneration of a single electron from a single Zeeman-resolved light-hole exciton with preserved angular momentum, K. Kuroyama, M. Larsson, C. Y. Chang, J. Muramoto, K. Heya, T. Fujita, G. Allison, S. R. Valentin, A. Ludwig, A. D. Wieck, S. Matsuo, A. Oiwa, and S. Tarucha: Physical Review B, 99 (2019) 85203.

[3]Entropy production by thermodynamic currents in ambipolar conductors with identical spin dynamics characteristics between holes and electrons, Mst. Sanjida Aktar, Masamichi Sakai, Shigehiko Hasegawa, Osamu Nakamura, and Hiroyuki Awano: Applied Physics Express, 12 (5) (2019) 063004.

[4]Automated tuning of inter-dot tunnel coupling in double quantum dots, C. J. van Diepen, P. T. Eendebak, B. T. Buijtendorp, U. Mukhopadhyay, T. Fujita, C. Reichl, L. M. K. Vandersypen: Applied Physics Letters, 113 (2018) 033101.

International Conferences

[1]Photon-spin conversion using gate-defined GaAs quantum dots (invited), Akira Oiwa: QD2018.

[2]Fabrications and transport properties of SiGe self-assembled quantum dots (oral), M. Tanaka, K. Kawaguchi, H. Kiyama, M. Bamesreiter, D. Bougeard, A. Oiwa: 2018 International Conference on Solid State Devices and Materials (SSDM2018).

[3]Transport through quantum dots formed in a (110) GaAs quantum well (poster), T. Nakagawa, R. Fukai, Y. Sakai, Y. Sakai, T. Fujita, H. Kiyama, T. Nakajima, J. Ritzmann, A. Ludwig, A. D. Wieck,: Spin qubit 4.

[4]Magnetic Doppler Broadening Measurement on Gadolinium-doped GaN (poster), M. Maekawa, S. Sakai, S. Hagiwara, A. Miyashita, K. Wada, A. Kawasuso, A. Yabuuchi, S. Hasegawa: The 18th International Conference on Positron Annihilation (ICPA-18).

[5]Effect of magnetic barrier layer thickness on magnetic properties in magnetic/nonmagnetic GdN/GaN superlattices grown by PA-MBE (poster), T. Kojima, S. Hasegawa: International workshop of nitride semiconductors 2018 (IWN2018).

[6]Magneto-optical characterization of GaN/TbN superlattice structures grown by PA-MBE (poster), S. Fujimori and S. Hasegawa: International workshop of nitride semiconductors 2018 (IWN2018).

[7]Single-electron charge sensing in self-assembled quantum dots (poster), Haruki Kiyama, Alexander Korsch, Naomi Nagai, Yasushi Kanai, Kazuhiko Matsumoto, Kazuhiko Hirakawa, Akira Oiwa: 34th International Conference on the Physics of Semiconductors.

Review Papers

Poincaré Interface - Quantum interface from single photon polarizations to single electron spins-, Akira Oiwa、Takafumi Fujita、Haruki Kiyama、Kazuyuki Kuroyama、Sadashige Matsuo、Seigo Tarucha, KOUGAKU, Optical Society of Japan, 47[4] (2018), 148-154.

Books

[1]Molecular beam epitaxy(H. Kasai, T. Koshikawa, R. Oiwa, N. Takahashi et al.) S. Hasegawa, “New Practical Vacuum Technology”, NTS Inc., (543-550) 2019.

Contributions to International Conferences and Journals

A. Oiwa	China-Japan International Workshop on Quantum Technologies (QTech2018) (Organizing Committee)
A .Oiwa	21th International Conference on Electron Dynamics in Semiconductors, Optoelectronics and Nanostructures (EDISON20) (Program Committee chair)
A. Oiwa	International Conference on Solid State Devices and Materials (SSDM2018 (Program Committee voice chair)
A. Oiwa	Compound Semiconductor Week 2019 (Program Committee)

Publications in Domestic Meetings

JPS 2018 Autumn Meeting	4 papers
JPS 2019 Spring Meeting	7 papers
12th Physical Property Science Workshop	2 papers
8th Semiconductor/Superconductor Quantum Phenomena and Information Workshop	1 paper
66th JSAP Spring Meeting	5 papers
17th Low-temperature Superconductor Youth Workshop	1 paper
79th JSAP Autumn Meeting	3 papers
Japan Surface Vacuum Meeting 2018	1 paper
2018 IEIC Society Conference	1 paper
Single-Nanometer Figuration and the Structure-Induced Property	1 paper

Academic Degrees

Master Degree for Engineering T. Kojima	Growth and magnetic characterization of magnetic semiconductor based GdN/GaN superlattice structures
Master Degree for Science M. Tanaka	Electrical transport and side-gate effects in Si self-assembled quantum dots
Master Degree for Science T. Chatani	Detection of photo-excited spins in a (110)-GaAs/AlGaAs QW by using inverse spin Hall effect
Master Degree for Science R. Hayashi	Irradiation effects on a two-dimensional electron system in a field-induced un-doped GaAs/AlGaAs quatnum well
Bachelor Degree for Engineering G. Fukuda	Fabrication and photostability evaluation of field-effect-induced two-dimensional electron gas utilizing modulation-doped ohmic contacts
Bachelor Degree for Engineering H. Idenishi	Detection of light-excited charge in InAs self-assembled quantum dots

Grant-in-Aid for Scientific Research

A. Oiwa	Interconversion of Quantum States Between Photon and Electron Spin Using Electrically Controlled Quantum Dots	¥45,630,000
A. Oiwa	Optical Spin Conversion	¥36,010,000
S. Hasegawa	Controlling spatial distribution of rare-earth elements in III-nitride semiconductors and their magnetic properties	¥4,810,000
H. Kiyama	Research towards full Bell-state measurement of electron spins in semiconductor quantum dots	¥3,510,000
T. Fujita	Single-spin shuttle physics and its application to rapid spin manipulation	¥3,770,000
A. Oiwa	Novel solid state phyics via spatial controls of quantum pairs	¥3,185,000
A. Oiwa	Steering committee of Nano Spin Conversion Science	¥1,495,000
Y. Zhang, A. Oiwa	Spintronics and informatics using layered two-dimensional semiconductor crystals	¥3,900,000
R. Fukai, A. Oiwa	Research on quantum interface from photon polarization to electron spin using lateral quantum dots	¥1,300,000

Entrusted Research

Akira Oiwa	Japan Science and Technology Agency	Creation of a Poincaré interface through the convergence of electronics and photonics	¥22,880,000

Cooperative Research

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

Department of Semiconductor Electronics（Department of Interface Quantum Science）

Original Papers

[1]Digital enzyme assay using attoliter droplet array, T. Ono, T. Ichiki and H. Noji: Analyst, 143 (2018) 4923-4929.

International Conferences

[1]High-Sensitive and Selective Detection of Human-Infectious Influenza Virus Using Biomimetic Graphene Field-Effect Transistor (oral), Takao Ono, Takuya Kawata, Shota Ushiba, Yasushi Kanai, Yasuhide Ohno, Kenzo Maehashi, Koichi Inoue, Yohei Watanabe, Shin'ichi Nakakita, Yasuo Suzuki, Toshio Kawahara, Masahiko Kimura, and Kazuhiko Matsumoto: 76th Device Research Conference.

[2]Detection of Human-Infectious Influenza Virus Using Sialoglycan-Modified Graphene Field-Effect Transistor (oral), Takao Ono, Takuya Kawata, Shota Ushiba, Yasushi Kanai, Yasuhide Ohno, Kenzo Maehashi, Koichi Inoue, Yohei Watanabe, Shin'ichi Nakakita, Yasuo Suzuki, Toshio Kawahara, Masahiko Kimura, and Kazuhiko Matsumoto: 2018 International Conference on Solid State Devices and Materials.

Patents

[1]K20180370 Graphene transistor and its fabrication process, 2019-029080

Publications in Domestic Meetings

The 79th JSAP Autumn Meeting 2018	4 papers
The 66th JSAP Spring Meeting 2019	2 papers

Grant-in-Aid for Scientific Research

T.Ono	Searching for enzyme reaction systems measurable with graphene transistors and their apprication to enzyme immunoassay	¥2,860,000

Entrusted Research

K.Matsumoto	JST	Construction of two-dimentional biological model platform using glycan-functionalized graphene	¥59,150,000
K.Matsumoto	JST	Construction of the technological basis for the prevention of influenza pandemic using a graphene platform	¥6,500,000

Cooperative Research

K.Inoue	Mitsubishi Electric Corporation	¥500,000
T.Ono	Murata Manufactureing Company,Ltd	¥3,336,000
T.Ono	TOSHIBA CORPORATION	¥2,616,000

Department of Advanced Electron Devices

Original Papers

[1]Raman Spectroscopic Studies of Dinaphthothienothiophene (DNTT), B.S. Bhardwaj, T. Sugiyama, N. Namba, T. Umakoshi, T. Uemura, T. Sekitani, P. Verma: Materials, 12 (2019) 615.

[2]Long-Term Implantable, Flexible, and Transparent Neural Interface Based on Ag/Au Core-Shell Nanowires, Teppei Araki, Fumiaki Yoshida, Takafumi Uemura, Yuki Noda, Shusuke Yoshimoto, Taro Kaiju, Takafumi Suzuki, Hiroki Hamanaka, Kousuke Baba, Hideki Hayakawa, Taiki Yabumoto, Hideki Mochizuki, Shingo Kobayashi, Masaru Tanaka, Masayuki Hirata, Tsuyoshi Sekitani.: Advanced Healthcare Materials, (2019) 1900130.

[3]Mechanism of chain polymerization in self-assembled monolayers of diacetylene on the graphite surface, D. Takajo and K. Sudoh: Langmuir, 35 (2019) 2123-2128.

International Conferences

[1]Magnetic Resonance Wireless Power Transmission System for an Implantable Sensor in the Common Marmoset. (poster), M. Fujii, S. Yoshimoto, T. Nezu, H. Ohta, H. Hamanaka, T. Araki, Y. Noda, T. Uemura, M. Hirata, T. Sekitani.: 40th International Conference of the IEEE Engineering in Medicine and Biology Society ’18, Honolulu, Hawaii.

[2]Design of Ultraflexible Organic Differential Amplifier Circuits for Wearable Sensor Technologies (oral), Masaya Kondo, Takafumi Uemura, Mihoko Akiyama, Naoko Namba, Masahiro Sugiyama, Yuki Noda, Teppei Araki, Shusuke Yoshimoto, Tsuyoshi Sekitani.: International Conference on Microelectronics Test Structures (ICMTS), M_4_5, Austin, Texas, USA.

[3]Patch-Type Brain Wave Measurement System Using Flexible Electronics. (invited), T. Uemura and T. Sekitani.: ECUST -OU Symposium 2018 East-China University of Science and Technology, Shanghai, China.

[4]Ultraflexible Organic Differential Amplifier for Biosignal Monitoring Systems. (invited), T. Uemura and T. Sekitani.: The 18th International Meeting on Information Display (IMID 2018), Busan, Korea.

[5]Low-Noise Signal Amplification Circuits Based on Organic Thin-Film Transistors. (invited), T. Uemura and T. Sekitani.: Collaborative Conference on Materials Research (CCMR) 2018, Incheon, Korea.

[6]Printable strain gauge of high sensitivity and wide range for simple structural health monitoring implemented with wireless measurement system. (oral), Teppei Araki, Shusuke Yoshimoto, Yuki Noda, Takafumi Uemura, Yuko Kasai, Shintaro Izumi, Tsuyoshi Sekitani. : MRS2018 Fall Symposium PM02, Conductive Materials Reliability in Flexible Electronics, Boston, USA.

[7]Design of Conductive Gel for Sensing Weak Biosignals with High S/N Ratio. (oral), Y. Noda, N. Toyoshima, T. Araki, S. Yoshimoto, T. Uemura, T. Sekitani.: 2018 Material Research Society (MRS) Fall meeting & exhibit, Boston.

[8]Development of Biocompatible Gel for Measuring the Biosignal with Low Noise. (oral), Y. Noda, N. Toyoshima, T. Araki, S. Yoshimoto, H. Iida, T. Uemura, T. Sekitani.: 67th Symposium on Macromolecules, Hokkaido, Japan.

[9]A High-Resolution Printing Technique of Ag-Nanowire-Based Electrodes for Transparent Flexible Organic Transistors on a 1-μm-Thick Polymer Film. (oral), A. Takemoto, T. Araki, Y. Noda, S. Yoshimoto, T. Uemura, T. Sekitani.: 2018 Material Research Society (MRS) Spring meeting & exhibit, Phoenix, USA.

[10]Threshold-Voltage Controls in Organic Transistors by the Gate Electrode Modification. (oral), K. Sakaguchi, T. Uemura, M. Kondo, T. Araki, S. Yoshimoto, Y. Noda, T. Sekitani.: 2018 Material Research Society (MRS) Spring meeting & exhibit, Phoenix, USA.

[11]Bio-Conformable Organic Differential Amplifier on Ultraflexible Polymer Substrate for Low-Noise Biosignal Monitoring. (oral), M. Sugiyama, T. Uemura, S. Yoshimoto, M. Akiyama, M. Kondo, T. Araki, Y. Noda, T. Sekitani.: 2018 Material Research Society (MRS) Spring meeting & exhibit, Phoenix, USA.

[12]Two-Months-Implantable Neural Interface Integrated with Transparent and Stretchable Metal-Nanowire-Based Tracks. (oral), T. Araki, F. Yoshida, Y. Noda, T. Uemura, S. Yoshimoto, T. Kaiju, T. Suzuki, H. Hamanaka, M. Hirata, T. Sekitani.: 2018 Material Research Society (MRS) Spring meeting &

exhibit, Phoenix, USA.

[13]Molecular Orientation Analysis in Organic Thin-Film Transistor Device by Polarized Raman Microscopy. (poster), T. Sugiyama, B. S. Bhardwaj, T. Umakoshi, N. Namba, T. Uemura, T. Sekitani, P. Verma.: SPIE Optics + Photonics 2018, 10726-42, San Diego, USA.

[14]Highly-uniform Triptycene Modifier Layer Based on Blade Coating for Ultraflexible Organic Circuits. (poster), M. Kondo, T. Uemura, T. Kajitani, Y. Noda, F. Ishiwari, Y. Shoji, M. Akiyama, N. Namba, M. Sugiyama, S. Yoshimoto, T. Araki, T. Fukushima, T. Sekitani.: 2018 Material Research Society (MRS) Fall meeting & exhibit, Boston, USA.

[15]Wireless Ultraflexible Magnetic Sensor Matrix System Integrated with Organic Driver and Amplifier Circuits. (poster), M. Kondo, M. Melzer, T. Uemura, D. Karnaushenko, S. Yoshimoto, M. Akiyama, Y. Noda, T. Araki, O. Schmidt, T. Sekitani.: 2018 Material Research Society (MRS) Spring meeting & exhibit, Phoenix, USA.

Review Papers
Flexible conductive materials and those mounting technology for flexible hybrid electronics. Teppei Araki and Tsuyoshi Sekitani, kinzoku, materials science & technology, AGNE Gijutsu Center Inc., 89[3] (2019), 238-242.

Books
[1] Stretchable wiring for patch-type brain sensor. Teppei Araki and Tsuyoshi Sekitani, “Frontiers of Printed Electronics for Industrialization” CMC Publishing Co., Ltd, (239-242) 2018.

Patents
[1]K20180117 Conductive Ink, 2018-171414

[2]K20180363 Disaster information system, 2019-009541

[3]K20180460 Conductive Ink and Carbon printed circuit board, 2019-065933

[4]K20170425 Production method and production equipment of electrodes for organic thin-film transistors, Production method of organic thin-film transistors, and organic thin-film transistors, 2018-083277

[5]K20180218 Chloride ion sensor and Method for measuring concentration of Chloride ion, 2018-194321

[6]K20180438 Chloride ion sensor and Method for measuring concentration of Chloride ion, 2019-046929

[7]K20180118 Adhesive sheet, 2019-045152

[8]K20170349 Electrode sheet, 2018-088572

[9]K20180397 Production method of organic semiconductor devices, 2019-048813

[10]K20180185 Structure diagnosis system, 2018-158754

[11]K20180437 Corrosion sensor , Corrosion detection method, 2019-046898

[12]K20180449 Amplifier circuit, 2019-062242

[13]K20180210 Corrosion sensor, Corrosion detection method, 2018-194319

[14]K20180344 Electrode structure, composition material for adhesive material, cross-linked material of polysaccharide, and production method of composition material for adhesive material, 2019-062553

[15]K20180190 Material for hydrophilic/hydrophobic area patterning, a substrate with the material for hydrophilic/hydrophobic area patterning, and production method with a part of hydrophilic/hydrophobic area patterning on the surface, 2019-007364

[16]K20180219 Structure diagnosis system, 2018-194320

[17]K20180184 Structure diagnosis system and method of diagnosing structure, 2018-158753

[18]K20180180 Carbon printed circuit board, 2018-171415

[19]G20170186TW Vibration sensor and Piezoelectric element, 107123539

[20]G20170186WO Vibration sensor and Piezoelectric element, PCT/JP2018/025589

[21]G20170185WO Electrode sheet, Electrode sheet manufacturing method, Biological signal acquiring devise, and Biological signal acquiring method, PCT/JP2018/027324

[22]G20180124WO Measuring devise, PCT/JP2019/003240

[23]G20180174WO Structure diagnosis system, PCT/JP2019/009810

[24]G20180171WO Structure diagnosis system, PCT/JP2019/010575

[25]G20180172WO Chloride ion sensor and Method for measuring concentration of Chloride ion, PCT/JP2019/010580

[26]G20180125WO Electrode sheet, PCT/JP2019/012870

[27]G20180170WO Corrosion sensor, Corrosion detection method, PCT/JP2019/010574

[28]G20180173WO Structure diagnosis system and method of diagnosing structure, PCT/JP2019/009809

[29]KP2015045 Method for producing metal nanowires, method for producing silver nanowires, 2015-518308

[30]G20140006US Method for producing metal nanowires, metal nanowires, method for producing silver nanowires, and silver nanowires, 14/893329

[31]G20140006CN Method for producing metal nanowires, metal nanowires, method for producing silver nanowires, and silver nanowires, 201480029788.70001

Publications in Domestic Meetings

The 22nd SANKEN International Symposium The 17th SANKEN Nanotechnology International Symposium	3 papers
66th JSAP Spring Meeting	1 paper
M&BE Seminar 2018	1 paper
13th Research society of graduate students on organic devices and physical properties	2 papers
The 74th ISIR Meeting	1 paper

The 35th SENSOR SYMPOSIUM on Sensor, Micromachines and Applies Systems			1 paper
LSI and System Workshop 2018			1 paper
Grant-in-Aid for Scientific Research			
T.Sekitani	Research and development of a sheet-type autonomic function monitoring system		¥12,350,000
T.Sekitani	Body Environment-simulated Active-dish using Stretchable Electronics		¥3,120,000
T.Araki	Research toward elucidation of charge trap mechanism in organic transistor		¥1,430,000
T.Uemura	Origin of low frequency noise in organic thin film transistors		¥10,790,000
S.Izumi	Non-contact biometric authentication using micro-wave Doppler sensor		¥2,860,000
S.Izumi	High-accuracy and non-contact bio-signal sensor system		¥5,929,000
Y.Noda	Fabrication of higher-order structure by printing method and its application to wearable biosignal measurement device		¥780,000
Entrusted Research			
T.Sekitani	New Energy and Industrial Technology Development Organization（NEDO）	Research and development of "Field Intelligence-Embedded Large-area, Distributed IoT Platform	¥34,999,000
T.Sekitani	Japan Agency for Medical Research and Development（AMED）	Ultra-thin Electronic Sensor System for Marmoset's Brain Signal measurement	¥44,920,000
T.Sekitani	New Energy and Industrial Technology Development Organization（NEDO）	Nanoscale interface control for realizing general-purpose ultra-small noise evaluation system	¥15,000,000
S.Izumi	Kobe University	ULP digital signal processing for sensor modules	¥2,001,000
Contribution to Research			
T.Sekitani	Nakatani Foundation		¥100,000
T.Sekitani	Nobuyuki Sasaki, Executive Director, SECOM Science and Technology Foundation		¥30,000,000
T.Sekitani	Syotaro Okawara, President, Tokyo Electric Power Services CO., Ltd		¥4,000,000
Cooperative Research			
T.Sekitani	Showa Denko K.K.		¥3,000,000
T.Sekitani	Mitsubishi Tanabe Pharma Corporation		¥0,000
T.Sekitani	SCREEN Holdings Co., Ltd		¥5,400,000
T.Sekitani	PGV Inc.		¥2,074,000
T.Sekitani	Panasonic Corporation		¥1,560,000
S.Izumi	Mitsubishi Electric Corporation		¥500,000
S.Izumi	**ROHM** Semiconductor		¥2,160,000
Other Research Fund			
S.Izumi	DENSO Corporation		¥550,000

Department of Intelligent Media

Original Papers

[1]Automatic collection of dual-task human behavior for analysis of cognitive function, F. Okura, I. Mitsugami, M. Niwa, K. Aoki, C. Zhou, Y. Yagi: ITE Transactions on Media Technology and Applications, 6 (2) (2018) 138-150.

[2]Gait Recognition Based on Normal Distance Maps, H. El-Alfy, I. Mitsugami, Y. Yagi: IEEE

Transactions on Cybernetics, 48 (5) (2018) 1526 - 1539.

[3]Depth Error Correction for Projector-Camera Based Consumer Depth Camera, H. Yamazoe, H. Habe, I. Mitsugami, Y. Yagi: Computational Visual Media, 4 (2) (2018) 103–111.

[4]The OU-ISIR Large Population Gait Database with Real-Life Carried Object and its performance evaluation, M.Z. Uddin, T.T. Ngo, Y. Makihara, N. Takemura, X. Li, D. Muramatsu, Y. Yagi: IPSJ Trans. on Computer Vision and Applications, 10 (5) (2018) 1-11.

[5]Gait-based Human Age Estimation using Age Group-dependent Manifold Learning and Regression, X. Li, Y. Makihara, C. Xu, Y. Yagi, M. Ren: Multimedia Tools and Applications, 77 (21) (2018) 28333-28354.

[6]Directional characteristics evaluation of silhouette-based gait recognition, Y. Shigeki, F. Okura, I. Mitsugami, K. Hayashi, Y. Yagi: IPSJ Transactions on Computer Vision and Applications, 10 (10) (2018) 1-10.

[7]Gait Energy Response Functions for Gait Recognition against Various Clothing and Carrying Status, X. Li, Y. Makihara, C. Xu, D. Muramatsu, Y. Yagi, M. Ren: Applied Science, 8 (1380) (2018) 1-22.

[8]Growth assessment of school-age children from dual-task observation, C. Zhou, I. Mitsugami, F. Okura, K. Aoki, Y. Yagi: ITE Transactions on Media Technology and Applications, 6 (4) (2018) 286-296.

[9]Decomposition of reflection and scattering by multiple-weighted measurements, T. Takatani, Y. Mukaigawa, Y. Matsushita, Y. Yagi: IPSJ Transactions on Computer Vision and Applications, 10 (13) (2018) 1-13.

[10]How convolutional neural networks diagnose plant disease, Y. Toda, F. Okura: Plant Phenomics, 2019 (9237136) (2019) 1-14.

[11]Early detection of lower MMSE scores in elderly based on dual-task gait, K. Aoki, T. T. Ngo, I. Mitsugami, F. Okura, M. Niwa, Y. Makihara, Y. Yagi, H. Kazui: IEEE Access, 7 (2019) 40085-40094.

[12]Estimating 3D human shape under clothing from a single RGB image, Y. Shigeki, F. Okura, I. Mitsugami, Y. Yagi: IPSJ Trans. on Computer Vision and Applications, 10 (16) (2018) 1-16.

[13]Tracking Abnormalities in Video Capsule Endoscopy via Convolutional Neural Networks by Intra-frame Training, Y. Yanagawa, T. Echigo, Y. Miyazaki, N. Takemura, Y. Yagi: Transactions of the Japanese Society for Artificial Intelligence, 33 (6) (2018) C-I33_1-12.

International Conferences

[1]Probabilistic Plant Modeling via Multi-view Image-to-image Translation, T Isokane, F. Okura, A. Ide, Y. Matsushita, Y. Yagi: Proc. IEEE Conf. on Computer Vision and Pattern Recognition (CVPR 2018), (2018) 2906-2915.

[2]Gait Recognition by Deformable Registration, Y. Makihara, D. Adachi, C. Xu, Y. Yagi: Prof. of the IEEE Computer Society Workshop on Biometrics 2018, (2018) 1-11.

[3]Geometrically Consistent Pedestrian Trajectory Extraction for Gait Recognition, Y. Makihara, G. Ogi, Y. Yagi: Proc. of the IEEE 9th Int. Conf. on Biometrics: Theory, Applications and Systems (BTAS 2018), (2018) 1-11.

[4]Seeing behind leaves: Multi-view reconstruction of three-dimensional branch structure, F. Okura, T. Isokane, A. Ide, Y. Matsushita, Y. Yagi: Proc. 5th International Plant Phenotyping Symposium (IPPS

2018), (2018) 1.
[5]Gait-based Age Estimation using a DenseNet, A. Sakata, Y. Makihara, N. Takemura, D. Muramatsu, Y. Yagi: Prof. of the Int. Workshop on Attention/Intention Understanding (AIU 2018), (2018) 1-7.

[6]Time-lapse Image Analysis for Rapid Drug Susceptibility Testing, A. Grushnikov, S. Hanada, Y. Matsumoto, K. Aoki, Y. Yagi: Proc. of the 25th International Workshop on Frontiers of Computer Vision (IWFCV), (O2-7) (2019) 1-4.

[7]Seeing behind leaves: Plant structure modeling via Bayesian image-to-image translation, F. Okura, T. Isokane, A. Ide, Y. Matsushita, Y. Yagi: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[8]Directional characteristics evaluation of silhouette-Based gait recognition, Y. Shigeki, F. Okura, I. Mitsugami, K. Hayashi, Y. Yagi: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[9]Age estimation from dual-task behavior for comprehensive growth assessment of children, C. Zhou, I. Mitsugami, K. Aoki, F. Okura, Y. Yagi: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[10]Geometrically Consistent Pedestrian Trajectory Extraction for Gait Recognition, Y. Makihara, G. Ogi, Y. Yagi: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[11]Tutorial on Action and Gait Recognition - from Basics to the Future, M.A.R. Ahad and Y. Makihara: The 1st Int. Conf. on Innovation in Engineering and Technology (ICIET 2018), (2018) .

[12][Tutorial] Human Identification at a Distance by Gait Analysis, S. Yu, Y. Huang, Y. Makihara, D. Muramatsu, L. Wang, Y. Yagi and T. Tan: Prof. of the 33rd AAAI Conf. on Artificial Intelligence, (2019) .

[13]Gait-based Age Estimation using a DenseNet, A. Sakata, Y. Makihara, N. Takemura, D. Muramatsu, Y. Yagi: The 1st International Symposium on Symbiotic Intelligent Systems, (2019) .

[14]Gait Energy Response Functions for Gait Recognition against Various Clothing and Carrying Status, X. Li, Y. Makihara, C. Xu, D. Muramatsu, Y. Yagi, M. Ren: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[15]The OU-ISIR Gait Database Comprising the Large Population Dataset with Age and Performance Evaluation of Age Estimation, C. Xu, Y. Makihara, G. Ogi, X. Li, Y. Yagi, J. Lu: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[16]Gait Recognition by Deformable Registration, Y. Makihara, D. Adachi, C. Xu, Y. Yagi: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[17]The OU-ISIR Large Population Gait Database with Real-Life Carried Object and its performance evaluation, M.Z. Uddin, T.T. Ngo, Y. Makihara, N. Takemura, X. Li, D. Muramatsu, Y. Yagi: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[18]Construction and Performance Evaluation of the OU-ISIR Large Population Gait Database with Real-life Carried Object, M.Z. Uddin, T.T. Ngo, Y. Makihara, N. Takemura, X. Li, D. Muramatsu, Y. Yagi: Proc. of the 22nd SANKEN International Symposium, (2019) .

[19]Eye-blink Detection on Mobile Phone, Md Atiqur Rahman Ahad and Md. Talal Bin Noman: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[20]The OU-ISIR Gait Database Comprising the Large Population Dataset with Age and Performance Evaluation of Age Estimation, C. Xu, Y. Makihara, G. Ogi, X. Li, Y. Yagi, J. Lu: Proc. of the 22nd SANKEN International Symposium, (2019) .

[21]Gait-based Age Estimation using a DenseNet, A. Sakata, Y. Makihara, N. Takemura, D. Muramatsu, Y. Yagi: Proc. of the 13th International Workshop on Robust Computer Vision, (2019) .

[22]Joint Intensity and Spatial Metric Learning for Robust Gait Recognition, Y. Makihara, A. Suzuki, D. Muramatsu, X. Li, Y. Yagi: The 7th Int. Conf. on Informatics, Electronics, and Vision (ICIEV 2018), (2018) .

[23]Joint Intensity and Spatial Metric Learning for Robust Gait Recognition, Y. Makihara, A. Suzuki, D. Muramatsu, X. Li, Y. Yagi: The 1st Int. Conf. on Innovation in Engineering and Technology (ICIET 2018), (2018) .

[24]Silhouette-based Gait Recognition from Image Sequences with Occlusion, D. Muramatsu: International Conference on Electrical, Computer and Communication Engineering (ECCE2019), (2019) .

[25]Human Gait Analysis, Y. Yagi: The 7th Int. Conf. on Informatics, Electronics, and Vision (ICIEV 2018), (2018) .

[26]Gait Image Analysis for Person Authentication, Y. Yagi: The 34th meeting of the Pacific Rim Applications and Grid Middleware Assembly (PRAGMA 34), (2018) .

Review Papers

Gait Recognition using Deep Learning, N. Takemura, K. Shiraga, Y. Makihara, D. Muramatsu, Y. Yagi, Image Lab., JAPAN INDUSTRIAL PUBLISHING CO., LTD., 29[1] (2018), 40-48.

Construction of a Sensing System for Diary and Its Applications, F. Okura, Y. Yagi, Y. Makihara. D. Muramatsu, System/Control/Information:, The Institute of Systems, Control and Information Engineers, 62[12] (2018), 514-519.

Reconstruction of Branch Structures Occluded by Leaves from Plant Image Sets, F. Okura, T. Isokane, A. Ide, Y. Matsushita, Y. Yagi, Image Lab., JAPAN INDUSTRIAL PUBLISHING CO., LTD., 30[1] (2019), 6-12.

Construction of Large Scale Gait Databases and Its Application to Gait Video Analysis, Y. Makihara, D. Muramatsu, N. Takemura, M.Z. Uddin, C. Xu, T. Echigo, T.T. Ngo, X. Li, G. Ogi, Y. Yagi, Image Lab., JAPAN INDUSTRIAL PUBLISHING CO., LTD., 30[3] (2019), 11-17.

Part I Trends in Research and Technology by Modality, D. Muramatsu, N. Yamamoto, Y. Makihara, Science and Technology Research Project 2018 Current Trends in Biometrics, National Diet Library, 2018[6] (2019), 1-25.

Contributions to International Conferences and Journals

Y. Makihara	IPSJ Transaction on Computer Vision and Applications (Associate Editor)
Y. Makihara	The 14th Int. Conf. on Signal Image Technology and Internet based Systems (SITIS 2018) (Program Committee Member)
Y. Makihara	The 31th IEEE Int. Conf. on Computer Vision and Pattern Recognition (CVPR 2018) (Reviewer)
Y. Makihara	The first International conference on Multimedia Analysis and Pattern Recognition (MAPR 2018) (Program Committee Member)
Y. Makihara	2018 ACM Int. Conf. on Multimedia Retrieval (ICMR 2018) (Technical Programm Committee)

Y. Makihara	The 24th Int. Conf. on Pattern Recognition (ICPR 2018) (Technical Committee)
Y. Makihara	The 15th European Conf. on Computer Vision (ECCV 2018) (Reviewer)
Y. Makihara	The 14th Asian Conf. on Computer Vision (ACCV 2018) (Program Committee Member)
Y. Makihara	The 26th ACM Multimedia Conference (MM 2018) (Program Committee Member)
Y. Makihara	The 29th British Machine Vision Conf. (BMVC 2018) (Reviewer)
Y. Makihara	The 10th International Conference on Knowledge and Systems Engineering (KSE-2018) (Program Committee Member)
Y. Makihara	2018 Multimedia Information Processing for Personality & Social Networks Analysis Workshop (Program Committee Member)
Y. Makihara	The 2018 Pacific-Rim Conference on Multimedia (PCM 2018) (Reviewer)
Y. Makihara	The 1st International Workshop on Attention/Intention Understanding (AIU 2018) (Program Committee Member)
Y. Makihara	The second International conference on Multimedia Analysis and Pattern Recognition (MAPR 2019) (Program Committee Member)
Y. Makihara	The 32nd IEEE Conf. on Computer Vision and Pattern Recognition (CVPR 2019) (Reviewer)
Y. Makihara	The 17th International Conference on Computer Vision (ICCV 2019) (Area chair)
Y. Makihara	2019 ACM Int. Conf. on Multimedia Retrieval (ICMR 2019) (Program Committee Member)
Y. Makihara	The 12th IAPR Int. Conf. on Biometrics (ICB 2019) (Reviewer)
Y. Makihara	The 30th British Machine Vision Conf. (BMVC 2019) (Reviewer)
Y. Makihara	The 5th Asian Conf. on Pattern Recognition (ACPR 2019) (Program Committee Member)
Y. Makihara	The 8th Int. Conf. on Informatics, Electronics, and Vision (ICIEV 2019) (Reviewer)
D. Muramatsu	The 24th Int. Conf. on Pattern Recognition (ICPR 2018) (Technical Member)
D. Muramatsu	The 5th Int. Conf. on Identity, Security, and Bahavior Analysis (ISBA 2019) (Program Committee Member)
F. Okura	AAAS Plant Phenomics (Editorial Board)
K. Aoki	The 24th Int. Conf. on Pattern Recognition (ICPR 2018) (Technical Member)

Publications in Domestic Meetings

Information Processing Society of Japan, Special Interest Group on Computer Vision and Image Media	7 papers
The 21th Meeting on Image Recognition and Understanding	1 paper
The Institute of Electronics, Information and Communication Engineering, Technical Group on Biometrics	4 papers
The 8th Symposium on Biometrics, Recognition, and Authentication	3 papers
Dynamic Alliance, G3 group meeting	1 paper
The 35th OASIC Symposium	1 paper
The virtual reality society of Japan, SIG-mixed reality	1 paper
The 63rd annual meeting of Japan Society for Neonatal Health and Development	1 paper
The Institute of Electronics, Information and Communication Engineering, Annual Meeting	1 paper

Academic Degrees

PhD for Information Science Y. Yanagawa	Research on Disease Tracking considering Peripheral Regions in Capsule Endoscopy Images
PhD for Information Science C. Zhou	Gait-based Health Status Assessment by Large-scale Data Collection
Master Degree for Information Science A. Ide	Estimation of Plant Branck Structures from a Single RGBD Image
Master Degree for	Segmentation-free Pedestrian Matching using STHOG Feature Extracted from a

Information Science Y. Kashimoto	Three-frame Image Sequence
Master Degree for Information Science Y. Shigeki	Estimating 3D human shape under clothing from a single RGB image
Master Degree for Information Science A. Nagano	Drug-resistant Vacteria Classification in STEM images and Visualization of Is Shape Features
Bachelor Degree for Engineering K. Ogawa	Performance Evaluation of Silhouette-based Gait Recognition using Semantic Segmentation
Bachelor Degree for Engineering Y. Nishiura	Confidential
Bachelor Degree for Engineering Y. Hayashi	Estimation of Human Perception-based Relative Gait Attributes
Bachelor Degree for Engineering R. Tanino	Drug-resistant Vacteria Classification in STEM images and Visualization of Is Shape Features

Grant-in-Aid for Scientific Research

Y. Yagi	Multi-modal gait recognitoin in the wild and its application to criminal investigation	¥17,810,000
Y. Makihara	Gait-based age estimation and aging process modeling	¥5,590,000
F. Okura	Gait analysis of dairy cows focusing long-term transition	¥1,040,000

Entrusted Research

Y. Yagi	SoftBank Corp.	Research on Gait Analysis: Current and Future Perspective	¥1,000,000
Y. Yagi	NEC Corporation	Research on Video-based Gait Analysis for Person Re-idenitification	¥10,000,000
Y. Yagi	Japan Science and Technology Agency	Novel Health Indices PAMs: Health Management Just from Walking	¥5,200,000
Y. Yagi	Support Project for Research Center to Realize Society 5.0	Research on Surveillance of Frail Elderly People	¥10,000,000
Y. Makihara	Support Project for Research Center to Realize Society 5.0	Project for Human Behavior Sensing Technology	¥8,500,000
Y. Makihara	Fellowship Program for Foreign Researchers (Trial) (Associated with JSPS Invitation Fellowship Program for Research in Japan)	Joint Research on Gait Video Analysis	¥816,000
D. Muramatsu	New Energy and Industrial Technology Development Organization（NEDO）	Development of core technologies of next-generation artificial intelligence and robotics (Japan-US joint research and development of next generation artificial intelligence technology, Research and development on empathetic intelligence technology	¥16,945,000

		toward personal interaction	
D. Muramatsu	Support Project for Research Center to Realize Society 5.0	Creation of Intelligent Technology for Prediction and Prevention of Sports Trauma Disorder Disease (Running)	¥10,000,000
D. Muramatsu	Research Enhancement and Promotion of Interdisciplinary Research by Institute for Datability Science	(Equipment) GPU Server for High-performance Computation	¥10,000,000
F. Okura	Japan Science and Technology Agency	Three-dimensional plant structure modeling and lifelog generation for growth analysis and prediction in future cultivation	¥12,610,000

Contribution to Research

Y. Yagi	Canon IT Solutions Inc.	¥500,000
Y. Yagi	NIKKO Co., Ltd., President and CEO, Kyoko Kumagai	¥10,000,000

Cooperative Research

Y. Yagi	Information Technology Research and Development Center, Mitsubishi Electric Corporation	¥20,000,000
Y. Yagi	Aida Engineering Co. Ltd.	¥1,200,000
Y. Yagi	Qoncept, Inc.	¥0,000
Y. Yagi	Rakuno Gakuen	¥0,000
Y. Makihara	the National Institute of Information and Communications Technology	¥0,000
F. Okura	DAIKIN INDUSTRIES, LTD.,	¥0,000

Other Research Fund

Y. Yagi	Signpost Corporation	¥1,562,000
Y. Makihara	DAIKIN INDUSTRIES, LTD.	¥4,500,000
Y. Makihara	DAIKIN INDUSTRIES, LTD.	¥4,200,000
D. Muramatsu	DAIKIN INDUSTRIES, LTD.	¥3,900,000

Department of Reasoning for Intelligence

Original Papers

[1]Highly biocompatible super-resolution fluorescence imaging using the fast photoswitching fluorescent protein Kohinoor and SPoD-ExPAN with Lp-regularized image reconstruction, T. Wazawa, Y. Arai, Y. Kawahara, H. Takauchi, T. Washio and T. Nagai: Microscopy, 67 (2) (2018) 89-98.

[2] Elucidation of the Strongest Predictors of Cardiovascular Events in Patients with Heart Failure, H. Fukuda, K. Shindo, M. Sakamoto, T. Ide, S. Kinugawa, A. Fukushima, H. Tsutsui, S. Ito, A. Ishii, T. Washio, M. Kitakaze: EBioMedicine, 33 (-) (2018) 185-195.

[3] Analysis of nanomechanical sensing signals; physical parameter estimation for gas identification, G. Imamura, K. Shiba, G. Yoshikawa and T. Washio: AIP (American Institute of Physics) Advances, 8 (-) (2018) 075007.

[4]Lowest probability mass neighbour algorithms: relaxing themetric constraint in distance-based neighbourhoodalgorithms, K. M. Ting, Y. Zhu, M. Carman, Y. Zhu, T. Washio and ZH Zhou: Machine Learning, 108 (2) (2019) 331–376.

[5]Selective detections of singleviruses using solid-state nanopores, A. Arima, M. Tsutsui, I. H. Harlisa, T. Yoshida, M. Tanaka, K. Yokota, W. Tonomura, M. Taniguchi, M. Okochi, T. Washio, and T. Kawai: Scientific Reports, 8 (-) (2018) 16305.

[6]Identifying Single Viruses Using Biorecognition Solid-State Nanopores, A. Arima, I. H. Harlisa, T. Yoshida, M. Tsutsui, M. Tanaka, K. Yokota, W. Tonomura, J. Yasuda, M. Taniguchi, T. Washio, M. Okochi and T. Kawai: J. Am. Chem. Soc., 140 (-) (2018) 16834−16841.

[7]Analysis of cause-effect inference by comparing regression errors, P. Blobaum, D. Janzing, T. Washio, S. Shimizu and B. Scholkopf: PeerJ Comput. Sci., 5 (-) (2019) e169.

[8]Field-effect transistor array modified by a stationary phase to generate informative signal patterns for machine learning-assisted recognition of gas-phase chemicals, T. Yoshizumi, T. Goda, R. Yatabe, A. Oki, A. Matsumoto, H. Oka, T. Washio, K. Toko and Y. Miyahara: Molecular Systems Design & Engineering, 4 (2) (2019) 386-389.

[9]A PV Power Output Estimation Method using Covariance between Sampled PV Power Output data and Power Flow, K. Yasunami, O. Yatsubo and T. Washio: IEEJ Transactions on Electronics, Information and Systems, 139 (2) (2019) 161-169.

[10]Identifying Single Particles in Air Using a 3D-Integrated Solid-State Pore, M. Tsutsui, K. Yokota, T. Yoshida, C. Hotehama, H. Kowada, Y. Esaki, M. Taniguchi, T. Washio, and T. Kawai: ACS Sens., Article ASAP, 4 (3) (2019) 748–755.

[11]Prediction and classification in equation-free collective motion dynamics, K. Fujii, T. Kawasaki, Y. Inaba and Y. Kawahara: PLOS Computational Biology, 14 (11) (2018) e1006545.

[12]Automatically recognizing strategic cooperative behaviors in various situations of a team sport, M. Hojo, K. Fujii, Y. Inaba, Y. Motoyasu and Y. Kawahara: PLOS ONE, 13 (12) (2018) e0209247.

International Conferences

[1]Cause-Effect Inference by Comparing Regression Errors, Patrick Bloebaum, Dominik Janzing, Takashi Washio, Shohei Shimizu, Bernhard Schoelkopf: Proc. AISTATS2018:The 21st International Conference on Artificial Intelligence and Statistics, Proc. 2018 (-) (2018) No.298.

[2]A Rare and Critical Condition Search Technique and its Application to Telescope Stray Light Analysis, K. Kisamori, T. Washio, Y. Kameda and R. Fujimaki: Proc. SIAM International Conference on Data Mining 2018 (SDM18), Proc. 2018 (-) (2018) No.567.

[3]Factorially-switching dynamic mode decomposition for Koopman analysis of time-variant systems, N. Takeishi, T. Yairi and Y. Kawahara: Proc. of the 57th IEEE Conf. on Decision and Control (CDC'18), - (-) (2019) 6402-5408.

[4]Metric on nonlinear dynamical systems with Perron-Frobenius operators, I. Ishikawa, K. Fujii, M. Ikeda, Y. Hashimoto and Y. Kawahara: Advances in Neural Information Processing Systems 31 (Proc. of NeurIPS'18), - (-) (2018) 2858-2868.

[5]Making Tree Ensembles Interpretable: A Bayesian Model Selection Approach, S. Hara and K. Hayashi: Proceedings of the 21st International Conference on Artificial Intelligence and Statistics, 84 (-) (2018) 77-85.

[6]Learning Graph Representation via Formal Concept Analysis (oral), Y. Yoneda, M. Sugiyama and T. Washio: Thirty-second Conference on Neural Information Processing Systems (NIPS) 2018 Workshop.

Review Papers

New Development of Analysis Method on Olfactory Sensing Data, G. Imamura, G. Yoshikawa and T. Washio, Journal of Japan Association on Odor Environment, Journal of Japan Association on Odor Environment, 49[5] (2018), 315-322.

Interpretability in Machine Learning, S. Hara, Journal of the Japanese Society for Artificial Intelligence, Japanese Society for Artificial Intelligence, 33[3] (2018), 366-369.

Patents

[1] K20170400 PU classification device, PU classification method, and PU classification program, 2018-087641

[2]K20180050 Flow path, 2018-131885

[3]K20170353 Information providing method, device and system for melody, 2018-084816

[4]K20180021 Information Processing Units, Methods, and Programs, 2018-149457

[5]G20170182WO Identification method, classification analysis method, identification equipment, classification analysis equipment and storage medium, WO2018/207524

[6]G20180164WO PU classification equipment, PU classification method, and PU classification program, PCT/JP2019/013650

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

Contributions to International Conferences and Journals

T. WASHIO	The SIAM Data Mining Conference 2018 (SDM 2018) (Program Committee)
T. WASHIO	The 22nd Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD2018) (Senior Program Committee)
T. WASHIO	24rd ACM SIGKDD Conference on Knowledge Discovery and Data Mining (Program Committee)
T. WASHIO	ACM Transaction on Knowledge Discovery from Data (TKDD) (Editorial Board Member)
T. WASHIO	Knowledge and Information Systems (KAIS): An International Journal (Associated Editor)
T. WASHIO	The 27th International Joint Conference on Artificial Intelligence and the 23rd European Conference on Artificial Intelligence (Program Committee)
T. WASHIO	SISAP 2018 – 11th International Conference on Similarity Search and Applications (Program Committee)
T. WASHIO	The 2018 IEEE International Conference on Data Mining (ICDM) (Area Program Committee Chair)
T. WASHIO	The 2018 ACM SIGKDD Workshop on Causal Discovery (CD 2018) (Senior Program Committee)
T. WASHIO	Journal of Data Mining and Knowledge Discocvery (Editorial Board Member)
T. WASHIO	The 33rd AAAI Conference on Artificial Intelligence (AAAI 2019) (Senior Program Committee)
T. WASHIO	The 2019 IEEE International Conference on Data Mining (ICDM) (Publicity Chair)
T. WASHIO	The 23rd Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD2019) (Senior Program Committee)
T. WASHIO	The 2019 ACM SIGKDD Workshop on Causal Discovery (CD 2019) (Program Committee)
T. WASHIO	Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD) (Vice Steering Committee Chair)
T. WASHIO	The IEEE International Conference on Data Mining (ICDM) (Steering Committee)
Y. KAWAHARA	The 28th International Joint Conference on Artificial Inteligence (Senior Program Committee)
Y. KAWAHARA	The 36th International Conference on Machine Learnig (Program Committee)
Y. KAWAHARA	The 24th ACM SIGKDD Conference on Knowledge Discovery and Data Mining

	(Program Committee)
Y. KAWAHARA	The 6th International Symposium on Computing and Networking (Program Committee)
Y. KAWAHARA	The 33rd AAAI Conference on Artificial Intelligence (AAAI 2019) (Senior Program Committee)
S. HARA	Neural Information Processing Systems 2018 (Program Committee)
S. HARA	The 33rd AAAI Conference on Artificial Inteligence (Program Committee)
S. HARA	The 7th International Conference on Learning Representations (Program Committee)
S. HARA	SIAM Inernational Confeence on Data Mining (Program Committee)
S. HARA	The 28th International Joint Conference on Artificial Inteligence (Program Committee)
S. HARA	The 36th International Conference on Machine Learnig (Program Committee)
S. HARA	The 23rd Pacific-Asia Conference on Knowledge Discovery and Data Mining (Program Committee)
S. HARA	ACM SIGKDD International Conference on Knowledge Discovery and Data (Program Committee)

Publications in Domestic Meetings

The 33rd Annual Conference of the Japanese Society for Artificial Intelligence	8 papers
The 83rd Annual Scientific Meeting of the Japanese Circulation Society	1 paper
The 21st Information-Based Induction Scieces Workshop	1 paper
The 66th JSAP Spring Meeting	1 paper
Workshop of Special Interest Group on Measurement Informatics	1 paper
The 99th CSJ Annual Meeting	1 paper
139th Annual Meeting of the Pharmaceutical Society of Japan	1 paper
The 32nd Annual Meeting, The Japanese Society for Artificial Intelligence	2 papers
Formum on Information Technology 2018	1 paper
32nd Conference of The Japanese Sciety for Artificial Intelligence	2 papers
21st Workshop on Information-Based Induction Sciences	3 papers

Academic Degrees

Master Degree for Engineering H. Inoue	Study on Causal Infrence Robust Against Outliers
Master Degree for Engineering T. Bito	Learning with coherence patterns via dynamic mode decomposition for multivariate time-series data
Master Degree for Engineering Y. Yoneda	Hierarchical Clustering Using Neighborhood Search and Formal Concept Analysis

Grant-in-Aid for Scientific Research

T. Washio	Study on Principles and Methods for Large Scale Causal Inference Based on Nonlinearity	¥1,300,000
Y. Kawahara	Statistical machine learning for extracting latent dynamics from data	¥4,940,000
S. Hara	Development of A Unified Criteria for Expaining Decisions of Deep Neural Networks	¥2,340,000

Entrusted Research

T. Washio	Japan Science and Technology Agency	Exploration of Novel Measurement and Analysis Approaches by Deep Synthesis and Investigation of Machine Learning and Advanced Measurement Technologies	¥28,730,000
T. Washio	Japan Science and Technology Agency	Extraction of Information Characterizing Cell Physiology	¥22,620,000

		from Super-High-Resolution Image time Series	
T. Washio	National Cerebral and Cardiovascular Center Hospital	Analysis of Hart Failure Case Big Data Using a Data Mining Method LAMP	¥500,000
S. Hara	Oki Electric Industry Co., Ltd	A Research on Explainable AI	¥650,000
Cooperative Research			
T. Washio	Kobe Steel, Ltd		¥1,080,000
T. Washio	National Institue for Materials Science		¥0,000
T. Washio	KSK Analytics Inc.		¥0,000
Y. Kawahara	University of Tsukuba, Roland Corporation		¥0,000
Y. Kawahara	NEC Corporation		¥0,000
S. Hara	Financial Engineering Group, Inc.		¥0,000
S. Hara	NEC Corporation		¥1,080,000
Other Research Fund			
T. Washio	DAIKIN INDUSTRIES, Ltd.		¥1,200,000
T. Washio	DAIKIN INDUSTRIES, Ltd.		¥1,200,000
Y. Kawahara	DAIKIN INDUSTRIES, Ltd.		¥600,000
Y. Kawahara	DAIKIN INDUSTRIES, Ltd.		¥1,200,000

Department of Knowledge Systems

Original Papers

[1]A Simple Syntax-based Preordering Method for Statistical Machine Translation, Sho Hoshino, Yusuke Miyao, Katsuhito Sudoh, Katsuhiko Hayashi, Masaaki Nagata: Journal of Information Processing, 60 (3) (2019) .

[2]Descriptions of Part-of Relationships for Ontology Building and Its Deployment – A Representation Model for Part Structures based-on Role Theory, K. Kozaki, R. Mizoguchi: Transactions of the Japanese Society for Artificial Intelligence, 34 (1) (2019) C-I52_1-13.

[3]Describing and Visualizing a Water-Energy-Food Nexus System, A. Endo, T. Kumazawa, M. Kimura, M. Yamada, T. Kato, K. Kozaki: Water, 10 (9) (2018) 1245.

[4]Clarifying Privacy, Property, and Power: Case Study on Value Conflict Between Communities, A. Ema, H. Osawa, R. Saijo, A. Kubo, T. Otani, H. Hattori, N. Akiya, N. Kanzaki, M. Kukita, K. Komatani, R. Ichise: Proceedings of the IEEE, 107 (3) (2019) 575-581.

[5]Development of the Supporting Tool for Constructing Causal Logics between Pieces of Domain Knowledge in the Field of Sustainability Science and Environmental Studies, K. Terukazu, K. Kozaki: Transactions of the Japanese Society for Artificial Intelligence, 33 (3) (2018) E-SGAI04_1-13.

International Conferences

[1]Word Segmentation from Phoneme Sequences based on Pitman-Yor Semi-Makov Model Exploiting Subword Information, R. Takeda, K. Komatani, A. Rudnicky: Proceedings of IEEE Workshop on Spoken Language Technology (SLT), (2018) 763-770.

[2]Reduction of Parameter Redundancy in Biaffine Classifiers with Symmetric and Circulant Weight Matrices, T. Matsuno, K. Hayashi, T. Ishihara, H. Manabe, Y. Matsumoto: The 32nd Pacific Asia Conference on Language, Information and Computation (PACLIC 32), (2018) 1-9.

[3]Inference of Functions, Roles, and Applications of Chemicals Using Linked Open Data and Ontologies, T. Kushida, K. Kozaki, T. Kawamura, Y. Tateisi, Y. Yamamoto, T. Takagi: The 8th Joint International Semantic Technology Conference (JIST2018), (2018) 385-397.

[4]Knowledge-based Identification of Emotional Status on Social Network, J. Vizcarra, K. Kozaki, M. Torres-Ruiz, R. Quintero: The Joint International Workshop on PAOS2018 and PASSCR2018, (2018) .

[5]Content-Based Visualization System for Sentiment Analysis On Social Networks, J. Vizcarra, K. Kozaki, M. Torres-Ruiz, R. Quintero: Poster & Demo in the 8th Joint International Semantic Technology Conference (JIST2018), (2018) .

[6]Learning to describe multimodally from parallel unimodal data? A pilot study on verbal and sketched object descriptions, T. Han, S. Zariess, K. Komatani, D. Schlangen: Workshop on the Semantics and Pragmatics of Dialogue (SEMDIAL2018 (AixDial)), (2018) 6-15.

[7]Predicting when drivers need AR navigation. The 8th Biennial Workshop on DSP for In-Vehicle and Mobile Systems, K. Yamabe, C. Suga, T. Misu, R. Takeda, K. Komatani: The 8th Biennial Workshop on DSP for In-Vehicle and Mobile Systems, (2018) .

[8]Multi-timescale Feature-extraction Architecture of Deep Neural Networks for Acoustic Model Training from Raw Speech Signal, R. Takeda, K. Nakadai, K. Komatani: Proceedings of IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), (2018) 2503-2510.

[9]Investigating Effectiveness of Linguistic Features Based on Speech Recognition for Storytelling Skill Assessment, S. Okada, K. Komatani: The 31st International Conference on Industrial, Engineering and Other Applications of Applied Intelligence Systems (IEA/AIE-2018), (2018) 148-157.

[10]Higher-order Syntactic Attention Network for Longer Sentence Compression, H. Kamigaito, K. Hayashi, T. Hirao, M. Nagata: The 16th Annual Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies (NAACL-HLT-2018), (2018) 1716-1726.

[11]Neural Tensor Networks with Diagonal Slice Matrices, T. Ishihara, K. Hayashi, H. Manabe, M. Shimbo, M. Nagata: The 16th Annual Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies (NAACL-HLT-2018), (2018) 506-515.

[12]Collection of Multimodal Dialog Data and Analysis of the Result of Annotation of Users' Interests, M. Araki, S. Tomimasu, M. Nakano, K. Komatani, S. Okada, S. Fujie, H. Sugiyama: Language Resources and Evaluation Conference (LREC), (2018) 1584-1588.

[13]Unsupervised Adaptation of Neural Networks for Discriminative Sound Source Localization with Eliminative Constraint, R. Takeda, Y. Kudo, K. Takashima, Y. Kitamura, K. Komatani: Proceedings of IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), (2018) 3514-3518.

Review Papers

Push-type Public Relations Linked to Web sites, K. Kozaki, J-LIS, Japan Agency for Local Authority Information Systems, (2018), 30-33.

Obtaining Information from Spoken Utterances for Smooth Dialogues, K. Komatani, The Journal of the Institute of Electronics, Information and Communication Engineers, The Institute of Electronics, Information and Communication Engineers, 101[9] (2018), 908-913.

Human-Machine Dialogue based on Speech Recognition Technology, K. Komatani, Manufacturing & Technology, Association for the Advancement of Manufacturing and Technology, 70[4] (2018), 19-25.

Embedding and Visualizing Knowledge Data in Vector Space, K. Hayashi, Mathmatical Science, SAIENSU-SHA Co.,Ltd., 57[6] (2019), 30-36.

Contributions to International Conferences and Journals

K. KOMATANI	ACL 2018 (Programme Committee)
K. KOMATANI	IWSDS (Programme Committee)
K. KOMATANI	D&D NLG4SDS (Reviewer)
K. KOMATANI	ICASSP 2018 (Reviewer)
K.Komatani	SIGDIAL 2018 (General Chair)
K.Komatani	Interspeech2018 (Programme Committee)
K.Komatani	NAACL-HLT 2018 (Programme Committee)
K.Komatani	COLING 2018 (Reviewer)
K.Komatani	SIGDIAL 2018 (Program Committee)
K.Komatani	D&D NLG4SDS (Reviewer)
K.Komatani	EMNLP 2018 (Reviewer)
K.Komatani	SLT 2018 (Reviewer)
K.Komatani	PerDial' 19 (Technical Program Committee member)
K.Komatani	IUI 2019 (Program Committee)
K.Komatani	NIPS 2018 (Reviewer)
K. Kozaki	JIST2018 (General Chair)
K. Kozaki	ESWC2018 (Program Committee)
K. Kozaki	KEOD2018 (Program Committee)
K.Hayashi	EMNLP 2018 (Reviewer)
K.Hayashi	NAACL-HLT 2019 (Reviewer)
K.Hayashi	IJCAI2019 (Reviewer)

Publications in Domestic Meetings

The Japan Society of Artificial Intelligence	3 papers
Special Interest Group of Semantic Web and Ontology	1 paper
Dialogue System Symposium	3 papers
The Association for Natural Language Processing	2 papers

Academic Degrees

Bachelor of Engineering	An Investigation of Inductive Abilities of Knowledge Graph Embedding Models for Compositional Relation Learning	
T. Kakibuchi		

Grant-in-Aid for Scientific Research

K. Komatani	Acquiring domain knowledge during dialogues for dialogue systems	¥5,200,000
K. Kozaki	Ontology Framework for Harmonizing Knowledge Integration across domains with Semantic Processing of Deep Domain knowledge	¥4,550,000
K. Hayashi	A study of efficient neural network learning based on matrix factorizations	¥1,820,000

Entrusted Research

K. Komatani	Japan Science and Technology Agency (JST)	Investigating Objective Evaluaton Measures in Multimodal Spoken Dialogues	¥3,900,000
K. Kozaki	The University of Tokyo (AMED)	Development of a Foundation for Intelligent Medical Information Systems	¥1,300,000
R. Takeda	Japan Science and Technology Agency (JST)	Automatic Adaptation of Lanugage and Acoustic Models in Spoken Dialogue Systems	¥5,915,000

Contribution to Research

K. Komatani	Canon IT Solutions Inc.	¥500,000
K. Komatani	Royal Soft Center INC.	¥2,000,000

Cooperative Research

K. Komatani	Honda Research Institute USA, Inc.	¥669,000
K. Komatani	Honda Research Institute Japan Co., Ltd.	¥3,600,000

K. Komatani	Honda Research Institute Japan Co., Ltd.	¥600,000
K. Hayashi	NTT Communication Science Laboratories, NTT Corporation.	¥1,500,000

Other Research Fund

K. Komatani	DAIKIN INDUSTRIES,LTD	¥600,000
K. Komatani	Royal Soft Center INC.	¥297,000
K. Komatani	DAIKIN INDUSTRIES,LTD	¥1,200,000
K. Kozaki	DAIKIN INDUSTRIES,LTD	¥1,200,000
K. Kozaki	DAIKIN INDUSTRIES,LTD	¥2,400,000

Department of Architecture for Intelligence

Original Papers

[1]Two-Stage Reinforcement Learning Algorithm for Quick Cooperation in Repeated Games, W. Fujita, K. Moriyama, K. Fukui and M. Numao: Transactions on Computational Collective Intelligence, 28 (2018) 48-65.

[2]Error Detection in Ocean Data Considering Spatial Autocorrelation, K. Hayashi, S. Ono, S. Hosoda, M. Numao and K. Fukui: Transactions of the Japanese Society for Artificial Intelligence, 33 (3) (2018) D-SGAI02_1-10.

[3]Quality Control of Ocean Observation Data Using Conditional Random Field, Y. Kamikawaji, H. Matsuyama, K. Fukui, S. Hosoda and S. Ono: Transactions of the Japanese Society for Artificial Intelligence, 33 (3) (2018) G-SGAI05_1-11.

[4]Development and Application of a Multi-Objective Optimization Tool for Re-newable Energy Mix in Municipalities, K. Hori, T. Matsui, S. Ono, K. Fukui, T. Hasuike and T. Machimura: Transactions of the Japanese Society for Artificial Intelligence, 33 (3) (2018) F-SGAI01_1-11.

[5]Efficient Decision Trees for Multi-class Support Vector Machines Using Entropy and Generalization Error Estimation, P. Kantavat, B. Kijsirikul, P. Songsiri, K. Fukui and M. Numao: International Journal of Applied Mathematics and Computer Science, 28 (4) (2019) 705-717.

[6]Defect Detection Method for Rolling Bearing Including Micro Defect by Feature Selection and Two Step Outlier Detection Method, M. Kitai, Y. Akamatsu and K. Fukui: Information Processing Society of Japan. Transactions on mathematical modeling and its applications, 12 (1) (2019) 32-42.

International Conferences

[1]Reinforcement Learning for Evolutionary Distance Metric Learning Systems Improvement, B. Ali, W. Kalintha, K. Moriyama, M. Numao and K. Fukui: Proc. The Genetic and Evolutionary Computation Conference (GECCO 2018), (2018) 155-156.

[2]Generating a Melody Based on Symbiotic Evolution for Musicians' Creative Activities, N. Otani, D. Okabe and M. Numao: Proc. The Genetic and Evolutionary Computation Conference (GECCO 2018), (2018) 197-204.

[3]TV commercial and emotion recognition using physiological data (poster), T. Emsawas, K. Fukui and M. Numao: The 22nd SANKEN International Symposium, Osaka, Japan, January 15-16, 2019.

[4]Analyzing the effect of video media on emotion using a VR headset platform and physiological data (oral), H. Uraji, T. Emsawas, J. L. Hagad, K. Fukui and M. Numao: Workshop on Computation: Theory and Practice (WCTP-2018), Metropolitan Manila, Philippines, September 17-18, 2018.

Review Papers

Emotion-driven Music Composition, M. Numao, The Journal of the Institute of Electronics, Information

and Communication Engineers, The Institute of Electronics, Information and Communication Engineers, 102[3] (2019), 221-227.

Books

[1]Basics of Machine Learning by Practical Examples with Python(K. Fukui) K. Fukui, Omusha, Ltd., 2018.

[2]Analysis of Good Sleep by Artificial Intelligence(Technical Infromation Institute Co., Ltd.) K. Fukui, Technical Infromation Institute Co., Ltd., (259-269) 2018.

Patents

[1]K20180362 Music Composition Method, JP2019-039502

[2]G20180030WO Sleep Quality Estimation System, Sleep Quality Model Creation Program, and Sleep Quality Estimation Program, PCT/JP2018/029517

[3]G20180149WO Fault Detection System, Fault Model Creation Program, and Fault Detection Program, PCT/JP2019/007758

Contributions to International Conferences and Journals

K. FUKUI	Workshop on Computation: Theory and Practice (WCTP-2018) (Program Committee Member)
K. FUKUI	Workshop on Mathematical Modeling and Problem Solving (PDPTA'18) (Program Committee Member)
K. FUKUI	International Conference on Business Management of Technology (BMOT2017) (Program Committee Member)
K. FUKUI	IEEE International Conference on Systems, Man, and Cybernetics (SMC2017) (Program Committee Member)
K. FUKUI	International Display Workshop(IDW'18) (Program Committee Member)
K. FUKUI	The Third International Workshop on GPU Computing and AI (GCA'18) (Program Committee Member)
K. FUKUI	International Symposium on Computing and Networking (CANDAR2018) (Program Committee Member)
K. FUKUI	New Generation Computing (Editorial Board)
M. NUMAO	New Generation Computing (Editor in Chief)
M. NUMAO	Pacific Rim International Conference on Artificial Inteligence (Program Committee Member)
M. NUMAO	Workshop on Computing Theory and Practice (General Co-chairs)
M. NUMAO	2018IEEE International Conference on Systems, Man, and Cybernetics(SMC2018) (Session Chair)
M. NUMAO	2018IEEE International Conference on Big Knowledge(ICBK) (Program Committee Member)

Publications in Domestic Meetings

Tohoku branch spring meeting of the Mining and Materials. Processing Institute of Japan	1 paper
Meeting on Artificial Intelligence and Knowledge Processing, The Institute of Electronics, Information and Communication Engineers	4 papers
SIG Mathmatical Modeling and Problem Solving, The Information Processing Society of Japan	1 paper
The Japan Society of Mechanical Engineer annual meeting	1 paper

Academic Degrees

Master Degree for Information Science J. Tanaka	Learning of Model Residual with Physics-based Neural Network
Master Degree for	Emotional Effects Analysis of Video Content using VR Headset and Biological

Information Science Y. Uraji	Information	
Doctor Degree for Information Science W. Kalintha	Kernelized Evolutionary Distance Metric Learning	

Entrusted Research

M. Numao	New Energy and Industrial Technology Development Organization(NEDO)	AI Special Course Learning with Real Data	¥14,634,000
K. Fukui	Osaka University Institute for Datability Science	Development of Anomaly Detection and Prediction in Sleep by Integrating Machine Learning and Sleep Science	¥1,000,000

Cooperative Research

M. Numao	Daikin Industries, Ltd.	¥357,000
M. Numao	AOI Pro.	¥0,000
M. Numao	National Institute of Information and Communications Technology(NICT)	¥0,000
M. Numao	Panasonic Corporation	¥2,000,000
K. Fukui	NTN Corporation	¥1,050,000
K. Fukui	Panasonic Corporation	¥1,800,000
K. Fukui	National Institute of Information and Communications Technology(NICT)	¥0,000

Other Research Fund

M. Numao	Innovative Asia	¥360,000
M. Numao	Innovative Asia	¥518,000
M. Numao	Panasonic Corporation	¥700,000
K. Fukui	Daikin Industries, Ltd.	¥4,500,000
K. Fukui	Panasonic Corporation	¥2,160,000
K. Fukui	Mitsumi Electric Co., Ltd.	¥550,000
K. Fukui	Daikin Industries, Ltd.	¥6,900,000

Department of Functionalized Natural Materials

Original Papers

[1]Self-Alignment Sequence of Colloidal Cellulose Nanofibers Induced by Evaporation from Aqueous Suspensions, K. Uetani, S. Izakura, T. Kasuga, H. Koga, M. Nogi: Colloids and Interfaces, 2 (4) (2018) 71.

[2]Robust Nanofibrillated Cellulose Hydro/Aerogels from Benign Solution/Solvent Exchange Treatment, J. Fan, S. Ifuku, M. Wang, K. Uetani, H. Liang, H. Yu, Y. Song, X. Li, J. Qi, Y. Zheng, H. Wang, J. Shen, X. Zhang, Q. Li, S. Liu, Y. Liu, Q. Wang, J. Li, P. Lu, Z. Fan, W. Chen: ACS Sustainable Chemistry & Engineering, 6 (5) (2018) 6624 − 6635.

[3]Estimation of the Intrinsic Birefringence of Cellulose Using Bacterial Cellulose Nanofiber Films, K. Uetani, H. Koga, M. Nogi: ACS Macro Lett., 8 (3) (2019) 250-254.

[4]Strongly anisotropic thermal conductivity and adequate breathability of bilayered films for heat management of on-skin electronics, T. Zhou, H. Wei, H. Tan, X. Wang, H. Zeng, X. Liu, S. Nagao, H. Koga, M. Nogi, T. Sugahara, K. Suganuma: 2D Materials, 5 (3) (2018) 035013.

International Conferences

[1]The characterization and application of nanopaper capacitor (poster), T. Kasuga, K. Uetani, H. Koga, M. Nogi: The 22nd SANKEN International Symposium.

[2]Electrical conductivity and optical bandgap of carbonized cellulose nanofiber papers (poster), D. Fukushima, K. Nagashima, T. Takahashi, T. Yanagida, Y. Nishina, K. Uetani, M. Nogi, H. Koga: The 22nd SANKEN International Symposium.

[3]Light-mediated direct heating of gold nanoparticles anchored within cellulose paper for catalytic applications (poster), Y. Huang, K. Uetani, M. Nogi, H. Koga: The 22nd SANKEN International Symposium.

[4]Drying Mechanism of Cellulose Nanopapers under Evaporation-Condensation Process (poster), K. Uetani, S. Izakura, T. Kasuga, H. Koga, M. Nogi: The 22nd SANKEN International Symposium.

[5]Measurement of Thermal Diffusivity Response to External Forces for Bulk Materials (poster), S. Izakura, K. Uetani, H. Koga, M. Nogi: The 22nd SANKEN International Symposium.

Review Papers
Stucturally dependent thermal conductivity of cellulose nanopapers, K. Uetani, Cellulose Communications, The cellulose society, 25[2] (2018), 46-50.

Development of transparent heat transfer cellulose nanopaper for flexible electronics, K. Uetani, Material Stage, Technical Information Institue Co., Ltd., 18[2] (2018), 43-45.

Report on the annual meeting, K. Uetani, Journal of Fiber Science and Technology, The Society of Fiber Science and Technology Japan, 74[8] (2018), P-418.

Development of anisotropic heat transfer material using cellulose nanofibers, K. Uetani, H.T. Oyama, Nanofiber, The Nanofiber Society, 9[1] (2018), 22-25.

【Column】 Develop a paper that conveys heat! (Kojiro Uetani, Osaka Univ.), K. Uetani, Science and Technology.com, Science and Technology.com, (2019), Article no. 694.

Development and application of heat transferable functional paper, K. Uetani, Journal of High Performance Paper Society, High Performance Paper Society, [57] (2019), 31-36.

Renovation of Paper Materials for Green Chemistry and Electronics, H. Koga, K. Nagashima, Y. Nishina, Ceramics, The ceramic society of Japan, 53[6] (2018), 391-394.

The Renovation Strategy of Paper and the Development of Device-Reactor Application, H. Koga, Japanese journal of paper technology, st-times.co.jp, 61[6] (2018), 53-59.

The Renovation Strategy of Paper for Functional Innovation, H. Koga, Cellulose Communications, The cellulose society of Japan, 25[3] (2018), 101-106.

Electric field observation around charged cellulose nanofibers by electron holography, M. Hongo, Z. Akase,T. Sato, D. Shindo, H. Koga, M. Nogi, Materia Japan, The Japan Institute of Metals and Materials, 58[2] (2019), 100.

Cellulose nanofiber material development in the electronic device field, M. Nogi, Adhesion, The Adhesion Society of Japan, 54[7] (2018), 270-276.

Books
[1]Thermal diffusivity measurement of cellulose nanopaper by Laser spot periodic heating radiation thermometry method K. Uetani, “Fundamentals of heat transfer engineering and thermophysical property measurement / thermal measures casebook”, R&D Support Center Co.,Ltd., (149-154) 2019.

[2]High dielectric paper substrates consisting of cellulose nanofibers and silver nanowires M. Nogi, H. Koga, “Frontiers of Printed Electronics for Industrialisation”, CMC Publishing Co.,Ltd., (219-223) 2018.

Patents

[1]K20180024 Method of controlling cell adhesion strength of cell culture substrate, method of producing cell culture substrate and cell culture substrate, 2018-084423

[2]K20180006 Method of controlling cell adhesion strength of cell culture substrate, method of producing cell culture substrate and cell culture substrate, 2018-084422

[3]K20180195 Device for capturing extracellular vesicles, 2018-203526

[4]K20180389 Device for capture and storage of extracellular vesicles, 2019-036490

[5]KP2015045 Method of manufacturing metal nanowire and method of manufacturing silver nanowire, 2015-518308

[6]G20140006US Method of manufacturing metal nanowire and method of manufacturing silver nanowire, 14/893329

[7]G20140006CN Method of manufacturing metal nanowire and method of manufacturing silver nanowire, 201480029788.70001

Publications in Domestic Meetings

The 69th Annual Meeting of The Japan Wood Research Society in Hakodate	4 papers
The 66th JSAP Annual Meeting 2019	2 papers
The 57th High Performance Paper Society Meeting	1 paper
The 39th Japan Symposium on Thermophysical Properties	1 paper
67th Symposium on Macromolecules	7 papers
The 25th Annual Meeting of Cellulose Society	2 papers
The 85th Pulp and Paper Research Conference of Japan Technical Association of the Pulp and Paper Industry	1 paper
Annual Meeting 2019 of The Society of Fiber Science and Technology	3 papers
The 99th CSJ Annual Meeting	1 paper
49th Annual Meeting of Union of Chemistry-Related Societies in Chubu Area	1 paper
2018 Annual Fall Meeting of The Japan Institute of Metals and Materials	1 paper
MES 2019 of The Japan Institute of Electronics Packaging	1 paper
The 74th annual meeting for the Japanese Society of Microscopy	1 paper
The 53th Research Meeting of the Socety of Polymer Science in Hokkaido Area	2 papers

Academic Degrees

Master Degree for Engineering T. Kasuga	Preparation and device applications of cellulose nanopaper from highly concentrated dispersions
Master Degree for Engineering D. Fukushima	Transition of electronic properties of cellulose nanofibers by carbonization

Grant-in-Aid for Scientific Research

M. Nogi	Development of non-volatile memory by using cellulose nanopapers	¥17,420,000
H. Koga	Development of wood nanocellulose-derived semiconductors for sensor applications	¥8,320,000
H. Koga	Development of wood flow reactors for chemical manufacturing	¥3,380,000
K. Uetani	Estimation of thermal conductive properties of nanocelluloses by using their accumulated materials	¥1,972,000

Entrusted Research

M. Nogi	The New Energy and Industrial Technology Development Organization	Property assessments for efficient utilization of wooden biomass	¥10,000,000
M. Nogi	Japan Science & Technology Agency	Evaluation of the film formation process and film properties of surface-modified nanofibers	¥7,800,000

Contribution to Research

K. Uetani	The Japan Prize Foundation	¥1,000,000
K. Uetani	Shimadzu Science Foundation	¥1,000,000
K. Uetani	Shorai Foundation	¥1,000,000
K. Uetani	Eno Science Foundation	¥2,000,000
K. Uetani	The Iwatani Naoji Foundation	¥2,000,000

Cooperative Research

M. Nogi	NIPPON SHOKUBAI CO., LTD.	¥0,000
M. Nogi	SUNACTIS CO.,LTD.	¥2,376,000
H. Koga	NIPPON SHOKUBAI CO., LTD	¥525,000

Other Research Fund

K. Uetani	SANKEN industry-academic-government collaboration promotion grants	¥80,000
H. Koga	Dynamic Alliance for Open Innovation Bridging Human, Environment and Materials	¥2,000,000

Department of Semiconductor Materials and Processes

Original Papers

[1]Effective passivation for nanocrystalline Si layer/crystalline Si solar cells by use of phosphosilicate glass, K. Imamura, Y. Onitsuka, S. Kunieda, H. Kobayashi: Solar Energy, 169 (2018) 297-301.

[2]Investigation of morphological and optical properties of nanostructured layers formed by the SSCT etching of silicon, S. Jurecka, K. Imamura, T. Matsumoto, H. Kobayashi: Appl. Surf. Sci., 461 (2018) 72-78.

[3]Planarization mechanism for 6H–SiC (0001) Si-faced surfaces using electrochemical reactions, K. Imamura, T. Akai, H. Kobayashi: Mater. Res. Express, 6 (2019) 055906-1-7.

International Conferences

[1]High efficiency crystalline Si solar cells with simple structure fabricated with surface structure chemical transfer method (plenary), H. Kobayashi: 24th World Nano Conference.

[2]Hydrogen generation from Si nanopowder and its application for medicine (invited), Y. Kobayashi, H. Kobayashi: 24th World Nano Conference.

[3]Fabrication of Anode with Si Swarf for Low-cost and High-performance Li Ion Battery (oral), T. Matsummoto, K. Kimura, H. Kobayashi: 233rd ECS meetimg.

[4]Si material for suppression of oxidative stress in human body (plenary), H. Kobayashi: 15th international sumposium on novel and nano mateials (ISNNM2018).

[5]Highly efficient and simple structure crystalline Si solar cells fabricated by use of surface structure chemical transfer method (invited), H. Kobayashi: 12th International Conference on Ceramic Materials and Components for Energy and Environmental Application (CMCEE 2018).

[6]High amount of hydrogen generation by the reaction of Si composition with water in the body to prevent oxidative stress-induced diseases (invited), K. Imamura, Y. Kobayashi, H. Kobayashi: 10th

international conference of Solid State Surfaces and Interfaces (SSSI 2018).

[7]Toward 22% efficiency nanocrystalline Si layer/crystalline Si solar cells with graded band-gap structure (invited), K. Imamura, H. Kobayashi: 10th international conference of Solid State Surfaces and Interfaces (SSSI 2018).

[8]Analysis of band-structure of nanocrystalline Si layer for high efficiency Si solar cells (poster), Y. Onitsuka, K. Imamura, H. Kobayashi: The 22nd SANKEN International Symposium, The 17th SANKEN Nanotechnology International Symposium.

[9]Surface structure chemical transfer method to fabricate low reflectance and low interface state density multi-Si with fixed abrasive machining (poster), S. Kunieda, K. Imamura, H. Kobayashi: The 22nd SANKEN International Symposium, The 17th SANKEN Nanotechnology International Symposium.

[10]Wrapping Si nanopowder in graphite sheets and improvement of cyclability of Si anode in Li ion batteries (poster), T. Matsumoto, T. Osato, J. Choi, H. Kobayashi: The 22nd SANKEN International Symposium, The 17th SANKEN Nanotechnology International Symposium.

Books

[1]Chapter 2 Si solar cell technology, improvement of power coversion efficiency and prospective, 1. Improvement of crystalline Si solar cells by chemical method(Technical Information Institute) H. Kobayashi, Y. Kobayashi, “Solar cells in the next generation and solar photovoltaics -Power conversion efficiency, application and potential of markets-”, Technical Information Institute, (29-38) 2018.

[2]Chapter 3 Eletrochemical measurement and analysis of secondary batteris and itheir materials, 20. Measurement and evaluation of electrochemical characteristics of Si anodes fabricated with Si swarf.(Technical Information Institute) T. Matsumoto, “Data analysis methods for electrochemical and impedance mesurements and their case studies.”, Technical Information Institute, (262-269) 2018.

Patents

[1]K20180370 Graphen transistor and its fabrication method, 2019-029080

[2]K20180026, JP2018-125861

[3]K20180095, JP2018-212706

[4]K20180347, JP2019-010035

[5]K20180365 Drug and its preparation, JP2019-01412

[6]K20180346, JP2019-010034

[7]K20180156, JP2018-212715

[8]K20180348, JP2019-010036

[9]K2018034, JP2019-010032

[10]KP2018110 Drug and its preparation, JP2019-512315

[11]K20180345, JP2019-010033

[12]K20180361, JP2019-010037

[13]K20170367, JP2018-125861

[14]K20180339, JP2019-010031

[15]G20180013WO Drug and its preparation, PCT/JP2018/025315

[16]KP2015034 Prodction methods and equipments of organic compounds by solid oxidation reactions., JP2015-508592

[17]K20140262 Field-effect element, JP2014-263047

[18]K20170227 Complex composition, JP2018-087905

[19]K20110051 Surface preparetion method of silicon substrate, production method of semiconductor equipment, semiconductor equipment、chemical transfer method and its production method, solar cell and its production method , JP6359519

[20]K20170060 Drug and its preparation, PCT/JP2018/025315

[21]K20150198 Oral formulations, feed, supplement, food additive and feallth food, JP2018-229323

[22]K20130324 Hydrogen production appratus, hydrogen production method, silicon fine pariticles for hydrogen production, and production method for silicon fine pariticles for hydrogen production, JP2018-240783

[23]K20130324 Hydrogen production apparatus, hydrogen production method, silicon fine pariticles for hydrogen fproduction, and production metthod for silicon fine particles for hydrogen production, JP6462572

[24]K20150198 Solid preparation , mehod for producing solid preparation,method for generating hydrogen, JP6467071

[25]K20150198 Solid preparation , mehod for producing solid preparation, method for generating hydrogen, JP2019-034384

[26]K20170227 Complex composition, PCT/JP2019/014285

Contributions to International Conferences and Journals

H. Kobayashi	Solid State Surfaces and Interfaces 2018 Chairman)	(SSSI 2018) (Science Committee
K. Imamaura	Solid State Surfaces and Interfaces 2018	(SSSI 2018) (Science Committee)

Publications in Domestic Meetings

Japan Materials Research Society Meeting	3 papers
Japan Applied Physics Meeting	2 papers
Surface Scinece Society of Japan	1 paper

Academic Degrees

Master of Science K. Mo	Reduction of carrier recombination at the rear surfaces of solar cells for improving efficiency of Si nanocrystal/crystalline Si solar cells by the surface structure chemical transfer method.

Grant-in-Aid for Scientific Research

H.Kobayashi	Fabrication of Si composition for internal hydrogen generation and elimination of hydroxyl radicals	¥15,210,000
K.Imamura	Fabrication of continuous interfaces of hetero junctions and	¥2,340,000

		improvement of crystalline silicon solar cells	
Entrusted Research			
H.Kobayashi	JST	Fabrication of silicon surface with ultra-low reflectivity with the interface control method and development of crystalline silicon solar cells with ultra-high efficiency	¥53,816,000
K.Matsumoto	JST	Develop Super Japanese by Human Power Activation/Enhancement of Industrial Competitiveness/Rich Society	¥94,152,000
K.Matsumoto	JST	Develop Super Japanese by Human Power Activation/Enhancement of Industrial Competitiveness/Rich Society	¥7,670,000
K.Matsumoto	JST	Construction of the technological basis for the prevention of influenza pandemic using a graphene platform	¥6,500,000
K.Matsumoto	JST	Construction of two dimensional biological model platform using sugar chain modified graphene	¥59,150,000
Contribution to Research			
H. Kobayashi	Marukan Co.,LTD.		¥600,000
H. Kobayashi	OSAKA Titanium Technologies Co.,Ltd.		¥20,000,000
Cooperative Research			
H. Kobayashi	Nisshin Kasei co., ltd.		¥0,000

Department of Advanced Hard Materials

Original Papers

[1]Nanocomposite microstructures dominating anisotropic elastic modulus in carbon fibers, M. Tane, H. Okuda, F. Tanaka: Acta Mater., 166 (2019) 75-84.

[2]Superior energy absorption in porous magnesium: contribution of texture development triggered by intra-granular misorientations, T. Mayama, M. Tane, Y. Tadano: Acta Mater., 165 (2019) 62-72.

[3]Self-activated surface dynamics in gold catalysts under reaction environments, N. Kamiuchi, K. Sun, R. Aso, M. Tane, T. Tamaoka, H. Yoshida, S. Takeda: Nat. Commun., 9 (2018) 2060.

[4]Crystal plasticity analysis of anisotropic deformation behavior of porous magnesium with oriented pores, T. Mayama, M. Tane, Y. Tadano: J. Phys. Conf. Ser., 1063 (2018) 012047.

[5]Thermoelectric Array Sensors with Selective Combustion Catalysts for Breath Gas Monitoring, W. Shin, T. Goto, D. Nagai, T. Itoh, A. Tsuruta, T. Aamatsu, K. Sato: Sensors, 18 (5) (2018) 1579.

[6]Fine Ti-dispersed Al_2O_3 composites and their mechanical and electrical properties, S. Shi, S. H. Cho, T. Goto, T. Sekino: J. Am. Ceram. Soc., 101 (7) (2018) 3181-3190.

[7]Microstructure and mechanical properties of TiN dispersed Si_3N_4ceramics via in-situ nitridation of coarse metallic Ti, S. Baba, T. Goto, S. H. Cho, T. Sekino: Journal of Silicate Based and Composite Materials, 70 (6) (2018) 195-203.

[8]Combinative effects of Y_2O_3 and Ti on Al_2O_3 ceramics for optimizing mechanical and electrical properties, S. Shi, S. H. Cho, T. Goto, T. Sekino: Ceramics International , 44 (15) (2018) 18382-18388.

[9]Formation of vertically grown 1D TiO_2 nanorods on the surface of. Al_2O_3/Ti composites by simple heat treatment and their photocatalytic performance., S. Shi, T. Goto, S. H. Cho, H. Hashimoto, S. Yin, S. W.

Lee, T. Sekino: J. Cera. Soc. Japan, 126 (10) (2018) 847-851.

[10]Surface-morphology modification of ceramic-based composites for photocatalytic activity via simple chemical and heat treatments, S. Shi, T. Goto, S. H. Cho, T. Sekino: J. Cera. Soc. Japan , 126 (11) (2018) 877-884.

[11]Electrochemically assisted room‐temperature crack healing of ceramic‐based composites, S. Shi, T. Goto, S. H. Cho, T. Sekino: J. Am. Ceram. Soc., 102 (7) (2019) 4236-4246.

[12]Effect of nitrogen gas pressure during heat treatment on the morphology of silicon nitride fibers synthesized by carbothermal nitridation, S. Baba, T. Goto, S. H. Cho, T. Sekino: Journal of Asian Ceramic Societies, 6 (4) (2018) 401-408.

[13]Transformation of dicalcium phosphate dihydrate into octacalcium phosphate with incorporated dicarboxylate ions, T. Yokoi, T. Goto, S. Kitaoka: J. Cera. Soc. Japan, 126 (6) (2018) 462-468.

[14]Sorption capacity of Cs^{+} on titania nanotubes synthesized by solution processing, T. Goto, S. H. Cho, S. W. Lee, T. Sekino: J. Cera. Soc. Japan, 126 (10) (2018) 801-807.

[15]Thermoelectric gas sensors with selective combustion catalysts, W. Shin, K. Tajima, N. Izu, T. Itoh, I. Matsubara, N. Murayama, M. Nishibori, T. Goto: J. Cera. Soc. Japan, 127 (2) (2019) 57-66.

[16]Synthesis of Silicon Nitride Ceramic Fibers and the Effect of Nitrogen Atmosphere on their Morphology, S. Baba, T. Goto, S. H. Cho, T. Sekino: Materials Science Forum, 922 (2018) 92-97.

[17]Solvothermal Synthesis of TiO_2- Modified Hydroxyapatite Using Water-Isopropanol Solution, T. Goto, S. H. Cho, C. Ohtsuki, T. Sekino: Materials Science Forum, 922 (2018) 86-91.

[18]Making insulating Al_2O_3 electrically conductive without loss of translucency using a small amount of ITO grain boundary phase, T. Kusunose, A. Fujita, T. Sekino: Scripta Materialia, 159 (2019) 24-27.

[19]Yb^{3+}, Er^{3+} and Tm^{3+} doped α-Sialon as upconversion phosphor, Y. K.Kshetri, J. S. Hoon, T.H. Kim, T. Sekino, S. W. Lee: Journal of Luminescence, 204 (2018) 485-492.

[20]Cr-doped TiO_2 nanotubes with a double-layer model: An effective way to improve the efficiency of dye-sensitized solar cells, H. H. Nguyen, G. Gyawali, J. S. Hoon, T. Sekino, S. W. Lee: Applied Surface Science, 458 (2018) 523-528.

[21]Temperature stability of PIN-PMN-PT ternary ceramics during pyroelectric power generation, J. Y. Kim, T. Moro, J. Y. Kim, S. Yamanaka, I. Murayama, T. Katou, T. Nakayama, M. Takeda, N. Yamada, Y. Nishihata, T. Fukuda, H. Tanaka, T. Sekino, Y. H. Kim: Journal of Alloys and Compounds, 768 (2018) 22-27.

[22]Optimized Surface Characteristics and Enhanced in Vivo Osseointegration of Alkali-Treated Titanium with Nanonetwork Structures, Y. Zeng, Y. Yang, L. Chen, D. Yin, H. Zhang, Y. Tashiro, S. Inui, T. Kusumoto, H. Nishizaki, T. Sekino, J. Okazaki, S. Komasa: International Journal of Molecular Sciences, 20 (2019) 1127.

International Conferences

[1]Elastic-modulus enhancement during room-temperature aging in β-Ti alloys (invited), M. Tane, A. Umeda, K. Hagihara, M. Ueda, T. Nakano, T. Sekino, T. Ichitsubo: International Conference on processing & manufacturing of advanced materials.

[2]Development of Multifunctional Ceramic-based Nanocomposites by Metal Dispersion (plenary), S.

Shi, S. H. Cho, T. Goto, T. Sekino: 3rd Global Congress & Expo on Materials Science & Engineering (GCEMSE2018) (69th Conference, Scientific Federation).

[3]Materials Tuning of Titania Nanotubes for Advanced Multifunctionalities (plenary), T. Sekino: The 15th International Symposium on Novel and Nano Materials (ISNNM-2018).

[4]The Photocatalytic Properties of Metal-doped Titanate Nanotubes (oral), S. H. Kim, M. S. Kim, J. H. Shin, S. Y. Sung, T. Sekino: The 15th International Symposium on Novel and Nano Materials (ISNNM-2018).

[5]Materials Tuning of Titania-based Nanostructures for Advanced Multifunctionalities (invited), T. Sekino: Materials Science Lecture Series in Cologne.

[6]In-situ Fabrication of Fine Ti-dispersed Alumina Composites and Their Mechanical and Electrical Multifunctionality (invited), S. Shi, S. H. Cho, T. Goto, T. Sekino: The 6th International Conference on the Characterization and Control of Interfaces for High Quality Advanced Materials (ICCCI 2018) & the 54th Summer Symposium on Powder Technology.

[7]Synthesis of Metal Nanoparticles-loaded Visible-light Responsible Titania Nanotubes and Their Photochemical Properties (plenary), T. Sekino, Y. Yamasaki, H, Nishida, S. H. Cho, T. Goto: 12th International Conference on Ceramic Materials and Components for Energy and Environmental Applications (CMCEE2018).

[8]Size and Doping Control for Titania Nanotubes and their Sensitized Solar Cell Properties (oral), T. Sekino, S. H. Cho, T. Goto: 12th International Conference on Ceramic Materials and Components for Energy and Environmental Applications (CMCEE2018).

[9]Development of Zirconia Ceramics with Fluorescent Color for Dental Applications (invited), H, Nishida, S. H. Cho, S. Okamura, T. Nakamura, T. Sekino: 12th International Conference on Ceramic Materials and Components for Energy and Environmental Applications (CMCEE2018).

[10]Synthesis of Sol-Gel Derived Bioactive Glass Nanoparticles and Their Low-temperature Sintering (oral), Y. J. Seo, S. H. Cho, T. Goto, T. Sekino: 12th International Conference on Ceramic Materials and Components for Energy and Environmental Applications (CMCEE2018).

[11]TiO_2 nanoparticles for co-catalyst free photocatalyst (oral), S. H. Cho, T. Goto, T. Sekino: The 2nd Symposium for A3 Foresight Program on Organic/Inorganic Nanohybrid platforms for Precision Tumor Imaging and Therapy.

[12]Tuning of Titania Nanotubes via Solution Chemical Processing for Multifunctionalization (plenary), T. Sekino: The 6th International Solvothermal and Hydrothermal Association Conference (ISHA2018).

[13]Hydroxyapatite formation from α-tricalcium phosphate treated by water controlled-release solvothermal process (oral), T. Goto, S. Yin, Y. Asakura, S. H. Cho, T. Sekino: The 6th International Solvothermal and Hydrothermal Association Conference (ISHA2018).

[14]Development of Ceramic-Metal Nanocomposites and Their Multifunctionalities (plenary), T. Sekino, S. Shi, T. Goto, S. H. Cho, T. Kusunose: The 5th International Conference on Competitive Materials and Technology Processes (IC-CMTP5).

[15]Nano-hybridization of titania nanotubes and polyaniline by novel photopolymerization process (oral), K. Tsukatani, S. Tsukuda, T. Goto, S. H. Cho, H. Nishida, T. Sekino: The 5th International Conference on Competitive Materials and Technology Processes (IC-CMTP5).

[16]Removal of Cs^{+} and Sr^{2+} from Aqueous Solution Using Titania Nanotube (oral), T. Goto, S. H. Cho, T. Sekino: The 5th International Conference on Competitive Materials and Technology Processes (IC-CMTP5).

[17]Adsorption Property of Dye on Needle-shaped Hydroxyapatite Synthesized by Solvothermal Treatment (oral), T. Goto, S. H. Cho, C. Ohtsuki, T. Sekino: 30th Symposium and Annual Meeting of the International Society for Ceramics in Medicine (BIOCERAMICS30).

[18]Synthesis and Characterization of Titanate nanostructure by Microwave Assisted Hydrothermal Method: An effect of process parameters on Nanostructures formation (invited), S. H. Cho, T. Goto, T. Sekino: The 35th International Korea-Japan Seminar on Ceramics (KJ-Ceramics35).

[19]A Study on Synthesis and Characterization of Titania Nanotubes using Peroxo Titanium Complex as Precursor (oral), H. S. Park, T. Goto, S. H. Cho, T. Sekino: The 35th International Korea-Japan Seminar on Ceramics (KJ-Ceramics35).

[20]Development of Metal-dispersed Ceramic-based Composites Tuned for Multi-task Application (plenary), S. Shi, T. Sekino: The 20th International Symposium on Eco-Materials Processing and Design (ISEPD2019).

[21]Sorption capacity of titania nanotube for removal of Cs^{+} and Sr^{2+} (invited), T. Goto, S. H. Cho, T. Sekino: The 20th International Symposium on Eco-Materials Processing and Design (ISEPD2019).

[22]Formation and Properties of Titania Nanotubes and Polyaniline Nano-hybrids by Novel Photopolymerization Process (poster), K. Tsukatani, S. Tsukuda, T. Goto, S. H. Cho, H. Nishida, T. Sekino: The 20th International Symposium on Eco-Materials Processing and Design (ISEPD2019).

[23]Effect of Nickel on Photocatalytic Activity of Chemically Treated Titania Nanotube (poster), Y. Kondo, T. Goto, S. H. Cho, H. Nishida, T. Sekino: The 20th International Symposium on Eco-Materials Processing and Design (ISEPD2019).

[24]Electrically Assisted Room-Temperature Crack Healing of Ceramic-Based Composites (poster), S. Shi, T. Goto, S. H. Cho, T. Sekino: The 22nd SANKEN International Symposium & the 17th SANKEN Nanotechnology International Symposium.

[25]Formation of Nanostructured Titania Layers on Ceramic-Metal Composites and Their Photochemical Functions (invited), S. Shi, T. Goto, S. H. Cho, S. W. Lee, T. Sekino: The 43rd International Conference & Exposition on Advanced Ceramics and Composites (ICACC2019).

[26]Synthesis of Sol-Gel Derived Bioactive Glass Nanoparticles and Their Low-temperature Sintering (oral), Y. J. Seo, S. H. Cho, T. Goto, T. Sekino: ICG Annual Meeting 2018, 59th Meeting on the Glass and Photonic Materials. 14th Symposium of the Glass Industry Conference of Japan.

Review Papers

Elastic properties of titanium and titanium alloys, M. Tane, Journal of Japan Institute of Light Metals, The Japan Institute of Light Metals, 68 (2018), 286-293.

Implementation of Fusion Reserch Fields for Young Reserchers -Expecting the Sprouting of Next Generation Advanced Materials and Device Researches, T. Sekino, M. Kakihana, CERAMICS JAPAN, The Ceramic Society of Japan, 53 (2018), 372-377.

Synthesis of Purification Materials Using Hydroxyapatite Derived from Fish Bones, T. Goto, K. Sasaki, Journal of the Society of Inorganic Materials, Japan, The Society of Inorganic Materials, JAPAN, 25 (2018), 297-303.

An example of the research career, T. Goto, Manufacturing & Technology, Association for the Advancement of Manufacturing and Technology, 71 (2019), 69-71.

Laboratory Report No.14, Dept. of Adv. Hard. Mater, ISIR, Osaka University, T. Goto, T. Sekino, FC Report, Japan Fine Ceramics Association, 36 (2018), 131.

Patents

[1]K20180150 Crack repairable composite material and non-heating electrochemical crack repair method using the same, JP2018-231732

Contributions to International Conferences and Journals

M. Tane	Materials Transaction (Editrial committee)
T. Sekino	Journal of Silicate Based and Composite Materials (Editorial Board)
T. Sekino	High Temperature Materials and Processes (International Editorial Board)
T. Sekino	The 4th International Conference on Competitive Materials and Technology Processes (IC-CMTP5) (The Organizers)
T. Sekino	The International Symposium on Eco-Materials Processing and Design (ISEPD 2018） (Organizing Committee/Editorial Committee)
T. Sekino	8th Advanced Functional Materials and Devices (AFMD-2018) (International Advisory Committee)
T. Sekino	Korea-Japan International Seminar on Ceramics (Organizing Committee)
T. Sekino	The 43th International Conference & Exposition on Advanced Ceramics & Composites (ICACC) (Symposiuym Co-organizer)
T. Sekino	International Conference on Characterization and Control of Interfaces for High Quality Advanced Materials (ICCCI 2018) (Organizing Committee)
T. Sekino	The 13th Pacific Rim Conference on Ceramic and Glass Technology (PacRim 13) (Organizing Committee)
T. Sekino	The 9th International Symposium on Functional Materials (ISFM2018) (International Advisory Committee)
T. Sekino	12th International Conference on Ceramic Materials and Components for Energy and Environmental Applications (CMCEE-2018) (Symposium Organizer)
T. Sekino	The 6th International Solvothermal and Hydrothermal Association Conference (ISHA2018) (International Advisory Committee)
T. Sekino	The International Symposium on Eco-Materials Processing and Design (ISEPD 2019） (Organizing Committee/Editorial Committee)
T. Sekino	5th Global Congress & Expo on Materials Science & Engineering (GCEMSE-2019) (Conference Chair)
T. Sekino	1st European Conference on Silicon and Silicon Based Materials (International Scientific Advisory Board)
T. Sekino	The 2nd international symposium on innovation in materials processing (ISIMP2019). (International Advisory Committee)
T. Sekino	Materials Challenges in Alternative and Renewable Energy 2019 (MCARE2019) (International Advisory Committee)
T. Sekino	The 2nd Global Forum on Advanced Materials and Technologies for Sustainable Development (GFMAT-2) (Symposium Organizer)
T. Sekino	The 15th International Ceramics Congress (CIMTEC2020) (Symposium International Advisory Board)
T. Sekino	The International Symposium on Hybrid Materials and Processing (HyMaP 2020) (Organizing Committee)

Publications in Domestic Meetings

2018 Fall Meeting, The Japan Institute of Metals and Materials	3 papers
Material Symposium for Young Research students	1 paper
The 177th ISIJ Meeting	1 paper
The 8th Activity Report Meeting on NJRC, and Activity Report Meeting of Dynamic	1 paper

Alliance in 2018	
The Ceramic Society of Japan, The 13th Kansai Branch Meeting	4 papers
Seminor in SHIRAISHI CENTRAL LABORATORIES Co., Ltd.	1 paper
The Ceramic Society of Japan, The 31th Fall Meeting	8 papers
2nd meeting on Fine Ceramics Research Group in Nagano	1 paper
The Ceramics Society of Japan, Kansai Branch, The 21th Young Researchers Forum	1 paper
The 6th Alliance Young Scientists Exchange Meeting	1 paper
The Ceramic Society of Japan, Symposium on Ceramic Resources and Environmental Materials Division 2018	1 paper
Ceramics Research Symposium 2018	1 paper
The 11th workshop on New Development of Solid Material Synthesis and Evaluation Technology	1 paper
The 74th ISIR meeting	1 paper
28th Annual Meeting of MRS-J, Dynamic Alliance, Environment and Energy Materials, Device and Process/ Group (G2) Meeting	5 papers
New Ceramics Forum, The 235th Special Research Meeting	1 paper
The Ceramic Society of Japan, The 57th Symposium on Basic Science of Ceramics	3 papers
The 1st Joint Forum for Graduate School of Medicine, Osaka University and ISIR, Osaka University	1 paper
The Ceramic Society of Japan, Annual Meeting 2019	8 papers

Academic Degrees

Master Degree for Engineering H. Edamatsu	Deformation-induced omega transformation in β-Ti alloys
Master Degree for Engineering K. Tsukatani	Development, structure and function of titania nanotubes/polyaniline nano-hybrids by photo-polymerization process
Ph.D (Engineering) S. Shi	Development of Electrically Multifunctionalized Ti-dispersed Al_2O_3 Composites with Photochemical and Crack-healing Behaviors
Ph.D (Engineering) S. Baba	Morphology Development of Silicon Nitride-based Ceramics and Nanofibers under Various Reaction Environments

Grant-in-Aid for Scientific Research

T. Sekino	Physical Photochemical Functionalization of Oxide Nanotubes through Hierarchical Structure Tuning	¥39,260,000
M. Tane	Peculiar phase transformation and mechanical properties in bcc titanium	¥3,510,000
T. Goto	Hydrothermal synthesis and investigation of Transition metal substituted hydroxyapatite for environmental remediation materials	¥1,040,000

Entrusted Research

T. Sekino	NEDO	Advanced Research Program for Energy and Environmental Technologies / Research & Development for waste heat recovery technology using pyroelectric effect based on temporal temperature variations.	¥13,639,000
T. Sekino	JSPS, Research Center for Science Systems	2018 Research on Academic Research Trends (Academic research trends in the fields related to inorganic materials and physical properties, nanomaterials science-Fusion of inorganic nanomaterials science and other	¥1,560,000

	fields and new developments in boundary areas-)	
Contribution to Research		
T. Sekino	Nikkato Corporation	¥1,000,000
T. Sekino	M3 Research Institute Co. Ltd.	¥100,000
T. Sekino	HakusuiTech Co., Ltd.	¥500,000
T. Sekino	Inaba Rubber Co. Ltd.	¥1,500,000
M. Tane	The Light Metal Educational Foundation, Inc.	¥150,000
M. Tane	The Amada Foundation	¥2,000,000
Cooperative Research		
T. Sekino	Sun Moon University	¥4,875,000
T. Sekino	Korea Institute of Ceramic Engineering and Technology (KICET)	¥0,000
T. Sekino	Daiichi Kigenso Kagaku Kogyo Co., Ltd.	¥0,000
T. Sekino	Korea Institute of Industrial Technology (KITECH)	¥1,960,000
T. Sekino	Lotus Alloy Co., Ltd.	¥420,000
T. Sekino	Panasonic Corp.	¥600,000
M. Tane	TORAY Co., Ltd	¥1,000,000

Department of Advanced Interconnection Materials

Original Papers

[1]Corrosion mechanism of Zn-30Sn high-temperature, lead-free solder in neutral NaCl solution, Z. H. Wang, C. T. Chen, J. C. Liu, G. Zhang and K. Suganuma: Corrosion Science, 140 (2018) 40-50.

[2]Printed wire interconnection using Ag sinter paste for wide band gap power semiconductors, S. J. Noh, C. Y. Choe, C. T. Chen, H. Zhang and K. Suganuma: Journal of Materials Science: Materials in Electronics, 29 (17) (2018) 15223–15232.

[3]Development of thermal shock-resistant of GaN/DBC die-attached module by using Ag sinter paste and thermal stress relaxation structure, D. J. Kim, C. T. Chen, A. Suetake, C. Y. Choe, T. Sugahara, S. Nagao and K. Suganuma: Microelectronics Reliability, 88–90 (2018) 779-787.

[4]Large-area die-attachment by silver stress migration bonding for power device applications, S. J. Noh, H. Zhang, J. Y. Yeom, C. T. Chen, C. F. Li and K. Suganuma: Microelectronics Reliability, 88–90 (2018) 701-706.

[5]Influence of thermal exposure upon mechanical/electrical properties and microstructure of sintered micro-porous silver, C. Y. Choe, S. J. Noh, C. T. Chen, D. J. Kim and K. Suganuma: Microelectronics Reliability, 88–90 (2018) 695-700.

[6]Thermal Shock Performance of DBA/AMB Substrates Plated by Ni and Ni–P Layers for High-Temperature Applications of Power Device Modules, C. Y. Choe, C. T. Chen, S. J. Noh and K. Suganuma: Materials, 11 (12) (2018) 2394.

[7]Highly densified Cu wirings fabricated from air-stable Cu complex ink with high conductivity, enhanced oxidation resistance, and flexibility, W. L. Li, Y. Yang, B. W. Zhang, C. F. Li, J. T. Jiu and K. Suganuma: Advanced materials interface, 5 (19) (2018) 1800798.

[8]Fabrication with Semiconductor Packaging Technologies and Characterization of a Large-Scale Flexible Thermoelectric Module, T. Sugahara, Y. Ekubaru, N. V. Nong, N. Kagami, K. Ohata. L. T. Hung, M. Okajima, S. Nambu and K. Suganuma: Advanced materials technologies, 4 (2) (2019) 1800556.

[9]Size-Controllable Synthesis of Bimodal Cu Particles by Polyol Method and Their Application in Die Bonding for Power Devices, Y. Gao, W. L. Li, H. Zhang, J. T. Jiu, D. W. Hu and K. Suganuma: IEEE

Transactions on Components, Packaging and Manufacturing Technology, 8 (12) (2018) 2190-2197.
[10]Nanoridge patterns on polymeric film by photodegradation copying method for metallic nanowire networks, J. Wang, S. Y. Zhang, Z. Y. Shi, J. T. Jiu, C. H. Wu, T. Sugahara, S. Nagao, K. Suganuma and P. He: RSC Advances, 8 (71) (2018) 40740-40747.

[11]Novel copper particle paste with self-reduction and self-protection characteristics for die attachment of power semiconductor under a nitrogen atmosphere, Y. Gao, W. L. Li, C. T. Chen, H. Zhang, J. T. Jiu, C. F. Li and K. Suganuma: Materials & Design, 160 (2018) 1265-1272.

[12]Thin Film of Amorphous Zinc Hydroxide Semiconductor for Optical Devices with an Energy-Efficient Beneficial Coating by Metal Organic, M. Karakawa, T. Sugahara, Y. Hirose, K. Suganuma and Y. Aso: Scientific Reports, 8 (2018) 10839.

[13]Three-Dimensional stretchable and transparent conductors with controllable strain-distribution based on template-assisted transfer printing, W. L. Li, Y. Yang, B. W. Zhang, L. Y. Li, G. M. Liu, C. F. Li, J. T. Jiu, K. Suganuma: ACS Applied Materials & Interfaces, 11 (2) (2018) 2140-2148.

[14]Fully embedded CuNWs/PDMS conductor with high oxidation resistance and high conductivity for stretchable electronics, B. W. Zhang, W. L. Li, Y. Yang, C. T. Chen, C. F. Li, and K. Suganuma: Journal of Material Science, 54 (8) (2019) 6381–6392.

[15]Large-Scale and Galvanic Replacement Free Synthesis of Cu@AgCore-Shell Nanowires for Flexible Electronics, B. W. Zhang, W. L. Li, J. T. Jiu, Y. Yang, J. B. Jing, C. T. Chen, C. F. Li, and K. Suganuma: , 58 (5) (2019) 3374–3381.

[16]Microstructure and mechanical properties of sintered Ag particles with flake and spherical shape from nano to micro size, C. T. Chen and K. Suganuma: Materials & Design, 162 (15) (2019) 311-321.

[17]Thermal shock reliability of a GaN die-attach module on DBA substrate with Ti/Ag metallization by using micron/submicron Ag sinter paste, Japanese Journal of Applied Physics: , 58 (2019) SBBD15.

[18]Fabrication of Ni–P coating film on diamond/Al composite and its soldering reliability, Q. Y. Shi, Z. Q. Liu, D. Wu, H. Zhang, D. R. Ni, K. Suganuma: Journal of Materials Science: Materials in Electronics, 29 (10) (2018) 8371–8379.

[19]Bottom–Up Electrodeposition of Large-Scale Nanotwinned Copper within 3D Through Silicon Via, F. L. Sun, Z. Q. Liu, C. F. Li, Q. S. Zhu, H. Zhang and K. Suganuma: Materials, 11 (2) (2018) 319-326.

[20]Heat-Resistant Microporous Ag Die-Attach Structure for Wide Band-Gap Power Semiconductors, S. J. Noh, H. Zhang, and K. Suganuma: Materials, 11 (12) (2018) 2531-2541.

International Conferences
[1]AE evaluation of GaN die-attach on DBC substrate, (oral), C. Y. Choe, S. J. Noh, C. Chen, S. Nagao and K. Suganuma ,: 15th International ceramics congress(CIMTEC 2018).

[2]Sintering Mechanism of Micron/submicron-size Silver Particles (oral), Jeyun Yeom, Cai-Fu Li, Katsuaki Suganuma,: 2018 International Conference on Electronics Packaging and iMAPS All Asia Conference (ICEP-IAAC2018),.

[3]Ag joint bonding technology for bare copper substrate in low temperature pressureless and air condition (oral), Zheng Zhang, Chuantong Chen, Hao Zhang, Jinting Jiu, Shijo Nagao and Katsuaki Suganuma,: 2019 International Conference on Electronics Packaging and iMAPS All Asia Conference (ICEP-IAAC2018),.

[4]Bonding Technology Using Cold-Rolled Ag Sheet in Die-Attachment Applications (oral), Seungjun Noh, Chanyang Choe, Chuantong Chen, Hao Zhang, Katsuaki Suganuma: International Power Electronics Conference(IPEC-Niigata 2018).

[5]Effect of oxygen on Ag sintering technology with low temperature pressureless (oral), Chuantong Chen, Chanyang, Choe, Zheng Zhang, Shijo Nagao, and Katsuaki Suganuma1: 19th International Conference on Electronic Packaging technology (ICEPT2018).

[6]Thermal shock reliability of GaN die-attached on DBA with Ag sinter paste, (oral), Dongjin Kim, Chuantong Chen, Chun Pei, Zheng Zhang, Shijo Nagao, Aiji Suetake, Tohru Sugahara and Katsuaki Suganuma,: 20th International Conference on Electronic Packaging technology (ICEPT2018).

[7]Size dependent beam bending toughness on porous network structure in sintered Ag targeted for wide bandgap power device packaging (oral), Shijo Nagao, Chuantong Chen, Hao Zhang, and Katsuaki Suganuma,: The Sixth International Indentation Workshop (IIW6).

[8]Influence of thermal exposure upon mechanical/electrical properties and microstructure of sintered micro-porous silver, (oral), Chanyang Choe, Seungjun Noh, Chuantong Chen, Dongjin Kim and Katsuaki Suganuma: 30th European Symposium on Reliability of Electron Devices, Failure Physics and Analysis(ESREF 2018).

[9]Effect of porosity on the mechanical properties of sintered porous Ag: micro-compression experiments and simulations (poster), Chuantong Chen, Chun Pei, Shijo Nagao, and Katsuaki Suganuma: The Sixth International Indentation Workshop (IIW6).

[10]Development of thermal shock-resistant of GaN/DBC die-attached module by using Ag sinter paste and thermal stress relaxation structure (poster), Dongjin Kim, Chuantong Chen, Aiji Suetake, Chanyang Choe, Tohru Sugahara, Shijo Nagao and Katsuaki Suganuma: 29th European Symposium on Reliability of Electron Devices, Failure Physics and Analysis(ESREF 2018).

[11]Sinter Joining and Wiring without Pressure Assist for GaN Power Device Interconnection, (invited), Katsuaki suganuma: TMS 147th Annual Meeting & Exhibition.

[12]Heat-Resistant Packaging Technology for Wide Bandgap Power Devices and Thermal Reliability Testing (invited), Katsuaki suganuma、Hao Zhang、Shijo Nagao、Chuantong Chen、T. Sugahara，A. Shimoyama、A. Suetake: IEEE International Power Electronics Conference(IPEC-Niigata 2018).

[13]SilverSinter Joining and its Reliability for WBG Die-attach (invited), Katsuaki suganuma: The Asia-Pacific Conference on Silicon Carbide and Related Materials(APCSCRM2018).

[14]Packaging Material Technology for Wide Band Gap Power Devices and Its Performance/Reliability Evaluation (invited), Katsuaki Suganuma、Naoki Sato、Aishi Suetake、Chanyang Choe、Toru Sugahara、Shijo Nagao、Chuantong Chen: Americas International Meeting on Electrochemistry and Solid State Science(Aimes 2018).

[15]Stretchable wirings prepared with PU and silver flakes (oral),
Cai-Fu Li, Hao Zhang, Wanli Li, Zhi-Quan Liu, Katsuaki Suganuma:
The Minerals, Metals & Materials Society (TMS) 2018 Annual Meeting & Exhibition, .

[16]Nearly perfect Ag joints prepared by Ag stress-migration-bonding (SMB) process (oral), Hao Zhang, Seungjun Noh, Norio Asatani, Yukiharu Kimoto, Shijo Nagao and Katsuaki Suganuma: International Symposium on 3D Power Electronics Integration and Manufacturing (3D-PEIM 2018.

[17]Thermostable porous Ag die-attach structure for high-temperature power devices (oral), Seungjun

Noh, Hao Zhang, and Katsuaki Suganuma: International Symposium on 3D Power Electronics Integration and Manufacturing (3D-PEIM 2018).

[18]Enhanced high temperature stability of printed Cu wirings based on large Cu particle ink, Ag element addition, and intense pulsed light sintering (oral), Wanli Li, Linying Li, Cai-Fu Li, Jinting Jiu, Katsuaki Suganuma: 19th International Conference on Electronic Packaging Technology,.

[19]Long-time stability of the stretchable wirings at different environment conditions (oral), Cai-Fu Li , Hao Zhang, Wanli Li, and Katusaki Suganuma:
9th International Conference on Flexible and Printed Electronics 2018 (ICFPE 2018).

[20]Low temperature curable Cu-Ag hybrid inks to balance the cost and stability of printed conductive patterns (oral), Wanli Li, Jinting Jiu, Katsuaki Suganuma: International Conference on Flexible and Printed Electronics,.

[21]Die attach module by Cu sheet interconnect for high temperature applications (oral), Chuantong Chen,Dongjin Kim,Zheng Zhang,Katsuaki Suganuma: 2018 20th International Conference on Electronic Materials and Packaging (EMAP).

[22]Improvement in bonding strength of Ag sinter joining on gold surface finished substrates by increasing the gold grain size (oral), Dongjin Kim,Chuantong Chen,Chun Pei,Zheng Zhang,Shijo Nagao,Aiji Suetake,Tohru Sugahara,Katsuaki Suganuma: 2018 IEEE 20th Electronics Packaging Technology Conference (EPTC).

[23]Long-term reliability of GaN/DBA die-attached module with Ag sinter paste and with high temperature solder (oral), Dongjin Kim,Zheng Zhang,Yukiharu Kimoto,Chuantong Chen,Seongjun Noh,Katsuaki Suganuma: 2018 20th International Conference on Electronic Materials and Packaging (EMAP).

[24]Thermal shock reliability of a GaN die-attach module on DBA substrate by using micron/submicron Ag sinter paste (oral), Dongjin Kim,Chuantong Chen,Chun Pei,Zheng Zhang,Shijo Nagao,Aiji Suetake,Tohru Sugahara,Katsuaki Suganuma: International Conference on Solid State Devices and Materials.

[25]A novel joining process for the die attachment of next generation Power Devices (invited), Hao Zhang、 Seungjun Noh、 Zhi-quan Liu、 Caifu Li、 Norio Asatani、Yukiharu Kimoto、 Aiji Suetake、Shijo Nagao、Tohru Sugahara、Katsuaki Suganuma:
The Minerals, Metals & Materials Society (TMS) 2019 Annual Meeting & Exhibition, .

[26]Highly conductive wiring and reliable bonding for stretchable electronics (invited), Cai-Fu Li, Hao Zhang; Wanli Li; Tohru Sugahara; ZhiQuan Liu; Katsuaki Suganuma:
The Minerals, Metals & Materials Society (TMS) 2019 Annual Meeting & Exhibition, .

[27]A nearly-perfect Ag joints prepared by novel Ag to Ag direct bonding (oral), Hao Zhang, Seungjun Noh ,Norio Asatani ,Yukiharu Kimoto ,Aiji Suetake ,Shijo Nagao ,Tohru Sugahara ,Katsuaki Suganuma: 2018 International Conference on Electronics Packaging and iMAPS All Asia Conference (ICEP-IAAC).

[28]Effect of temperature on electrochemical corrosion of Zn-30Sn lead-free solder (oral), Zhenghong Wang,Zelin Yang,Shenbo Zeng,Gong Zhang,Jianchun Liu,Chuantong Chen,Katsuaki Suganuma: 2018 International Conference on Electronics Packaging and iMAPS All Asia Conference (ICEP-IAAC).

[29]Effect of pre-annealing of Au metallization structure on the bonding performance with low temperature pressureless sintering Ag (oral), Chuantong Chen、Zheng Zhang、Shijo Nagao、Katsuaki Suganuma、Tomohito Iwashige、Kazuhiko Sugiura、Kazuhiro Tsuruta: 2018 International Conference on

Electronics Packaging and iMAPS All Asia Conference (ICEP-IAAC).

Review Papers

Development of large-scale flexible thermoelectric conversion module utilizing semiconductor high density packaging technology, Chemical Industry, Chemical Industry Publisher, 70 (2019), 26-33.

Patents

[1]K20180291 酸窒化物の成膜方法, 2019-018081

[2]K20180193 金属製部材の接合方法、金属製部材接合体及び回路基板, 2018-189518

[3]KP2018068 銅銀合金の合成方法、導通部の形成方法、銅銀合金、および導通部, 2018-565905

[4]K20180240 熱電変換モジュール、および、熱電変換モジュールの製造方法, 2019-038901

[5]G20180047TW 銅銀合金の合成方法、および導通部の形成方法、銅銀合金、および導通部, 107125313

[6]G20180047WO 銅銀合金の合成方法、導通部の形成方法、銅銀合金、および導通部, PCT/JP2018/027602

[7]G20180144WO 基板評価用チップ及び基板評価装置, PCT/JP2019/006438

[8]G20180047EP 銅銀合金の合成方法、導通部の形成方法、銅銀合金、および導通部,

[9]G20180047KR 銅銀合金の合成方法、導通部の形成方法、銅銀合金、および導通部,

[10]G20180047US 銅銀合金の合成方法、導通部の形成方法、銅銀合金、および導通部,

[11]G20180144TW 基板評価用チップ及び基板評価装置, 108105838

[12]G20180047CN 銅銀合金の合成方法、導通部の形成方法、銅銀合金、および導通部,

[13]KP2015045 金属ナノワイヤの製造方法及び銀ナノワイヤの製造方法, 2015-518308

[14]KP2017008 銅粒子の製造方法, 2017-503734

[15]K20130056 接合構造体の製造方法、接合構造体および装置, 2013-169168

[16]K20130186 樹脂硬化物の製造方法, 2013-217195

[17]G20140006US 金属ナノワイヤの製造方法及び金属ナノワイヤ並びに銀ナノワイヤの製造方法及び銀ナノワイヤ, 14/893329

[18]G20150081TW 接合材、接合材の製造方法、接合構造体の作製方法, 105137692

[19]G20140006CN 金属ナノワイヤの製造方法及び金属ナノワイヤ並びに銀ナノワイヤの製造方法及び銀ナノワイヤ, 201480029788.70001

[20]G20160150 Bonding Device, JP2017-022285

[21]K20180240 Thermoelectric conversion module and fabrication method of thermoelectric conversion module, JP2019-38901

Grant-in-Aid for Scientific Research

Zhang Hao	Abnormal growth of hillocks from Ag surface ands its control	¥910,000

Entrusted Research

K.Suganuma	JST	Heat resistant GaN power packaging	¥35,750,000
K.Suganuma	NEDO	Council for Science, Technology and Innovation, Cross-ministerial Strategic Innovation Promotion Program, ”Next-generation power electronics/Consistent R&D of next-generation SiC power electronics”	¥23,072,000
K.Suganuma	NEDO	Renewable energy technology innovation support project by venture companies (use of geothermal and heat) / Development of 250 ° C heat-resistant flexible thermoelectric module for use of heat waste	¥5,895,000
K.Suganuma	NEDO	Development of cooling unit for a high-performance vehicle cooler with a spontaneous cooling promotion mechanism	¥3,640,000
K.Suganuma	METI	Development of reliability design and evaluation system for high heat-resistant power semiconductor modules based on experimental and simulation integrated evaluation	¥0,000

Contribution to Research

K.Suganuma	Daicel Co.,
K.Suganuma	Uyemura Inductries Co.
K.Suganuma	Showa Denko Co.
K.Suganuma	Senju metal Co.
K.Suganuma	Osaka University Research Association of Industry and Science, **RAIS**
T.Sugahara	E Thermogenetech Co.

Cooperative Research

K.Suganuma	ASTOM
K.Suganuma	Siemens AG ,Senju metal Co.,Showa Denko Co.,Uyemura Inductries Co.
K.Suganuma	Stanley Electric Co.,
K.Suganuma	Mitsui Mining Smelting Co.,
K.Suganuma	Soken Co., Denso Co.
K.Suganuma	Pi Crystal Co.
K.Suganuma	Senju metal Co.,

K.Suganuma	Huawei Co.
K.Suganuma	Uyemura Inductries Co.
K.Suganuma	Yamato Scientific Co.,
K.Suganuma	Nippon Shokubai
K.Suganuma	Nippon Shokubai
K.Suganuma	Asahi Intecc Co.,Ltd
K.Suganuma	Tokuyama Co.
K.Suganuma	ITRI
K.Suganuma	Daicel Co.,
K.Suganuma	Hyundai Mobis Co., Ltd
K.Suganuma	imec
K.Suganuma	E Thermogenetech Co.
K.Suganuma	E Thermogenetech Co.
S.Nagao	UACJ Co.

Other Research Fund

K.Suganuma	JSPS	¥9,350,000

Department of Excited Solid-State Dynamics

International Conferences

[1]Measurement for the dispersion of the excited states in the transition metal dichalcogenide by the use of photon-energy-dependent ARPES , S.Tanaka, K.Ueno, S. Ideta and K. Tanaka: The first international workshop on Momentum Microscopy & Spectroscopy for Materials Science.

[2]Direct detection of the electron-phonon matrix element in graphite via High-resolution electron energy loss spectroscopy , S. Tanaka, F.C. Bocquet and F. S. Tautz: The22nd SANKEN International symposium.

[3]Optical Control of Structural Transformation to Form Nano-scaled Order Phases Including sp^3-like Interlayer Bonds in Graphite , E. Inami, K. Nishioka, J. Kanasaki, K. Tanimura: The 22nd SANKEN International Symposium/ The 17th SANKEN Nanotechnology International Symposium (Osaka).

Contributions to International Conferences and Journals

S. TANAKA Scientific Reports (Editor)

Publications in Domestic Meetings

Annual meeting of Japanese Physical Sociey	2 papers
Annual meeting of Japanese society of synchrotron radiation	1 paper
Annual meeting of the Japan society of vacuum and surface science	1 paper
Annual meeeting of the materials research society of Japan	2 papers

Grant-in-Aid for Scientific Research

J. Kanasaki	Development of ultra high space- and time-resolved spectroscopy and its application to photoinduced phase transformation research	¥,000

Department of Accelerator Science（Department of Beam Physics）

International Conferences

[1]Nonlinear Phenomena on Solids by Using THz-FEL (invited), Akinori Irizawa: ICSM2018.

[2]Nonlinear phenomena on semiconductors by THz-FEL irradiation (invited), Akinori Irizawa:

LEES2018.

[3]Novel Responses of Solids by Terahertz Free Electron Laser (invited), Akinori Irizawa: Channeling2018.

[4]Lase Induced Fine Structure on Si by THz-FEL Irradiation (oral), A. Irizawa, S. Suga, T. Nagashima, A. Higashiya, M. Hashida, S. Sakabe: IRMMW-TH z 2018.

Review Papers

Development and use of ISIR THz-FEL, The Japan Society of Infrared Science and Technology, Journal of the Japan Society of Infrared Science and Technology, The Japan Society of Infrared Science and Technology, 28(1) (2018), 5-14.

Contributions to International Conferences and Journals

A.Irizawa	2019 International Workshop on Infrared Microscopy and Spectroscopy with Accelerator Based Sorces (International Advisory Committee)	

Publications in Domestic Meetings

Physical Society of Japan	1 paper
The Japanese Society for Synchrotron Radiation Research	1 paper
Conference of FEL and High-Power Radiation	1 paper

Grant-in-Aid for Scientific Research

A.Irizawa	Study on LIPSS generation by free electron laser	¥1,170,000

Contribution to Research

A.Irizawa	Shunichi Hayashi General Manager, Advanced Technology Research Center, Technology Development Division, Nippon Steel & Sumitomo Metal Corporation	¥500,000

Cooperative Research

A. Irizawa	University of Rome, INFN	¥0,000

Department of Beam Materials Science

Original Papers

[1]Resist image quality control via acid diffusion constant and/or photodecomposable quencher concentration in the fabrication of 11 nm half-pitch line-and-space patterns using extreme-ultraviolet lithography, T. Kozawa, J. J. Santillan, and T. Itani: Jpn. J. Appl. Phys., 57 (2018) 056501.

[2]Study of electron-beam and extreme-ultraviolet resist utilizing polarity change and radical crosslinking, S. Enomoto and T. Kozawa: J. Vac. Sci. Technol. B , 36 (2018) 031601.

[3]Dissolution behavior of negative-type photoresists for display manufacture studied by quartz crystal microbalance method, A. Tsuneishi, S. Uchiyama, and T. Kozawa: Jpn. J. Appl. Phys. , 57 (2018) 046501.

[4]Electron-hole pairs generated in ZrO2 nanoparticle resist upon exposure to extreme ultraviolet radiation, T. Kozawa, J. J. Santillan, and T. Itani: Jpn. J. Appl. Phys. , 57 (2018) 026501.

[5]Analysis of dissolution factor of line edge roughness formation in chemically amplified electron beam resist, Takahiro Kozawa: Jpn. J. Appl. Phys. , 57 (2018) 126502.

[6]Relationship between C=C double bondconversion and dissolution kinetics in crosslinking-type photoresists for display manufacture, studied by real-time Fourier transform infraredspectroscopy and quartz crystal microbalancemethods, A.Tsuneishi, S. Uchiyama1, R. Hayashi, K. Taki, and T.Kozawa: Jpn. J. Appl. Phys. , 57 (2018) 096501.

[7]Effects of an organotin compound on radiation-induced reactions of extremeultraviolet resists utilizing

polarity change and radical crosslinking, S.Enomoto, T.Yoshino, K. Machida, and T.Kozawa: Jpn. J. Appl. Phys. , 58 (2018) 016504.

[8]Dependence of relationship between chemical gradient and line width roughness of zirconia nanoparticle resist on pattern duty, acid generator, and developer, T. Kozawa, A. Nakajima, T. Yamada, Y. Muroya, J. J. Santillan, and T. Itani: Jpn. J. Appl. Phys. , 58 (2019) 036501.

[9]Relationship between Resolution Blur and Shot Noise in Line Edge Roughness Formation of Chemically Amplified Resists Used for Extreme-Ultraviolet Lithography, Takahiro Kozawa, Julius Joseph Santillan, Toshiro Itani: J. Photopolym. Sci. Technol., 31 (2018) 183-188.

[10]Comparison of radical generation efficiencies of the oxime-based initiator radicals using galvinoxyl radical as an indicator, A. Tsuneishi, D. Sakamaki, Q. Gao, T. Shoda, T. Kozawa, and S. Seki,: Jpn. J. Appl. Phys. , 57 (2018) 086504.

[11] Synthesis of hyperbranched polyacetals containing C-(4-t-butylbenz)calix[4] resorcinarene: Resist properties for extreme ultraviolet (EUV) lithography, H. Kudo, M. Fukunaga, K. Shiotsuki, H. Takeda, H. Yamamoto, T. Kozawa, and T. Watanabe: Reactive and Functional Polymers , 131 (2018) 361–367.

[12] Synthesis and Property of Tannic Acid Derivatives and Their Application for Extreme Ultraviolet Lithography System, H. Kudo, S. Ohori, H. Takeda, H. Ogawa, T. Watanabe, H. Yamamoto, and T. Kozawa,: J. Photopolym. Sci. Technol. , 31 (2018) 221-225 .

[13] Sensitizers in extreme ultraviolet chemically amplified resists: mechanism of sensitivity improvement, Y. Vesters, J. Jiang, H. Yamamoto, D. D. Simone, T. Kozawa, S. D. Gendt, and G. Vandenberghe: J. Micro/Nanolith. MEMS MOEMS, 17 (2018) 043506.

[14]An improved method for modelling coolant radiolysis in ITER, Z. Fang, X. Cao, L. Tong, Y.Muroya, G. Whitaker, M.Momeni, M. Lin: Fusion Engineering and Design , 127 (2018) 91-98.

[15] Efficient separation of Re(VII) by radiation-induced reduction from aqueous solution, Yun Shang, Jiaxin Xiao, Hanqin Weng, Fuhai Li, Sheng Chen, Shinichi Yamashita, Yusa Muroya, Mingzhang Lin: Chem. Eng. J., 341 (2018) 317-326.

[16]PWR secondary water chemistry guidelines in Japan - Purpose and technical background., Hirotaka Kawamura, Yasuhiko Shoda, Takumi Terachi, Yosuke Katsumura, Shunsuke Uchida, Takayuki Mizuno, Yusa Muroya, Yasuo Tsuzuki, Ryuji Umehara, Hideo Hirano, Takao Nishimura.: Prog. Nucl. Energ., 114 (2019) 121-137.

[17]Observation of dissociative quasifree electron attachment to nucleoside via excited anion radical in solution, Jun Ma, Anil Kumar, Yusa Muroya, Shinichi Yamashita, Tsuneaki Sakurai, Sergey A. Denisov, Michael D. Sevilla, Amitava Adhikary, Shu Seki, Mehran Mostafavi: Nat. Commun., 10 (2019) 102.

[18]Reaction Intermediates of Nitric Oxide Synthase from Deinococcus radiodurans as Revealed by Pulse Radiolysis; Evidence for Intramo-lecular Electron Transfer from Biopterin to FeII-O2 Complex, Y. Tsutsui, K. Kobayashi, F. Takeuchi, M. Tsubaki, and T. Kozawa: Biochemistry, 57 (2018) 1611-1619.

[19]Redox-dependent Axial Ligand Replacement and Its Functional Significance in Heme-bound Iron Regulatory Proteins, M. Ogura, R. Endo, H. Ishikawa, Y. Takeda T. Uchida, K. Iwai, K. Kobayashi and K. Ishimori: J. Inorganic Biochem., 182 (2018) 238-248.

[20]Pulse Radiolysis Studies for Mechanism in Biochemical Redox Reactions, Kazuo Kobayashi: Chem. Rev., 119 (2019) 4413-4462.

[21]Effects of molecular weight and dispersity on performance of main-chain-scission-type resist, Ayako Nakajima, Manabu Hoshino, Masakazu Hashimoto, and Takahiro Kozawa: Jpn. J. Appl. Phys. , 58 (2019) 020909.

[22]Pulse radiolysis of methacrylic acid ligand for zirconia nanoparticle resist, Teppei Yamada, Satoshi Ishihara, Yusa Muroya, Julius Joseph Santillan, Shinichi Yamashita, Toshiro Itani, and Takahiro Kozawa: Jpn. J. Appl. Phys., 58 (2019) 036503.

[23]Incorporation of chemical amplification in dual insolubilization resists, Satoshi Enomoto, Takumi Yoshino, Kohei Machida, and Takahiro Kozawa: Jpn. J. Appl. Phys., 58 (2019) 056504.

[24]Effects of low temperature buffer on carbon nano wall's growth, Rupesh Singha, Toshio Kawahara, Yuhsuke Ohmi, Yasuhide Ohno, Kenzo Maehashi, Kazuhiko Matsumoto, Kazumasa Okamoto, Risa Utsunomiya, Masamichi Yoshimura: Mater. Today Comm., 17 (94) (2018) 94-99.

[25] Elucidation of radiation chemical primary process of resist materials using pulse radiolysis and its application. K. Okamoto , T. Kozawa, Hoshasenkagaku, 107 (2019) 9-15.

[26]Photochemistry and the role of light during the submerged photosynthesis of zinc oxide nanorods, Lihua Zhang, Melbert Jeem, Kazumasa Okamoto, Seiichi Watanabe: Sci. Rep., 8 (2018) 177.

International Conferences

[1]Improvement of Sensitivity of Chemically Amplified Resists by Adding Diphenyl Sulfone (oral), S. Kawai , K. Okamoto , H. Yamamoto and T. Kozawa: 31st International Microprocesses and Nanotechnology Conference.

[2]Lamellar Orientation of PSPMMA Block Copolymer via Electron-Beam Induced Porlarity Switch in Nitrophenyl Selfassembled monolayer (SAM) (poster), H. Yamamoto, G. Dawson, T. Kozawa: 31st International Microprocesses and Nanotechnology Conference.

[3]Stochasticity in EUV lithography (oral), T. Kozawa, J.J.Santillan, T. Itani: 16th FRAUNHOFER IISB.

[4]Material design for the improvement of ZEP520A performance (oral), T. Kozawa, A. Nakajima, M. Hoshino, M. Hashimoto: SPIE Photomask Technology and Extreme Ultraviolet Lithography.

[5]Pattern formation mechanism of zirconia nanoparticle resist used for extreme-ultraviolet lithography, (oral), T. Kozawa, T. Yamada, S. Ishihara, H. Yamamoto, Y. Muroya, J. J. S. Santillan, Toshiro Itani: SPIE Photomask Technology and Extreme Ultraviolet Lithography.

[6]Sequential Radiation Chemical Reactions in Aqueous Solutions of Halide Anions (poster), S. Yamashita, K. Hata, Y. Muroya and Y. Katsumura: 7th Asia Pacific Symposium on Radiation Chemistry (APSRC-2018).

[7]Pulse radiolysis and gamma radiolysis studies on formation process of nanoparticles in organics-free platinum colloidal solution (poster), M. Kariya, Y Muroya, K. Ishida, Y. Wada, T. Ito, N. Ota, S. Yamashita, T. Kozawa: 7th Asia Pacific Symposium on Radiation Chemistry (APSRC-2018).

[8]Gamma radiolysis study on solid nitrate calcines of reprocessing liquid waste (poster), Y. Muroya, A. Suzuki: 7th Asia Pacific Symposium on Radiation Chemistry (APSRC-2018).

[9]Ps and ns pulse radiolysis studies on radiation-induced primary process of ligands of metal resists (poster), T. Yamada, S. Ishihara, H. Yamamoto, Y. Muroya, Y. Komuro, D. Kawana, A. Yamazaki, S. Yamashita, T. Kozawa: 7th Asia Pacific Symposium on Radiation Chemistry (APSRC-2018).

[10]Analysis of line-and-space patterns of ZrO2 nanoparticle resist on the basis of EUV sensitization mechanism (oral), T. Kozawa, T. Yamada, Y. Muroya, J. J. Santillan, T. Itani: SPIE ADVANCED LITHOGRAPHY 2019.

[11]Improvement of dual insolubilization resist performance through the incorporation of various functional units (oral), S. Enomoto, T. Yoshino, K. Machida, T. Kozawa: SPIE ADVANCED LITHOGRAPHY 2019.

[12]Fundamental study on dissolution kinetics of poly(4-hydroxystyrene) for development of high-resolution resists (poster), A. Nakajima, K. Watanabe, K. Matsuoka, T. Kozawa, Y. Komuro, D. Kawana, A. Yamazaki: SPIE ADVANCED LITHOGRAPHY 2019.

Patents

[1]K20180412 Polymers, Resist materials including corresponding polymers, Fabrication methods of devices and inverse patterns using corresponding polymers and resist materials, JP2019-030452

[2]K20180043 Fabrication method of resist patterns, JP2018-105274

[3]K20180007 Fabrication method of resist patterns, JP2018-086159

Contributions to International Conferences and Journals

Takahiro Kozawa	31st International Microprocesses and Nanotechnology Conference (Organaizing Committtee)
Takahiro Kozawa	31st International Microprocesses and Nanotechnology Conference (Steering Committtee Chair)
Takahiro Kozawa	32nd International Microprocesses and Nanotechnology Conference (Organizing Committee Vice Chair)
Takahiro Kozawa	2018 International Symposium on Extreme Ultraviolet Lithography (Steering Committee)
Kazumasa Okamoto	31st International Microprocesses and Nanotechnology Conference (Program Committee)
Kazumasa Okamoto	32st International Microprocesses and Nanotechnology Conference (Program Committee)

Publications in Domestic Meetings

The 45th Symposium on Biomolecular Science	1 paper
The 55th Japan Radioisotope Association Meeting	3 papers
NGL2018	1 paper
2018 Annual meeting of Atomic Energy Society of Japan in Autumn	3 papers
The 79th JSAP Autumn Meeting 2018	1 paper
The 61st Meeting of Japanese Society of Radiation Chemistry	6 papers
The 91st Annual Meeting of the Japanese Biochemical Society	1 paper
2018 Academic Lecture of The Japan Society of Vacuum and Surface Science	1 paper
The 99th CSJ Annual Meeting	1 paper
2019 Annual meeting of Atomic Energy Society of Japan in Spring	2 papers

Academic Degrees

Master Degree for Engineering M. Kariya	Formation process of nanoparticles in organics-free colloidal platinum aqueous solution by quantum beam irradiation
Master Degree for Engineering T. Yamada	Study on quantum beam-induced reaction mechanism of metal oxide resists
Doctor Degree for Engineering	Mechanism analysis in pattern formation of negative type photoresist using novel quantum yield measurement and quartz crystal microbalance method

A. Kimura Doctor Degree for Engineering S. Enomoto	Studies on metal-containing chemically amplified resist utilizing polarity change and crosslinking used for extreme ultraviolet lithography	
Grant-in-Aid for Scientific Research		
T. Kozawa	Development of single nano materials based on quantum beam and data science	¥10,010,000
Y. Muroya	Investigation of role of hydrated water in formation of DNA damage induced by ionizing radiation.	¥500,000
Entrusted Research		
Y. Muroya	Nippon Nuclear Fuel Development Co., Ltd. (NFD)	Practical development of the flexible waste management method enhancing potential of MA P&T technology
Y. Muroya	Central Research Institute of Electric Power Industry	
A. Nakajima	Toshiba Memory Corporation	
Cooperative Research		
T. Kozawa	NuFlare Technology, Inc.	
T. Kozawa	Toyo Gosei Co., Ltd	
T. Kozawa	Zeon Corporation	
T. Kozawa	National Institutes for Quantum and Radiological Science and Technology	¥0,000
K. Okamoto	Hokkaido Univ., Tohoku Univ., QST, Chubu Univ.	¥2,300,000
K, Okamoto	Hokkaido Univ.	¥200,000
Other Research Fund		
Y. Muroya	Japan Science & Technology Agency	¥2,439,000

Department of Molecular Excitation Chemistry

Original Papers

[1]Electron transfer dynamics of quaternary sulfur semiconductor/MoS_2 layer-on-layer for efficient visible-light H_2 evolution, Xiaowei Shi, Mamoru Fujitsuka, and Tetsuro Majima: Appl. Catal. B, 235 (2018) 9-16.

[2]Rapid electron transfer of stacked heterodimers of perylene diimide derivatives in a DNA duplex, Tadao Takada, Syunya Ishino, Ami Takata, Mitsunobu Nakamura, Mamoru Fujitsuka, Tetsuro Majima, and Kazushige Yamana: Chem. Eur. J., 24 (2018) 8228-8232.

[3]Defect state-induced efficient hot electron transfer in Au nanoparticles/reduced TiO_2 mesocrystal photocatalysts, Jiawei Xue, Ossama Elbanna, Sooyeon Kim, Mamoru Fujitsuka, and Tetsuro Majima: Chem. Commun., 54 (2018) 6052-6055.

[4]Amplifying fluorescence signal contrast of aptamer-modified microspheres inspired by whispering-gallery mode lasing, Sooyeon Kim, Ayaka Kuroda, Mamoru Fujitsuka, and Tetsuro Majima: RSC Adv., 8 (2018) 20822-20828.

[5]2D/2D heterostructured CdS/WS_2 with efficient charge separation improving H_2 evolution under visible light irradiation, Ke Zhang, Mamoru Fujitsuka, Yukou Du, and Tetsuro Majima: ACS Appl. Mater. Interfaces, 10 (2018) 20458-20466.

[6]Charge carrier dynamics in TiO_2 mesocrystals with oxygen vacancies for photocatalytic hydrogen generation under solar light irradiation, Ossama Elbanna, Mamoru Fujitsuka, Sooyeon Kim, and Tetsuro Majima: J. Phys. Chem. C, 122 (2018) 15163-15170.

[7]Pulse radiolysis of TIPS-pentacene and a fluorene-bridged bis(pentacene): Evidence for intramolecular singlet-exciton fission, Joshua K. G. Karlsson, Alparslan Atahan, Anthony Harriman, Sachiko Tojo, Mamoru Fujitsuka, and Tetsuro Majima: J. Phys. Chem. Lett., 9 (2018) 3934-3938.

[8]Spirally configured (*cis*-stilbene) trimers: Steady-state and time-resolved photophysical studies and organic light-emitting diode applications, Shiang-Fu Hung, Po-Hsun Fang, Yi Wei, Fang-Yuan Tsai, Chien-Tien Chen, Takumi Kimura, Shingo Samori, Mamoru Fujitsuka, Tetsuro Majima, Chun-Hao Lin, Shiang-Hau Peng, and Jwo-Huei Jou: ACS Appl. Mater. Interfaces, 10 (2018) 25561-25569.

[9]Defects rich g-C_3N_4 with mesoporous structure for efficient photocatalytic H_2 production under visible light irradiation, Daming Ruan, Sooyeon Kim, Mamoru Fujitsuka, and Tetsuro Majima: Appl. Catal. B, 238 (2018) 638-646.

[10]Donor-donor'-acceptor triads based on [3.3]paracyclophane with a 1,4-dithiafulvene donor and a cyanomethylene acceptor: Synthesis, structure, and electrochemical and photophysical properties, Katsuya Sako, Tomoya Hasegawa, Hiroyuki Onda, Michito Shiotsuka, Motonori Watanabe, Teruo Shinmyozu, Sachiko Tojo, Mamoru Fujitsuka, Tetsuro Majima, Yasukazu Hirao, Takashi Kubo, Tetsuo Iwanaga, Shinji Toyota, and Hiroyuki Takemura: Chem. Eur. J., 24 (2018) 11406-11417.

[11]Factors affecting photocatalytic activity of visible light-responsive titanium dioxide doped with chromium ions, Naoto Nishiyama, Keisuke Kozasa, Toshihiro Okajima, Mamoru Fujitsuka, Tetsuro Majima, and Suzuko Yamazaki: Catal. Sci. Technol., 8 (2018) 4726-4733.

[12]Facet effects of Ag_3PO_4 on charge-carrier dynamics: Trade-off between photocatalytic activity and charge-carrier lifetime, Sooyeon Kim, Yue Wang, Mingshan Zhu, Mamoru Fujitsuka, and Tetsuro Majima: Chem. Eur. J., 24 (2018) 14928-14932.

[13]Influence of charge distribution on structural changes of aromatic imide derivatives upon one-electron reduction revealed by time-resolved resonance Raman spectroscopy during pulse radiolysis, Bo Zhuang, Mamoru Fujitsuka, Sachiko Tojo, Dae Won Cho, Jungkweon Choi, and Tetsuro Majima: J. Phys. Chem. A, 122 (2018) 8738-8744.

[14]Synthesis and spectroscopic analysis of benzylidene imidazolone linked to P-porphyrins through axial ligand, Jin Matsumoto, Kyosuke Takemori, Jun Ishikawa, Yu Nabetani, Mamoru Fujitsuka, Tetsuro Majima, and Masahide Yasuda: Med. Chem. Res., 27 (2018) 2530-2537.

[15]Significant structural relaxations of excited [*n*]cycloparaphenylene dications (n = 5–9), Mamoru Fujitsuka, Eiichi Kayahara, Chao Lu, Shigeru Yamago, and Tetsuro Majima: Phys. Chem. Chem. Phys., 20 (2018) 29207-29211.

[16]Unprecedented effect of CO_2 calcination atmosphere on photocatalytic H_2 production activity from water using g-C_3N_4 synthesized from triazole polymerization, Jing Xu, Mamoru Fujitsuka, Sooyeon Kim, Zhouping Wang, and Tetsuro Majima: Appl. Catal. B, 241 (2018) 141-148.

[17]The role of nitrogen defects in graphitic carbon nitride for visible-light-driven hydrogen evolution, Jiawei Xue, Mamoru Fujitsuka, and Tetsuro Majima: Phys. Chem. Chem. Phys., 21 (2019) 2318-2324.

[18]Black phosphorous sensitized TiO_2 mesocrystals photocatalyst for hydrogen evolution with visible and near-infrared light irradiation, Osaama Elbanna, Mingahan Zhu, Mamoru Fujitsuka, and Tetsuro Majima: ACS Catal., 9 (2019) 3618-3626.

[19]Efficient photocatalytic H_2 evolution using NiS/$ZnIn_2S_4$ heterostructures with enhanced charge separation and interfacial charge transfer, Aihua Yan, Xiaowei Shi, Fei Huang, Mamoru Fujitsuka, Tetsuro Majima: Appl. Catal. B, 250 (2019) 163-170.

[20]Efficient Visible-Light-Driven Hydrogen Generation on g-C3N4 Coupled with Iron Phosphide, Zhichao Sun, Mamoru Fujitsuka, Chuan Shi, Mingshan Zhu, Anjie Wang, Tetsuro Majima: ChemPhotoChem, 3 (2019) 540-544.

[21]Formation of the charge-localized dimer radical cation of 2-ethyl-9,10-dimethoxyanthracene in solution phase, Jungkewon Choi, Doo-Sik Ahn, Mamoru Fujitsuka, Sachiko Tojo, Hyotcherl Ihee, and Tetsuro Majima: Chem. Eur. J., 25 (2019) 5586-5594.

International Conferences

[1]Application of Time-Resolved Resonance Raman to Pulse Radiiolysis (invited), M. Fujitsuka: The 2nd Workshop on Particle Beam Utilization.

[2]Application of Time-Resolved Resonance Raman to Pulse Radiiolysis (invited), M. Fujitsuka: International Conference on Raman Spectroscopy.

[3]Significant structural relaxations of [*n*]cycloparaphenylene dications (n = 5 - 9) in the excited states (invited), M. Fujitsuka, E. Kayahara, S. Yamago, and T. Majima: 14th Korea-Japan Symposium on Frontier Photoscience.

[4]Structural Changes of Aromatic Imides upon One-Electron Reduction Revealed by Time-Resolved Resonance Raman Spectroscopy during Pulse Radiolysis (oral), M. Fujitsuka, B Zhuang, S. Tojo, and T. Majima: The 7th Asia Pacific Symposium on Radiation Chemistry.

[5]Fluorescence blinking adaptable to structural analysis of nucleic acids (invited), K. Kawai: Physical Chemistry Colloquium.

[6]Fluorescence blinking adaptable to structural analysis of nucleic acids (oral), K. Kawai, A. Maruyama: Fluorescent Biomolecules and their Building Blocks (FB3).

[7]Single-Molecule Level Analysis of DNA by Controlling the Fluorescence Blinking (invited), K. Kawai: The 7 th International Mini-symposium on Advanced Coordination Chemistry.

[8]Structural analysis of nucleic acids by controlling fluorescence blinking (oral), K. Kawai, A. Maruyama: IUPAC photochemistry.

Review Papers

Studies on structural dynamics of reaction intermediates by vibrational spectroscopy, M. Fujitsuka, Houshasenkagaku (Radiation Chemistry), 105 (2018), 37-40.

Recent development of radiation chemistry based on time-resolved resonance Raman, M. Fujitsuka, Manufacturing and Technology, 70 (2018), 86-89.

Molecular Technology toward Expansion of Nucleic Acid Functionality, M. Kimoto, K. Kawai, Molecular Technology, Wiley-VCH, 2 (2018), 165-181.

Single molecule analysis of nucleic acids by controlling the blinking, K. Kawai, FBC News Letter, Forum on Biomolecular Chemistry, 58 (2019), 5-10.

Publications in Domestic Meetings

Annual Meeting on Photochemistry 2018	4 papers
The 61st Meeting of Japanese Society of Radiation Chemistry	1 paper
2018 MRS Fall Meeting & Exhibit	2 papers
The 99th CSJ Annual Meeting	4 papers

Academic Degrees

Doctor Degree for Enginnering XIAOWEI SHI	Studies on Photocatalytic Activity of Semiconductor Composites for Hydrogen Generation Based on Charge Transfer Kinetics under Solar Light Irradiation
Master Degree for Enginnering YUE WANG	Charge Carrier Dynamics and Photocatalytic Activities of Silver Phosphate towards Light-driven Water Splitting
Master Degree for Enginnering Hiroki Kawakami	Electron Transfer Processes from Excited Naphthalene Diimide Radical Anions in Intensely Interacting Aromatic Imide Molecules
Master Degree for Enginnering Haruna Kubo	Excited State Property and Electron Transfer Process of Perylenediimide Dianion
Master Degree for Enginnering BO ZHUANG	Structural Changes upon One-Electron Reduction of Aromatic Imide Derivatives Studied by Time-Resolved Raman Resonance Raman Spectroscopy during Pulse Radiolysis

Grant-in-Aid for Scientific Research

K.Kawai	DNA Real-Time Single-Molecule Observation of DNA Conformational Changes	¥5,460,000
LU CHAO	Reactions of Super Reductants and Oxidants Explored by Ultrafast Spectroscopy	¥1,430,000
M.Fujitsuka	New Organic Chemistry and Materials Science of Curved pi-Conjugated Molecules	¥1,560,000

Contribution to Research

M.Fujitsuka	M3 laboratory, Inc.,	¥100,000

Other Research Fund

M. Fujitsuka	International Joint Research Promotion Program (Support for Short-term Personnel Expenses)	¥2,500,000

Department of Synthetic Organic Chemistry

Original Papers

[1]Enantioselective Synthesis of Spiro (isoxazole-isoxazoline) Hybrid Ligand, Bijan Mohon Chaki, Kazuhiko Wakita, Shinobu Takizawa, Kazuhiro Takenaka, Hiroaki Sasai□: Heterocycles, 97 (1) (2018) 493-505.

[2]Phosphine-Catalyzed Dual Umpolung Domino Michael Reaction: Facile Synthesis of Hydroindole- and Hydrobenzofuran-2-Carboxylates, Kenta Kishi, Shinobu Takizawa,* Hiroaki Sasai*: ACS Catal., 8 (6) (2018) 5228-5232.

[3]Vanadium-Catalyzed Dehydrogenation of N-Heterocycles in Water, Nadine Zumbrägel, Makoto Sako, Shinobu Takizawa, Hiroaki Sasai,* Harald Gröger*: Org. Lett., 20 (16) (2018) 4723-4727.

[4]Enantioselective Aza-Wacker-Type Cyclization Promoted by Pd-SPRIX Catalyst, Abhijit Sen, Kazuhiro Takenaka,* Hiroaki Sasai*: Org. Lett., 20 (21) (2018) 6827-6831.

[5]Chiral Dinuclear Vanadium Complex-mediated Oxidative Coupling of Resorcinols, Makoto Sako, Takanori Aoki, Nadine Zumbrägel, Lukas Schober, Harald Gröger, Shinobu Takizawa,* Hiroaki Sasai*: J. Org. Chem., 84 (3) (2018) 1580-1587.

International Conferences

[1]Chiral Dinuclear Vanadium Complex-mediated Oxidative Coupling of Monocyclic Phenols (oral), Makoto Sako, Takanori Aoki, Shinobu Takizawa, Hiroaki Sasai: 43rd International Conference on Coordination Chemistry (ICCC 2018).

[2]Enantioselective Oxidative C-H/C-H Coupling Catalyzed by Chiral Dinuclear Vanadium(V) Complex (poster), Makoto Sako, Takanori Aoki, Shinobu Takizawa, Hiroaki Sasai: The 4th International Symposium on C-H Activation (ISCHA4).

[3]Enantioselective Synthesis of Tetrahydrocyclopenta[b]indole Bearing a Chiral Quaternary Carbon Center via Pd(II)-SPRIX-catalyzed C-H Activation (poster), Shinobu Takizawa, Mohamed Ahmed Abozeid, Hiroaki Sasai: The 4th International Symposium on C-H Activation (ISCHA4).

[4]Chiral Catalyzed Domino Reactions (poster), Miki Kusaba, H. D. P. Wathsala, Makoto Sako, Kenta Kishi, Shinobu Takizawa, Hiroaki Sasai: Biotechnology and Chemistry for Green Growth (JSPS Japanese-German Graduate Externship Program).

[5]Vanadium(V) Complex-catalyzed Oxidative Hetero-coupling Reactions (poster), Yuzhao Jiang, Makoto Sako, Shinobu Takizawa, Hiroaki Sasai: Biotechnology and Chemistry for Green Growth (JSPS Japanese-German Graduate Externship Program).

[6]Chiral Dinuclear Vanadium Complex-mediated Oxidative Coupling of Phenols (poster), Makoto Sako, Takanori Aoki, Shinobu Takizawa, Hiroaki Sasai: The 14th International Kyoto Conference on New Aspects of Organic Chemistry (IKCOC-14).

[7]Enantioselective Synthesis of Bicyclic Pyrrolidine Derivatives via One-Pot Sequential Organo and Palladium Catalysis (poster), Bijan Mohon Chaki, Linpeng Zhu, Kazuhiro Takenaka, Jianfei Bai, Shinobu Takizawa, Hiroaki Sasai: The 14th International Kyoto Conference on New Aspects of Organic Chemistry (IKCOC-14).

[8]Catalytic Enantioselective Sequential C-C Bond Forming Reactions in Flow System (poster), H. D. P. Wathsala, Makoto Sako, Kenta Kishi, Shinobu Takizawa, Hiroaki Sasai: The 14th International Kyoto Conference on New Aspects of Organic Chemistry (IKCOC-14).

[9]Facile Synthesis of Spirooxindoles via Enantioselective Double Michael Reaction (poster), Miki Kusaba, Kenta Kishi, Jianfei Bai, Shinobu Takizawa, Hiroaki Sasai: The 14th International Kyoto Conference on New Aspects of Organic Chemistry (IKCOC-14).

[10]Catalytic Cyclative Hydroamination Based on Palladium Enolate Umpolung (poster), Yuya Nomoto, Miki Kusaba, Kazuhiro Takenaka, Hiroaki Sasai: International Research Training Group “SELECTIVITY IN CHEMO- AND BIOCATALYSIS” FINAL AACHEM-OSAKA SYMPOSIUM.

[11]Efficient Optimization of Enantioselective Domino Reaction Based on Bayesian Optimization (poster), H. D. P. Wathsala, Masaru Kondo, Makoto Sako, Satoshi Hara, Kazunori Ishikawa, Takayuki Takaai, Shinobu Takizawa, Takashi Washio, Hiroaki Sasai: The 22nd SANKEN International Symposium/17th SANKEN Nanotechnology International Symposium.

[12]Recent progress in chiral vanadium catalysis (invited), Hiroaki Sasai: 11th International Vanadium Symposium.

Review Papers

Chiral Vanadium Complex-catalyzed Enantioselective Oxidative Coupling Reactions, Makoto Sako, Shinobu Takizawa, Hiroaki Sasai, J. Synth. Org. Chem. Jpn., The Society of Synthetic Organic Chemistry, 76[9] (2018), 874-884.

Asymmetric Synthesis of Pancratistatins via Catalytic Desymmetrization of Benzene, Makoto Sako, Farumashia, The Pharmaceutical Society of Japan, 54[7] (2018), 710.

Patents

[1]K20180093 含リンチオフェン共重合体、およびその製造方法, 2018-245582

Publications in Domestic Meetings

Grant-in-Aid for Scientific Research on Innovative Areas "Middle Molecular Strategy: Creation of Higher Bio-Functional Molecules by Integrated Synthesis" The 3rd Plenary Meeting	1 paper
Symposium on Molecular Chirality 2018	4 papers
Grant-in-Aid for Scientific Research on Innovative Areas "Middle Molecular Strategy: Creation of Higher Bio-Functional Molecules by Integrated Synthesis" The 6th Meeting for Progress Report	1 paper
The 7th JACI/GSC Symposium	2 papers
JSPC 2018 Summer Symposium	2 papers
The 38th Organic Chemistry Junior Researcher's Seminar	4 papers
The 5th Grant-in-Aid for Scientific Research on Innovative Areas "Middle Molecular Strategy: Creation of Higher Bio-Functional Molecules by Integrated Synthesis" Young Researcher's Symposium	1 paper
The 48th Congress of Heterocyclic Chemistry	1 paper
The 65th Symposium on Organometallic Chemistry	2 papers
The 44th Symposium on Progress of Reaction and Synthesis	1 paper
Grant-in-Aid for Scientific Research on Innovative Areas "Middle Molecular Strategy: Creation of Higher Bio-Functional Molecules by Integrated Synthesis" The 4th Plenary Meeting	1 paper
The 11th Symposium on Organocatalysis	1 paper
The 99th CSJ Annual Meeting	12 papers
The 139th Meeting of the Pharmaceutical Society of Japan	4 papers

Academic Degrees

Master Degree for Science Y. Adachi	Studies on Catalytic Asymmetric Synthesis of Enterolactones Using Ir-catalyzed Tischenko Reactions
Master Degree for Science K. Kataoka	Development of New Chiral Ligands Based on Tetraphenylene Skeleton
Master Degree for Science T. Takiishi	Studies on One-pot Syntheis of Nitrogen-containing Aromatic Compounds Using Vanadium Catalysts
Master Degree for Science Y. Tamori	Development of Efficient Synthesis of Heterohelicenes Using Vanadium Catalysts

Grant-in-Aid for Scientific Research

H.Sasai	Development of Cooperative Chemo- and Biocatalysts and their Application in the Practical Synthesis of Biologically Active Molecules	¥2,470,000
S.Takizawa	Development of multifunctional asymmetric catalysts based on chirality control and integration of oxo-metal complex	¥2,470,000
S.Takizawa	Molecular Transformation Based on Integration of Asymmetric Domino Catalysis	¥2,340,000
S.Takizawa	化学反応を目視（色の変化）でモニタリングする解析・評価法の開発	¥1,430,000
M.Sako	Synthesis of Functional Aromatic Heterocyclic Compounds by Asymmetric Oxidation Coupling	¥2,080,000
K.Takenaka	パラジウムエノラートの触媒的極性転換反応の機構解明と精密合成への展開	¥1,820,000
T.Kondo	キラルなケイ素錯体を用いた環境にやさしい不斉合成手法の開発	¥1,430,000

Cooperative Research

S.Hirao	Daihachi Chemical Industry Co.,Ltd.	¥0,000

Department of Regulatory Bioorganic Chemistry

Original Papers

[1]Bicyclic and tricyclic C-C mismatch-binding ligands bind to CCG trinucleotide repeat DNAs, T. Shibata, K. Nakatani: Chem. Commun., 54 (2018) 7074-7077.

[2]1,3-Di(quinolin-2-yl)guanidine binds to GGCCCC hexanucleotide repeat DNA in C9ORF72, T. Shibata, K. Nakatani, E. Murakami: Bioorg. Med. Chem. Lett., 28 (2018) 2364-2368.

[3]Expanding chemical space of DNA-binding molecules with three base-binding units, Y. Yagi, H. Aikawa, T. Yamada, K. Nakatani: Bioorg. Med. Chem. Lett., 28 (2018) 2894-2898.

[4]Small synthetic molecule-stabilized RNA pseudoknot as an activator for －1 ribosomal frameshifting, S. Matsumoto, N. Caliskan, M. V. Rodnina, A. Murata, K. Nakatani: Nucleic Acids Res., 46 (2018) 8079-8089.

[5]CGG repeat DNA assisted dimerization of CGG/CGG binding molecule through intermolecular disulfide formation, T. Yamada, S. Miki, L. Ni, K. Nakatani: Chem. Commun., 54 (2018) 13072-13075.

[6]A dimeric 2,9-diamino-1,10-phenanthroline derivative improves alternative splicing in myotonic dystrophy type 1 cell and mouse models, J. Li, M. Nakamori, J. Matsumoto, A. Murata, C> Dohno, A. K. Kiliszek, K. Taylor, K. Sobczak, K. Nakatani: Chem. Eur. J., 24 (2018) 18115-18122.

International Conferences

[1]Repeat-Assisted Dimerization of Thiol Modified Mismatch Binding Ligand (poster), T. Yamada, K. Nakatani: International Roundtable of Nucleosides, Nucleotides, and Nucleic Acids (IRT).

[2]Synthesis and evaluation of ligands binding to C9orf72 GGCCCC repeat DNA related to ALS/FTD (poster), E. Murakami, T. Shibata, K. Nakatani: The Third A3 Roundtable Meeting on Chemical Probe Research Hub.

[3]Recognition of DNA GGGGCC repeats by novel naphthyridine tetramer (oral), Y. Lu, C. Dohno, K. Nakatani: International Symposium on Nucleic Acids Chemistry (ISNAC) 2018.

[4]Rationally engineered ribozyme activatable by ligand induced restoration of tertiary structure (poster), C. Dohno, M. Kimura, K. Nakatani: International Symposium on Nucleic Acids Chemistry (ISNAC) 2018.

[5]Synthetic small molecule-stabilized RNA pseudoknot as an activator for –1 ribosomal frameshifting (poster), A. Murata, S. Matsumoto, N. Caliskan, M. V. Rodnina, K. Nakatani: International Symposium on Nucleic Acids Chemistry (ISNAC) 2018.

[6]Development of Isoquinoline Ligand Binding to r(CUG) Repeats (poster), J. Matsumoto, J. Li, M. Nakamori, A. Murata, C. Dohno, K. Nakatani: International Symposium on Nucleic Acids Chemistry (ISNAC) 2018.

[7]1,3-Di(quinolin-2-yl)guanidine binding to C9orf72 GGCCCC repeat DNA in ALS/FTD (poster), E. Murakami, T. Shibata, K. Nakatani: The 22nd SANKEN International Symposium / The 17th SANKEN Nanotechnology International Symposium.

[8]Synthesis and evaluation of naphthyridine tetramer targting DNA GGGGCC repeat sequences (poster), Y. Lu, C. Dohno, K. Nakatani: The 22nd SANKEN International Symposium / The 17th SANKEN Nanotechnology International Symposium.

[9]Targeting Trinucleotide Repeat Sequences by Small Organic Molecules (invited), K. Nakatani: Trends in Nucleic Acid, TINA 2018, CHINA.

[10]Fluorescent molecules binding to DNA bulges and mismatches: toward application for the practical use (invited), K. Nakatani: Fluorescent Biomolecules and their Building Blocks (FB3).

[11]Fluorescent Ligand binding to DNA and Its Potential Application in PCR and Sensing Disease Related Repeat Sequences (invited), K. Nakatani: 3rd International Caparica Conference on Chromogenic and Emissive Materials (IC3EM).
[12]Targeting DNA and RNA repeats responsible for Neurological Disorders by Small Organic Molecules (invited), K. Nakatani: The 3rd A3 Roundtable Meeting on Chemical Probe Research Hub.

[13]Targeting DNA- and RNA-repeats responsible for Neurological Disorders by Small Molecules (invited), K. Nakatani: 18th International Symposium at TMIMS on Structured Nucleic Acids.

[14]Small molecules targeting DNA and RNA repeats as potential drugs for neurological disorders (invited), K. Nakatani: Indo-Japan (NCBS/InStem-Osaka) Meeting: Interfacing chemistry and biology.

[15]Targeting RNA structure and function by synthetic RNA binding ligands (invited), C. Dohno: Indo-Japan (NCBS/InStem-Osaka) Meeting: Interfacing chemistry and biology.

Patents
[1]K20170318 SCA31 inhibitor, 2018-073666

[2]G20180178WO SCA31 inhibitor, PCT/JP2019/012776

[3]K20140043 PCR method and PCR kit, 2014-169900

[4]G20150035EP PCR method and PCR kit, 15833348.4

[5]G20150035EPDE PCR method and PCR kit, 15833348.4

Publications in Domestic Meetings

13th Annual Meeting of Japanese Society for Chemical Biology	1 paper
The 12th Annual Meeting of Japan Society for Molecular Science	1 paper
The 99th CSJ Annual Meeting	8 papers
59TH ANNUAL MEETING OF THE JAPANESE SOCIETY OF NEUROLOGY	1 paper
399th Chem-Bio Infomatics Conference	1 paper

Academic Degrees

Doctoral Degree for Science J. Matsumoto	Studeis on molecules binding to CUG trinucleotide repeat targeting Myotonic Dystrophy type 1
Doctoral Degree for Science Y. Lu	Study on novel naphthyridine tetramers targeting GGGGCC repeat
Master Degree for Science R. Minami	Exploration of novel molecular structures binding to nucleic acids
Master Degree for Science E. Murakami	Generation and binding evaluation of GGCCCC repeat binding molecule N, N'-diquinolinyl guanidine
Master Degree for Science	Development of DNA-binding molecules that chemically modify pyrimidine bases in repeat sequences

Y. Yagi

Grant-in-Aid for Scientific Research

K. Nakatani	Chemical Biology Studies on Trinucleotide Repeat Disease using Repeat-Binding Molecules	¥70,850,000
C. Dohno	Gene expression RNA switch using small molecule ligands that regulate RNA higher order structures and functions	¥7,150,000
A. Murata	Small molecule-driven -1 ribosomal frame shifting and regulation of tansport localization of proteins	¥1,170,000
T. Shibata	Elucidation of action mechanism of repeat RNA-binding small molecules that improves disease phenotype in spinocerebellar ataxia type 31	¥1,950,000
T. Yamada	Development of small molecules that selectively hydrolyze over-extened RNA repeats	¥2,210,000

Entrusted Research

K. Nakatani	Japan Agency for Medical Research and Development (AMED)	Therapeutic development for non-coding repeat disease targeting novel ATG independent RAN translation	¥4,720,000
K. Nakatani	Promotion of reseach ability and interdisciplinary research by dataability	Development of discrimination method for small molecule drug candidates targeting non-coding RNA	¥0,000

Cooperative Research

K. Nakatani	Nitto LASEI CO., LTD.	¥864,000
K. Nakatani	Yamato Scientific Co. Ltd.	¥3,600,000
K. Nakatani	JAPAN TABACCO INC.	¥7,839,000
K. Nakatani	Veritas In Silico Inc.	¥1,432,000
K. Nakatani	Ajinomoto Co., Inc.	¥1,000,000
K. Nakatani	Veritas In Silico Inc., Mitsubishi Gas Chemical Company, Inc., and CHIBA INSTITUTE OF TECHNOLOGY	¥1,000,000

Other Research Fund

K. Nakatani	JSPS (Bilateral Programs Israel)	¥2,450,000
K. Nakatani	JSPS (Bilateral Programs Neth.)	¥2,450,000
C. Dohno	JSPS (Bilateral Programs India)	¥980,000

Department of Organic Fine Chemicals

Original Papers

[1]Cooperativity basis for small-molecule stabilization of protein–protein interactions, PJ De Vink, SA Andrei, Y Higuchi, C Ottmann, LG Milroy, L Brunsveld: Chemical Science, 10 (10) (2019) 2869-2874.

[2]Structural Effects of Fusicoccin upon Upregulation of 14-3-3-Phospholigand Interaction and Cytotoxic Activity, Junko Ohkanda, Atsushi Kusumoto, Louvy Punzalan, Ryoma Masuda, Chenyu Wang, Prakash Parvatkar, Dai Akase, Misako Aida, Motonari Uesugi, Yusuke Higuchi, Nobuo Kato: Chemistry–A European Journal, 24 (60) (2018) 16066-16071.

[3]Rationally Designed Semisynthetic Natural Product Analogues for Stabilization of 14-3-3 Protein–Protein Interactions, Sebastian A Andrei, Pim de Vink, Eline Sijbesma, Ling Han, Luc Brunsveld, Nobuo Kato, Christian Ottmann, Yusuke Higuchi: Angewandte Chemie International Edition, 57 (41) (2018) 13470-13474.

[4]Total Biosynthesis of Brassicicenes: Identification of a Key Enzyme for Skeletal Diversification, Akihiro Tazawa, Ying Ye, Taro Ozaki, Chengwei Liu, Yasushi Ogasawara, Tohru Dairi, Yusuke Higuchi, Nobuo Kato, Katsuya Gomi, Atsushi Minami, Hideaki Oikawa: Organic letters, 20 (19) (2018) 6178-6182.

Entrusted Research

Y. Higuchi	AMED-CREST	Synthesis of Alkyne-Sph analogues as chemical tools and SPNS2 inhibitors	¥7,000,000

Contribution to Research

Y.Higuchi	Kunihiro Kaihatsu	¥413,000

Cooperative Research

Y.Higuchi	Protectea Ltd.	¥0,000

Other Research Fund

Y. Higuchi	Osaka University	¥1,000,000

Department of Biomolecular Science and Reaction

Original Papers

[1]Development of a macrophage-targeting and phagocytosis-inducing bio-nanocapsule-based nanocarrier for drug delivery., H. Li, K. Tatematsu, M. Somiya, M. Iijima, S. Kuroda: Acta Biomater, 73 (2018) 412-423.

[2]CD11c-specific bio-nanocapsule enhances vaccine immunogenicity by targeting immune cells., H. Matsuo, M. Somiya, M. Iijima, T. Arakawa, S. Kuroda: J Nanobiotechnology, 16 (2018) 59.

[3]A hepatitis B virus-derived human hepatic cell-specific heparin-binding peptide: identification and application to a drug delivery system, Q. Liu, M. Somiya, M. Iijima, K. Tatematsu, S. Kuroda: Biomater Sci, 7 (1) (2018) 322-335.

[4]Automated Single-Cell Analysis and Isolation System: A Paradigm Shift in Cell Screening Methods for Bio-medicines., K. Tatematsu, S. Kuroda: Adv Exp Med Biol, 1068 (2018) 7-17.

[5]Essential Role of the a3 Isoform of V-ATPase in Secretory Lysosome Trafficking via Rab7 Recruitment., N. Matsumoto, M. Sekiya, K. Tohyama, E. Ishiyama-Matsuura, G. H. Sun-Wada, Y. Wada, M. Futai, M. Nakanishi-Matsui: Sci Rep, 8 (2018) 6701.

[6]Combating herpesvirus encephalitis by potentiating a TLR3-mTORC2 axis., R. Sato, A. Kato, T. Chimura, S. Saitoh, T. Shibata, Y. Murakami, R. Fukui, K. Liu, Y. Zhang, J. Arii, G. H. Sun-Wada, Y. Wada, T. Ikenoue, G. N. Barber, T. Manabe, Y. Kawaguchi, K. Miyake: Nat Immunol, 19 (2018) 1071-1082.

[7]In crystallo thermodynamic analysis of conformational change of the topaquinone cofactor in bacterial copper amine oxidase., T. Murakawa, S. Baba, Y. Kawano, H. Hayashi, T. Yano, T. Kumasaka, M. Yamamoto, K. Tanizawa, T. Okajima: Proc Natl Acad Sci USA, 116 (2019) 135-140.

[8]Oriented immobilization to nanoparticles enhanced the therapeutic efficacy of antibody drugs., M. Iijima, K. Araki, Q. Liu, M. Somiya, S. Kuroda: Acta Biomater, 86 (2019) 373-380.

[9]Induction of lipid droplets in non-macrophage cells as well as macrophages by liposomes and exosomes, K. Fujita, M. Somiya, S. Kuroda, S. Hinuma: Biochem Biophys Res Commun, 510 (1) (2019) 184-190.

[10]Robo2 contains a cryptic binding site for neural EGFL-like (NELL) protein 1/2, N. Yamamoto M. Kashiwagi, M. Ishihara, T. Kojima, A. D. Maturana, S. Kuroda, T. Niimi: J Biol Chem, 294 (12) (2019) 4693-4703.

International Conferences

[1]Characterization of Bovine Milk-Derived Extracellular Vesicles as Delivery System for Therapeutics (poster), A. Kogure, M. Somiya, Y. Yoshioka, T. Ochiya: Annual meeting of International Society for Extracellular Vesicles.

[2]Development of Macrophage-targeting and Phagocytosis-inducing Bio-nanocapsule-based DDS Nanocarrier (poster), H. Li, M. Somiya, S. Kuroda: 2018 Annual Meeting of Controlled Release Society.

[3]Identification of hepatitis B virus-derived heparin-binding domain: application for liposomal drug delivery. (poster), Q. Liu, M. Somiya, S. Kuroda: 2018 Annual Meeting of Controlled Release Society.

[4]Functional analysis of serine proteinase involved in biosynthesis of active-site subunit of quinohemoprotein amine dehydrogenase (poster), T. Oozeki, T. Nakai, K. Tanizawa, T. Okajima: The 22th SANKEN International Symposium.

Review Papers

Precise orientation of biomolecules on the nano-interface using bio-nanocapsule. M. Iijima and S. Kuroda, KAGAKU TO SEIBUTSU, JSBBA, 56 (2018), 591-597.

Individual differences in sensory of smell, K. Tatematsu, S. Kuroda, Biomedia, Seibutsu-kogaku kaishi, Japan, 96 (2018), 655.

Grant-in-Aid for Scientific Research

S. Kuroda	Development of Neo-bionanocapsule for Various In Vivo Targets	¥35,490,000
S. Kuroda	Development of human olfactory receptor-expressing cell array for quantification of all odorant molecules	¥18,200,000
T. Okajima	Elucidation of enzyme catalytic mechanism regulating transition state by linking conformational change and fluctuations of the active site	¥4,550,000
M. Somiya	mRNA sorting into exosomes and its application for drug delivery	¥1,820,000

Entrusted Research

S. Kuroda	University of the Ryukyus	Establishment of human-derived antibody against human T-cell leukemia virus	¥990,000
S. Kuroda	University of the Ryukyus	Development of human olfactory receptor-based sensor for sensing shochu flavors	¥351,000
S. Kuroda	University of the Ryukyus (AMED)	Development of antibody drug aiming prevention of HTLV-1 mother-to-child infection and evaluation its medicinal effect using primate model	¥1,950,000
M. Somiya	Japan Agency for Medical Research and Development(AMED)	Discovery of Novel Therapeutics in Kidney Cancer）	¥3,000,000

Contribution to Research

S. Kuroda	Nippon Bartenders' Association	¥30,000
S. Kuroda	Suntory Global Innovation Center Limited	¥700,000
S. Kuroda	Prof. Shuji Hinuma	¥300,000
M. Somiya	JGC-S Scholarship Foundation	¥2,000,000
K. Okamoto	Research Council for Vitamin B	¥146,000

Cooperative Research

S. Kuroda	Soda Aromatic Co., Ltd.	¥2,431,000
S. Kuroda	Maruho Hatsujyo Kogyo Co., Ltd.	¥10,400,000

S. Kuroda	Toshiba Co., Tokyo University of Agriculture	¥1,080,000
S. Kuroda	Meiji Seika Pharma Co., Ltd.	¥2,606,000
S. Kuroda	University of the Ryukyus	¥762,000
S. Kuroda	Kyoto Prefectural Police	¥0,000
K. Tatematsu	Komihakko Co.	¥2,352,000

Other Research Fund

S. Kuroda	Suntory Global Innovation Center Limited	¥278,000

Department of Biomolecular Science and Regulation

Original Papers

[1]A human ABC transporter ABCC4 gene SNP (rs11568658, 559 G>T, G187W) reduces ABCC4-dependent drug resistance, M. Tsukamoto, M. Yamashita, S. Sato, T. Nishi, and H. Nakagawa: Cells, 8 (2019) 39.

[2]Crystal structures of multidrug efflux pump MexB bound with highmolecular- mass compounds, K. Sakurai, S. Yamasaki, K. Nakao, K. Nishino, A. Yamaguchi, and R. Nakashima: Scientific Reports, 9 (1) (2019) 4359.

[3]Salmonella Enteritidis TolC outer membrane channel is essential for egg white survival, Raspoet, R., V. Eeckhaut, K. Vermeulen, L. De Smet, Y. Wen, K. Nishino, F. Haesebrouch, R. Ducatelle, B. Devreese, and F. Van Immerseel: Poultry Science, 98 (5) (2019) 2281-2289.

[4]Crystal structure of the multidrug resistance regulator RamR complexed with bile acids, Yamasaki, S., R. Nakashima, K. Sakurai, S. Baucheron, E. Giraud, B. Doublet, A. Cloeckaert, and K. Nishino: Scientific Reports, 9 (1) (177) 177.

International Conferences

[1]MFSD2B is a novel sphingosine 1-phosphate transporter in erythroid cells (invited), N. Kobayashi, S.Kawasaki-Nishi, M. Otsuka, Y. Hisano, A. Yamaguchi, and T. Nishi: 2nd Japan-Korea Lipid Joint Symposium.

[2]MFSD2B mediates sphingosine 1-phosphate export from erythroid cells (poster), N. Kobayashi, S.Kawasaki-Nishi, M. Otsuka, Y. Hisano, A. Yamaguchi, and T. Nishi: 59TH IN¬TER¬NA¬TIONAL CONFERENCE ON THE BIOS¬CIENCE OF LIP¬ID. Lipid Fluxes and Meta¬bol¬ism - From Fun¬da¬mental Mech¬an¬isms to Hu¬man Dis¬ease.

[3]The ABC-Type Efflux Pump MacAB Influence Viruence in Salmonella enterica serovar Typhimurium (poster), Sohei Nakano, Ami Yamagishi, Seiji Yamasaki, Kunihiko Nishino: The 22nd SANKEN International Symposium, The 17th SANKEN Nanotechnology International Symposium.

[4]Mutational analysis of the inhibitor-binding pit in the efflux transporter MexB (poster), Naoki Koga, Seiji Yamasaki, Keisuke Sakurai, Ryosuke Nakashima, Akihito Yamaguchi, Kunihiko Nishino: The 22nd SANKEN International Symposium, The 17th SANKEN Nanotechnology International Symposium.

[5]Regulation of Bacterial Multidrug Efflux System Involved in Multidrug and Bile Resistance Regulation of Bacterial Multidrug Efflux System Involved in Multidrug and Bile Resistance (invited), Kunihiko Nishino: The 22nd SANKEN International Symposium, The 17th SANKEN Nanotechnology International Symposium.

Review Papers

Identification of a novel S1P transporter in erythrocytes, N. Kobayashi, S. Kawasaki-Nishi and T. Nish, SEIKAGAKU, The Japanese Biochemical Sociey, 90[5] (2018), 581-587.

Analysis and inhibitor development against bacterial multidrug efflux transporters, S. Yamasaki, R. Nakashima, A. Yamaguchi, K. Nishino, BIO Clinica, Hokuryukan, 34[2] (2019), 86-90.

Contributions to International Conferences and Journals

K. NISHINO	Frontiers in Micirobiology (Antimicrobials, Resistance and Chemotherapy) (Associate Editor)
K. NISHINO	Scientific Reports (Ad-Hoc Reviewer)
K. NISHINO	PLoS One (Ad-Hoc Reviewer)
K. NISHINO	PLoS Pathogen (Ad-Hoc Reviewer)
K. NISHINO	Medical Research Council (Reviewer)
K. NISHINO	Antimicrobial Agents and Chemotherapy (Ad-Hoc Reviewer)
K. NISHINO	Frontiers in Micirobiology (Ad-Hoc Reviewer)

Publications in Domestic Meetings

Japanese Conference on the Biochemistry of Lipids	1 paper
IPSJ SIG-CVIM: Computer Vision and Image Media	1 paper
The 41st Annual Meeting of the Molecular Bioloy Society of Japan	1 paper
Cell and Developmental Biology Meeting	2 papers
The 1st PE association	1 paper
The 66th Annual Meeting of the Japanese Society of chemotherapy and the 99th of the Japanese association for infectious Diseases	1 paper
The 4st COI2021Workshop	1 paper
30th SYMPOSIUM ON MICROBIAL SCIENCE	2 papers
The 1st COI2021Workshop	6 papers
The 6th Alliance y oung researcher's exchange meeting	1 paper
The 74th scientific lecture and the 3rd Sanken homecoming day	1 paper
The 1st gathering with Graduate school of medicine and the institute of Scientific and Industrial research	1 paper
The Academic exchange meeting with the institute of Scientific and Industrial research ,Osaka Univ and Institute of industrial Science, University of Tokyo	1 paper
In the 99th CSJ Annual Meeting	1 paper
JST Fair 2018	1 paper
The 5th COI2021Workshop	1 paper
The 4th COI2021Meeting	1 paper
Advanced Seminara at RIMD in Osaka U.	1 paper
The 6th Bio-related Chemistry Symposium Young Forum The 33rd Biofunction-Related Chemistry Subcommittee Young Forum The 5th Bio-Technology Division Young Forum	1 paper
56th Annual Meeting of the Biophysical Society of Japan	1 paper
The 7th Osaka University COI Symposium	1 paper
Dynamic Alliance for Creating Innovation that Connects People, Environment and Substance Life Function Material and Device System G3 Subcommittee	1 paper
Life & Medical Innovation Project Symposium	1 paper

Grant-in-Aid for Scientific Research

K. Nishino	Study on mechanisms of bacterial multidrug resistance and pathogenicity modulated by transporters and development of novel therapeutic methods	¥5,850,000
K. Nishino	Mechanisms of Bacterial Competition and Coordination: Adaptation to Hostile Environments	¥2,210,000
M. Nishino	Development of automatic discrimination technology of multidrug resistant bacteria by machine learning and artificial intelligence	¥1,430,000
S. Yamasaki	Analysis and inhibitor development of bacterial drug efflux pump for the avoidance of resistant bacteria pandemic	¥1,430,000
M. Nishino	The presence of an intracellular sorting transport zone and its	¥6,500,000

		significance in the polar transport of epithelial cells	
Entrusted Research			
K. Nishino	AMED	Research on the development of inhibitors of bacterial multi-drug efflux pumps	¥10,000,000
T. Nishi	Advanced Research and Development Programs for Medical Innovation, AMED	Creation of a novel approach for drug development by elucidation of the regulation mechanism of cell migration with S1P transporters	¥27,774,000
K. Nishino	Japan Science and Technology Agency	Improvement of intestinal flora	¥28,691,000
S. Yamasaki	Japan Science & Technology Agency (JST)	Development of a sensor for stagnant toilet water measurement and the elucidation of the relationship between health conditions and feces components in water	¥6,500,000
S. Yamasaki	Network Joint Research Center for Materials and Devices	Development of a bacterial efflux compound assay for rapid detection of resistant bacteria	¥200,000
S. Yamasaki	Japan Science & Technology Agency (JST)	Survey and research for utilization of health and medical BIG data on bacteria	¥1,300,000
Contribution to Research			
M. Nishino	Mitsuko Hayashi-Nishino		¥2,000,000
M. Nishino	The Naito Foundation		¥2,000,000
Cooperative Research			
K. Nishino	Fukoku Co., Ltd.		¥250,000
K. Nishino	Ayano Satoh (Okayama University)		¥91,000
K. Nishino	Junichi Yamagishi (Nihon Pharmaceutical University)		¥127,000
K. Nishino	Aixin Yan (University of Hong Kong)		¥330,000
K. Nishino	Yuji Morita (Aichi Gakuin University)		¥320,000
K. Nishino	Axel Cloeckaert (INRA, France)		¥0,000
K. Nishino	Filip Van Immerseel (Ghent University)		¥0,000
K. Nishino	Corinna Kehrenberg (Tierärztliche Hochschule Hannover)		¥0,000
Other Research Fund			
K. Nishino	Ministry of Education, Culture, Sports, Science and Technology		¥500,000
K. Nishino	Ministry of Education, Culture, Sports, Science and Technology		¥500,000

Department of Biomolecular Science and Engineering

Original Papers

[1]An improved inverse-type Ca2+ indicator can detect putative neuronal inhibition in Caenorhabditis elegans by increasing signal intensity upon Ca2+ decrease., Hara-Kuge S, Nishihara T, Matsuda T, Kitazono T, Teramoto T, Nagai T and Ishihara T.: PLoS ONE, 13 (4) (2018) e0194707.

[2]Green monomeric photosensitizing fluorescent protein for photo-inducible protein inactivation and cell ablation., Riani Y D, Matsuda T, Takemoto K, Nagai T.: BMC Biology, 16:50 (2018) 1-12.

[3]Uninterrupted monitoring of drug effects in human-induced pluripotent stem cell-derived cardiomyocytes with bioluminescence Ca2+ microscopy., Suzuki K*, Onishi T*, Nakada C, Takei S, J. Daniels M, Nakano M, Matsuda T and Nagai T.: BMC Research Notes, 11:313 (2018) 1-6.

[4]Significance of PGR5-dependent cyclic electron flow for optimizing the rate of ATP synthesis and consumption in Arabidopsis chloroplasts., Sato R, Kawashima R, Mai Duy Luu T, Nakano M, Nagai T

and Masuda S.: Photosynthesis Research, 139 (2018) 359-365.

[5]A platform of BRET-FRET hybrid biosensors for optogenetics, chemical screening, and in vivo imaging., Komatsu N, Terai K, Imanishi A, Kamioka Y, Sumiyama K, Jin T, Okada Y, Nagai T and Matsuda M.: Scientific Reports, 8:8984 (2018) 1-14.

[6]Spontaneously blinking fluorescent protein for simple single laser super-resolution live cell imaging., Arai Y, Takauchi H, Ogami Y, Fujiwara S, Nakano M, Matsuda T and Nagai T.: ACS Chemical Biology, 13 (8) (2018) 1938-1943.
[7]Simultaneous monitoring of Ca2+ responses and salivary secretion in live animals reveals a threshold intracellular Ca2+ concentration for salivation, Nezu A, Morita T, Nagai T and Tanimura A.: The Physiological Society, 104 (1) (2018) 61-69.

[8]Cooperative interaction among BMAL1, HSF1, and p53 protects mammalian cells from UV stress., Kawamura, G., Hattori, M., Takamatsu, K., Tsukuda, T., Ninomiya, Y., Benjamin, I., Sassone-Corsi, P., Ozawa, T. and Tamaru, T.: Communications Biology, 1:204 (2018) 1-13.

International Conferences
[1]A bimodal bioluminescent calcium indicator toward spatiotemporally scalable imaging (oral), Mitsuru Hattori, Israt Farhana, Kazushi Suzuki, Tomoki Matsuda, Takeharu Nagai: 20th International Symposium on Bioluminescence and Chemiluminescence.

[2]Acid-tolerant monomeric GFP derived from Olindias formosa (oral), Hajime Shinoda, Yuanqing Ma, Ryosuke Nakashima, Keisuke Sakurai, Tomoki Matsuda, Takeharu Nagai.: 20th International Symposium on Bioluminescence & Chemiluminescence.

[3]Bioluminescent Probes for Vivid Visualization of Biological Phenomena (invited), Nagai Takeharu: Symposium Next Generation Technologies for Neuroscience.

[4]Acid-tolerant monomeric GFP derived from Olindias formosa (poster), Hajime Shinoda, Yuanqing Ma, Ryosuke Nakashima, Keisuke Sakurai, Tomoki Matsuda, Takeharu Nagai.: Symposium Next Generation Technologies for Neuroscience.

[5]Super-duper multi-color bioluminescent proteins for bioimaging (invited), Nagai Takeharu: World Congress of Basic and Clinical Pharmacology.

[6]Fluorescent and Bioluminescent Protein Based Probes for Visualization of Biological events (invited), Matsuda Tomoki: 24th iCeMS International Symposium.

[7]Genetically-encoded indicators towards nanoscopic calcium imaging (oral), Lu Kai: First UK/Japan Super-resolution Bioimaging Meeting.

[8]Super-resolution of ‘Physiological Functions’ and Diagnostics of Activity Architecture in Live Cells (oral), Wazawa Tetsuichi: First UK/Japan Super-resolution Bioimaging Meeting.

[9]Evolution of fluorescent proteins toward easy and bio-compatible super-resolution imaging (oral), Nagai Takeharu: First UK/Japan Super-resolution Bioimaging Meeting.

[10]Acid resistant monomeric GFP from Olindias formosa (oral), Hajime Shinoda, Yuanqing Ma, Ryosuke Nakashima, Keisuke Sakurai, Tomoki Matsuda, Takeharu Nagai.: 13h KAIST-OSAKA U Symposium 2018.

[11]Bimodal Ca2+ indicator toward spatiotemporally-scalable imaging (poster), Israt Farhana, Kazushi Suzuki, Tomoki Matsuda, Takeharu Nagai: Janelia conference: Fluorescent Proteins and Biological

Sensors VI.

[12]A bimodal fluorescent and bioluminescent Ca2+ indicator toward spatiotemporallyscalable imaging (invited), Takeharu Nagai: Janelia conference: Fluorescent Proteins and Biological Sensors VI.

[13]Bimodal Ca2+ indicator toward spatiotemporally-scalable imaging (poster), Israt Farhana, Kazushi Suzuki, Tomoki Matsuda, Takeharu Nagai: The 22nd SANKEN International Symposium.

[14]A reversibly photoconvertible chemiluminescent protein for bioimaging with high depth resolution (poster), Yuhei Ogami, Mitsuru Hattori, Takeharu Nagai: The 22nd SANKEN International Symposium.
[15]Development of a reversibly photoswitchable fluorescent protein with fast chromophore maturation and enhanced brightness for cell imaging (poster), Shusaku Uto, Tetsuich Wazawa, Takeharu Nagai: The 22nd SANKEN International Symposium.

[16]Generation of inventive genetically modified chemiluminescent plants by using a potent new generation luciferase (poster), Quang Tran, Kenji Osabe, Takeharu Nagai: The 22nd SANKEN International Symposium.

[17]Toward photoacoustic bioimaging with a chromoprotein (poster), Yoshimasa IKE, Tetusichi WAZAWA, Tomoki MATSUDA, Takeshi NAMITA, Tsuyoshi SHINA, Takeharu NAGAI: The 22nd SANKEN International Symposium.

[18]Bimodal Ca2+ indicator toward spatiotemporally-scalable imaging (poster), Israt Farhana, Kazushi Suzuki, Tomoki Matsuda, Takeharu Nagai: The 22nd SANKEN International Symposium.

[19]A bimodal bioluminescent Ca2+ indicator toward spatiotemporally-scalable imaging (invited), Tomoki Matsuda, Israt Farhana, Kazushi Suzuki, Takeharu Nagai: SPIE. PHOTONICS WEST BIOS.

[20]Genetically-encoded indicator towards nanoscopic calcium imaging (oral), Lu Kai: Early Career Seminar, MRC-LMCB at UCL.

[21]Singularity biology (invited), Takeharu Nagai: The 16th International Membrane Research Forum.

Review Papers
Fluorescent Proteins for Investigating Biological Events in Acidic Environments, Shinoda H, Michael S and Nagai T., Int J Mol Sci., MDPI, 19[6] (2018), 1548.

Books
[1]High biocompatible imaging by SPoD-ExPAN(Y. Harada, T. Nagai) T. Wazawa, T. Nagai, “Observe all living creatures! 100 how to and selection guide for imaging.”, Yodosya, 36[20] (115-116) 2018.

[2]Fluorescent protein_i. General introduction(Y. Harada, T. Nagai) H. Shinoda, T. Nagai, “Observe all living creatures! 100 how to and selection guide for imaging.”, Yodosya, 36[20] (150-152) 2018.

[3]Fluorescent protein_i. General introduction(Y. Harada, T. Nagai) T. Matsuda, T. Nagai, “Observe all living creatures! 100 how to and selection guide for imaging.”, Yodosya, 36[20] (153-155) 2018.

[4]Fluorescent protein_v. Magnesium indicator(Y. Harada, T. Nagai) T. Matsuda, T. Nagai, “Observe all living creatures! 100 how to and selection guide for imaging.”, Yodosya, 36[20] (160-161) 2018.

[5]Fluorescent protein_vi. Membrane poteintial probe for brain activity measurement(Y. Harada, T. Nagai) S. Inagaki, M. Agetsuma, T. Nagai, “Observe all living creatures! 100 how to and selection guide for imaging.”, Yodosya, 36[20] (162-164) 2018.

[6]Fluorescent protein(Y. Harada, T. Nagai) K. Suzuki, T. Nagai, “Observe all living creatures! 100 how to and selection guide for imaging.”, Yodosya, 36[20] (174-175) 2018.

[7]Optogenetic Control of the Generation of Reactive Oxygen Species for Photoinducible Protein Inactivation and Cell Ablation(Sophie Vriz, Takeaki Ozawa) Nagai T, Riani YD., “Optogenetics”, Royal Society of Chemistry, (117-135) 2018.

Patents

[1]K20180152 Measurement of water hardness, 2019-006110
[2]K20170171 The use of chemiluminescent protein and their substrate, 2018-106866

[3]G20140031US Fluorescent protein, 15/021371

Contributions to International Conferences and Journals

T. Nagai	Biophysics and Physicobiology (Editorial Board)
T. Nagai	MICROSCOPY (Editorial Board)
T. Nagai	ACS Sensor (Editorial Board)

Publications in Domestic Meetings

The 13th Annual Meeting of Japanese Society for Molecular Imaging	1 paper
The 18th Annual Meeting of the Protein Science Society of Japan	1 paper
The 20th Annual Meeting of The Photobiology Association of Japan	1 paper
The 56th Annual Meeting of the Biophysical Society of Japan	3 papers
The 38th Annual Meeting of The Japanese Society For Magnesium Research	1 paper

Academic Degrees

Master Degree for Engineering IKE Yoshimasa	Novel red chromoprotein derived from a Jellyfish Olindias formosa applicable to bioscience
Master Degree for Engineering UTO Shusaku	Development of a reversibly photoswitchable fluorescent protein with fast chromophore maturation and enhanced brightness for cell imaging
Master Degree for Engineering OGAMI Yuhei	A reversibly photoconvertible chemiluminescent protein for spatiotemporal regulation of the luminescence in bioimaging
Master Degree for Engineering FARHANA Israt	A biomodal Ca2+ indicator toword spatiotemporally-scalable imaging
Doctor Degree for Engineering Kushida Yuki	Development of biomimetic chemical sensing system by using virus like particles
Doctor Degree for Engineering Yemima Dani Riani	Development of a Genetically Encoded Monomeric Green Photosensitizer for Light-inducible Protein Inactivation and Cell Ablation
Doctor Degree for Engineering Shinoda Hajime	Development of acid-tolerant monomeric green fluorescent protein from Olindias formosa

Grant-in-Aid for Scientific Research

T.Nagai	Verification of Joule heat hypothesis in cell heat production	¥18,980,000
T.Nagai	Singularity Biology	¥66,040,000
T.Nagai	Development of molecular tools for visualization and manipulation of celllar functions in whole body	¥26,650,000
T.Nagai	Development of constitutive energy biosynthesis system with chemilumino-genetics	¥3,250,000
T.Matsuda	Visualization and photomanipulation of migrating neuronal cells and surrounded field during the formation of brain tissue	¥14,560,000

T.Wazawa	Analyses of the dynamics of actin filaments and myosin by superresolution fluorescence imaging	¥1,040,000

Entrusted Research

T. Nagai	Japan Science and Technology Agency (JST)	Superresolution of "physiological functions" and diagnostics of activity　architecture in live cells	¥46,807,000
T. Nagai	Japan Science and Technology Agency (JST)	Development of all-in-one microscopy for chemiluminescence imaging	¥35,009,000
T. Nagai	New Energy and Industrial Technology Development Organization（NEDO）	Establishement of fundamental technology required for the development of electric power independent multifunctional biological based device	¥16,100,000
M. Hattori	Japan Science and Technology Agency (JST)	Development of illumination technique using chemiluminescent proteins	¥31,676,000

Contribution to Research

T. Nagai	M3 Laboratory Inc.	¥100,000

Cooperative Research

T. Nagai	Nikon Co.,Ltd.	¥0,000
T. Nagai	DRVision Technologies LLC	¥7,140,000
T. Nagai	Sumitomo Forestry Co., Ltd.	¥1,140,000
T. Nagai	DRVsion Technologies, Nikon Co.,Ltd.	¥0,000

Other Research Fund

T. Nagai	Sumitomo Forestry Co., Ltd.	¥220,000

Department of Translational Datability

Original Papers

[1]An Online Algorithm for Mining Data Streams, M. Kawabata, Y. matsubara and Y. Sakurai: IPSJ Transactions on Databases, 11 (1) (2018) 1-10.

International Conferences

[1]StreamScope: Automatic Pattern Discovery over Data Streams., M. Kawabata, Y. matsubara and Y. Sakurai: ACM SIGMOD Workshop on Exploiting Artificial Intelligence Techniques for Data Management (aiDM), 5 (1) (2018) 5-8.

[2]Mining and Forecasting of Big Time-series Data, Y. sakurai: , (2019) .

[3]Smart Analytics for IoT Big Data, Y. sakurai: , (2018) .

[4]Real-time Forecasting of IoT Big Data: Foundations and Challenges, Y. sakurai: , (2018) .

Patents

[1] Labeling method, labeling program and system, 2019-036210

[2] FORECASTING DEVICE, PARAMETER SET PRODUCTION METHOD AND PROGRAM, 16/316946

Contributions to International Conferences and Journals

Y. Sakurai	DASFAA SC (Int. Conf. on Database Systems for Advanced Applications) (2014～) (Steering Committee Member)
Y. Sakurai	19th IEEE International Conference on Data Mining (ICDM2019) (Senior Programme Committee Member)

Y. Sakurai	25th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD2019) (Programme Committee Member)
Y. Matsubara	25th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD2019) (Programme Committee Member)
Y. Sakurai	28th International World Wide Web Conference (WWW 2019) (Programme Committee Member)
Y. Sakurai	2019 ACM International Conference on Management of Data (SIGMOD 2019) (Programme Committee Member)
Y. Sakurai	2019 ACM International Conference on Management of Data (SIGMOD 2019) (Programme Committee Member)
Y. Sakurai	27th ACM International Conference on Information and Knowledge Management (CIKM 2018) (Programme Committee Member)
Y. Sakurai	24th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD2018) (Programme Committee Member)
Y. Sakurai	27th International World Wide Web Conference (WWW 2018) (Programme Committee Member)

Publications in Domestic Meetings

Forum on Information Technology（FIT 2018）	1 paper
The 32nd Annual Conference of the Japanese Society for Artificial Intelligence, 2018	1 paper
Forum on Data Engineering and Information Management (DEIM)	1 paper

Grant-in-Aid for Scientific Research

Y. Sakurai	Development of Technologies for Realtime Analysis of Online Activities	¥650,000
K. Tajima	Development of Methods for Social Information Analysis and Behavior Prediction Based on Web Information	¥3,380,000
Y. Sato	Elucidation of key mechanisms of persistent/latent HTLV-1 infection by analyzing single cell data with data mining technique	¥1,300,000
N. Mitsutake	Construction of the logic for determine disease names based on the analysis of National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB)	¥3,900,000
Y. Imanaka	ICT and AI method development for early detection and prevention of worsening in disease and frailty of elderly people	¥650,000
Y. Matsubara	Mining and Forecasting of Coevolving Online Activities	¥5,850,000
Y. Matsubara	Non-linear Mining of IoT Big Data	¥10,062,000

Entrusted Research

Y. Matsubara	Japan Society and Technology Agency	Fast Mining and Forecasting of Complex Time-series Event Streams	¥3,900,000

Cooperative Research

Y. Sakurai	JTEKT	¥,000
Y. Sakurai	Hitachi	¥,000
Y. Sakurai	Fujitsu Laboratories	¥,000
Y. Sakurai	Mitsubishi Heavy Industries Machine Tool	¥,000
Y. Sakurai	Mitsubishi Heavy Industries Engine & Turbocharger	¥,000
Y. Sakurai	Mitsubishi Heavy Industries	¥,000

Department of New Industrial Projection

Laboratory of Cell Membrane Structural Biology

Original Papers

[1]Crystal structures of multidrug efflux pump MexB bound with high-molecular-mass compounds, K. Sakurai, S. Yamasaki, K. Nakao, K. Nishino, A. Yamaguchi and R. Nakashima: Scientific Reports, 9 (1) (2019) 4359.

[2]Crystal structure of the multidrug resistance regulator RamR complexed with bile acids, S. Yamasaki, R. Nakashima, K. Sakurai, S. Baucheron, E. Giraud, B. Doublet, A. Cloeckaert, k. Nishino: Scientific Reports, 9 (1) (2019) 177.
[3]Molecular mechanisms of AcrB-mediated multidrug export, M. Zwama, A. Yamaguchi: Research in Microbiology, 169 (7-8) (2018) 372-383.

Publications in Domestic Meetings

Thr 91st Annual Meeting of the Japanese Biochemical Society	1 paper
The 56th Annual Meeting of The Biophysical Society of Japan	2 papers
30th SYMPOSIUM ON MICROBIAL SCIENCE	1 paper

Entrusted Research

A.Yamaguchi	Japan Science and Technology Agency(JST)	Studies on the structural basis of multidrug efflux transport and the development of multidrug transporter inhibitors	¥13,000,000

Cooperative Research

A.Yamaguchi	Fine Japan Co.,Ltd.	¥480,000
A.Yamaguchi	Fuji Film Co.	¥2,000,000

Mitsubishi Electric Collaborative Research Division for Wide-area Security Technolog

Publications in Domestic Meetings

The Institute of Electronics, Information and Communication Engineering, Technical Group on Biometrics	1 paper
The Institute of Electronics, Information and Communication Engineering, Annual Meeting	1 paper

Division of SCREEN Single-Molecule Analysis

Division of Nano-Lithography Research

Original Papers

[1]Alternative developer solutions and processes for EUV and ArFi lithography, Masahiko Harumoto, Julius Joseph Santillan, Chisayo Nakayama, Yuji Tanaka, Tomohiro Motono, Masaya Asai, and Toshiro Itani: J. Photopolym. Sci. Technol., 32 (2019) 321-326.

[2]Resist patterning characteristics using KrF laser-ablation process, Hiroshi Yamaoka, Julius Joseph Santillan, Nobutaka Uemori, and Toshiro Itani: J. Photopolym. Sci. Technol., 32 (2019) 355-360.

Contribution to Research

T.Itani	Marubun Co.	¥500,000
T.Itani	Litho Tech Japan Co.	¥2,000,000

Cooperative Research

T.Itani	NAGASE & CO., LTD., Nagase ChemteX Co.	¥24,000,000
T.Itani	Marubun Co.	¥1,620,000
T.Itani	Litho Tech Japan Co.	¥0,000

Institute for Advanced Co-Creation Studies

Books

[1]74. Downconversion probe(Takeharu Nagai, Yoshie Harada) Yasuko.Osakada, “Jikkenigaku-zokango”, Yodosha, 36(20) (190-191) 2018.

Publications in Domestic Meetings

The 99th CSJ Annual Meeting	3 papers

Annual meeting on photochemistry 2018			2 papers
Grant-in-Aid for Scientific Research			
Y.Osakada	The development of optogenetic method using hybrid materials		¥2,470,000
Y.Osakada	The development of XEOL nanomaterials toward braking emitted photon irradiation for effective radiation therapy		¥910,000
Entrusted Research			
Y.Osakada	2016-2021 Ministry of education, culture, sports, science and technology (MEXT), Initiative for realizing diversity in the research envronment (collaboration type)	Studies on the fluorine modified molecules and polymers for biological application	¥1,800,000

Department of Functional Nanomaterials and Nanodevices

Original Papers

[1]Surface analysis of self-assembled ZnO-NiO nanostructures, A.S.Borowiak, O. Nakagawara, L. Mingyu, G. Tan and H. Tanaka: Surface Science, 679 (2019) 6-10.

[2]Improving resistance change with temperature and thermal stability inFe3O4 films for high-temperature resistorsr, K. Fujiwara, S. Tsubota, and H. Tanaka: Applied Physics Express, 12 (2018) 2857（1-9）.

[3]Beyond electrostatic modification: design and discovery of functional oxide phases via ionic-electronic doping, H.-T. Zhang, Z.Zhang, H. Zhou, H. Tanaka, D. D. Fong and S. Ramanathan: Adv. Phys., 4 (2018) 1523686（1-42）.

[4]Correlation between Ni Valence and Resistance Modulation on a SmNiO3 Chemical Transistor, D. Kawamoto, A. N. Hattori, M. Yamamoto, X. L. Tan, K. Hattori, H. Daimon, and H. Tanaka: ACS Appl. Electron. Mater., 1 (2018) 82-87.

[5]Arrangement of self-assembled ZnO-NiO nanostructures using topographical templates towards oxide directed self-assembly, G. Tan, O. Nakagawara, A. N. Hattori and H. Tanaka: AIP Advances, 8 (2018) 085503 (1-4).

[6]Fabrication of the electric double layer transistor with (La,Pr,Ca)MnO3 nanowall wire channel, A. N. Hattori, H.Nakazawa, T.Nakamura and H.Tanaka: Mod. Phys. Lett. B, 32 (2018) 1840058 (1-7).

[7]Non-contact detection of nanoscale structures using optical nanofiber, H. Maruoka, Y. Oe, H. Takashima, A. N. Hattori, H. Tanaka, S. Takeuchi: Opt. Express, 27 (2019) 367-376.

[8]Strongly correlated perovskite lithium-ion shuttles, Y. Sun, M. Kotiuga, D. Lim, B. Narayanan, M. Cherukara, Z. Zhang, Y. Dong, R. Kou, C. Sun, Q. Lu, I. Waluyo, A. Hunt, H. Tanaka, A. N. Hattori, S. Gamage, Y. Abbate, V. G. Pol, H. Zhou, S. Sankaranarayanan, B. Yildiz, K. M. Rabe, S. Ramanathan: Proc. Natl. Acad. Sci. USA, 115 (2018) 9672-9677.

[9]Electric transport properties for three-dimensional angular-interconnects of Au wires crossing facet edges of atomically-flat Si{111} surfaces, S. Takemoto, A. N. Hattori, K. Hattori, H. Tanaka, H. Daimon: Jpn. J. Appl. Phys., 57 (2018) 085503-1-4.

[10]Single-step metal-insulator transition in thin film-based vanadium dioxide nanowires with a 20 nm electrode gap, Y. Tsuji, T. Kanki, Y. Murakami and H. Tanaka: Appl. Phys. Exp., 12 (2019) 025003- 1 - 4 .

[11]Formation of single-crystal VO2 thin films on MgO(110) substrates using ultrathin TiO2 buffer layers,

Y. Higuchi, T. Kanki, and H. Tanaka: Appl. Phys. Exp., 11 (2018) 085503-1-4.

[12]Enhancement of electronic-transport switching in single-crystal narrower VO2 nanowire channels through side-gate electric fields, M. Chikanari, T. Kanki, T. Wei and H. Tanaka: Appl. Phys. Lett., 113 (2018) 053102-1-5.

[13]Stochastic Resonance in Bioinspired Electronic Device Using Polymer Field Effect Transistors, Y. Suzuki, T. Kanki, H. Tanaka, T. Inoue,N. Wada, K. Matsubara and N. Asakawa: Key Engin. Mater., 790 (2018) 20-27.
[14]Morphology of phase-separated VO2 films deposited on TiO2(001) substrate, Y. Cho, S. Aritomi, T. Kanki, K. Kinoshita, N. Endo, Y. Kondo, D. Shindo, H. Tanaka, Y. Murakami: Mater. Res. Bull., 102 (2018) 289-293.

[15]Pronounced photogating effect in atomically thin WSe2 with a self-limiting surface oxide layer, Y. Cho, S. Aritomi, T. Kanki, K. Kinoshita, N. Endo, Y. Kondo, D. Shindo, H. Tanaka, Y. Murakami: Appl. Phys. Lett., 112 (2018) 181902.

[16]Layer-by-Layer Oxidation Induced Electronic Properties in Transition-Metal Dichalcogenides, S. R. Das, K. Wakabayashi, M. Yamamoto, K. Tsukagoshi, S. Dutta: J. Phys. Chem. C, 122 (2018) 17001.

[17]Gate-Tunable Thermal Metal-Insulator Transition in VO2 Monolithically Integrated into a WSe2 Field-Effect Transistor, Mahito Yamamoto, Ryo Nouchi, Teruo Kanki, Azusa N Hattori, Kenji Watanabe, Takashi Taniguchi, Keiji Ueno, Hidekazu Tanaka: ACS Appl. Mater. Interfaces., 11 (2019) 3224-3230.

[18]Growth of vanadium dioxide thin films on hexagonal boron nitride flakes as transferrable substrates, Shingo Genchi, Mahito Yamamoto, Koji Shigematsu, Shodai Aritomi, Ryo Nouchi, Teruo Kanki, Kenji Watanabe, Takashi Taniguchi, Yasukazu Murakami, Hidekazu Tanaka: Sci. Rep., 9 (2019) 2857.

International Conferences
[1]Basics and Applications of　Electronic Phase Change Oxides (invited), Hidekazu Tanaka: 2018 MRS Spring Meeting & Exhibit.

[2]Functional oxide nano/micro-structured devices using VO2 (invited), Hidekazu Tanaka: 2018　Korean Physics Society (KPS) Spring　Meeting.

[3]Transistors Based on the Phase-Change Oxides Contacted with 2D Layered Materials (invited), Hidekazu Tanaka, Mahito Yamamoto: 30th PCOS（Phase change Oriented Science）2018.

[4]Control of electrical properties on strongly correlated oxides via ionic-electronic coupling (invited), Hidekazu Tanaka: The 8th Indo-Japan Seminar.

[5]Transistors Based on 2D Semiconductors/Dielectrics Contacted with the Phase-Change Oxides (invited), Hidekazu Tanaka: E-MRS-J-MRS Joint symposium.

[6]Basic and Applications of Electronic Phase Change Oxides (invited), Hidekazu Tanaka, Mahito Yamamoto, Teruo Kanki, Azusa N. Hattori, Yuto Anzai: 7th imec Handai International Symposium.

[7]Current activities on Nanotechnology at ISIR-Osaka Universit (invited), Hidekazu Tanaka: Workshop on MICROACTUATORS.

[8]Room temperature hydrogenation in functional oxide nanowires by an electric field via air nanogap (invited), Teruo Kanki: 17th Edition of International conference on Emerging Trends in Materials Science and Nanotechnology(Roma, Italy).

[9]Electrochemical proton-intercalation into oxide nanowires at room temperature (invited), Teruo Kanki: EMN Meeting on Nanowires(Prague, Czech Repulic).

[10]Creation of VO2 resistance modulation device dependent on crystal orientation using strain effect by electrostatic force (poster), Fumiya Endo, Teruo Kanki, Luca Pellegrino, Nicola Manca, Daniele Marré, Hidekazu Tanaka: The 22nd SANKEN International Symposium.

[11]Electronic resistivity modulation by proton control using an electric field effect in HVO2-FET structures (poster), Keita Muraoka, Teruo Kanki, Takafumi Uemura, Tsuyoshi Sekitani, Hidekazu Tanaka: The 22nd SANKEN International Symposium.

[12]Enhancement of resistive modulation in nano-convex VO2 FET (poster), Yoshihide Tsuji, Teruo Kanki, Takafumi Uemura, Tsuyoshi Sekitani, Hidekazu Tanaka: The 22nd SANKEN International Symposium.

[13]A discrete resistance change in the 3D nanostructured metal oxide due to the nano-confinement effect (invited), A. N. Hattori and H. Tanaka: NanoWorld Conference.

[14]Investigation of transport dynamics for the phase-separated nanodomains in strongly correlated manganite (invited), A. N. Hattori, T. V. A. Ngyuen, M. Nagai, M. Ashida, H. Tanaka: International Nanophotonics and Nanoenergy Conference2018.

[15]A discrete resistance change for the spatial nano-confined electric domain in the strongly correlated metal oxides (invited), A. N. Hattori and H. Tanaka: Nanotech-2018 (Nanotechnology and Material Science Congress).

[16]Creation of atomically-ordered surfaces on the three-dimensionally architected Si structure (oral), A. N. Hattori, S. Takemoto, K. Hattori, H. Daimon, H. Tanaka: The 14th International Conference on Atomically Controlled Surfaces, Interfaces and Nanostructures.

[17]Metal-insulator transition properties in the strongly electron correlated metal oxide nanowire structures (poster), A. N. Hattori, T. Yamanaka, K. Hayashi, S. Tsubota, Y. Naitoh, H. Akinaga and H. Tanaka: The 8th Indo-Japan Seminar “Designing Emergent Materials”.

[18]Purified Verwey Transition of Single Domain Fe_3O_4 Nanowire (poster), R. Rakshit, A. N. Hattori, H. Tanaka: The 8th Indo-Japan Seminar “Designing Emergent Materials”.

[19]Three-dimensional Nanoconfinement Supports Verwey Transition in Fe_3O_4 Nanowire at 10 nm length scale (poster), R. Rakshit, A. N. Hattori, Y. Naitoh, H. Shima, H. Akinaga, and H. Tanaka: Handai-Kansai-GiessenDai Joint Seminar on Materials Science and Engineering.

[20]Correlation of Ni valence and resistance modulation on $SmNiO_3$ chemical transistor (poster), D. Kawamoto, A. N. Hattori, M. Yamamoto, H. Tanaka: The 14th International Conference on Atomically Controlled Surfaces, Interfaces and Nanostructures.

[21]Fabrication of $NdNiO_3$ film with controlled Ni/Nd ratio by PLD technique (poster), T. Yamanaka, A. N. Hattori, H. Tanaka: The 22nd SANKEN International Symposium.

[22]Steep-Slope Transistors Based on 2D Semiconductors Contacted with the Phase-Change Material VO2 (oral), Mahito Yamamoto1 Teruo Kanki Azusa Hattori Ryo Nouchi Kenji Watanabe Takashi Taniguchi Keiji Ueno Hidekazu Tanaka: 2018 MRS Spring Meetng & Exhibit.

[23]Carrier injection from VO2 into MoS2 and WSe2 (oral), Mahito Yamamoto, Ryo Nouchi, Teruo Kanki, Azusa N. Hattori, Shu Nakaharai, Kenji Watanab, Takashi Taniguch, Yutaka Wakayam, Keiji Ueno,

Hidekazu Tanaka: Annual Meeting of the Physical Society of Taiwan.

[24]Color thickness identification of hexagonal boron nitride supportedo on a transfer polymer (poster), Yuto ANZAI, Mahito YAMAMOTO, Kenji WATANAB, Takashi Taniguchi, Hidekazu Tanaka: The 22nd SANKEN International Symposium.

[25]Growth and characterization of VO2 thin films on hexagonal boron nitride (poster), Shingo GENCHI, Koji SHIGEMATSU, Shodai ARITOMI, Mahito YAMAMOTO, Teruo KANKI, Kenji WATANBE , Takashi TANIGUCH , Yasukazu MURAKAMI, Hidekazu Tanaka: .
[26]Growth and characterization of VO2 thin films on hexagonal boron nitride (poster), Shingo GENCHI, Koji SHIGEMATSU, Shodai ARITOMI, Mahito YAMAMOTO, Teruo KANKI, Kenji WATANBE , Takashi TANIGUCH , Yasukazu MURAKAMI, Hidekazu Tanaka: 5th Interactive Materials Science Cadet International Symposium 2018.

[27]Nanosize Effect in BFO-FZO Co-Deposited Nanostructured Thin Films (poster), A. S. Borowiak, B. Gautier and H. Tanaka: 2018 ISAF-FMA-AMF-AMEC-PFM Joint Conference (IFAAP2018).

[28]Nanosize effect in multiferroic BiFeO3-semiconducting (Fe,Zn)3O4 nanostructures (poster), A. S. Borowiak, B. Gautier and H. Tanaka: European Materials Research Society （E-MRS2018）.

Contributions to International Conferences and Journals

H. Tanaka	The 26th International Workshop on Oxide Electroncis (Organaizing Committtee)
H. Tanaka	Compound Semiconductor Week (CSW2019) (Organaizing Committtee)

Publications in Domestic Meetings

The 79th JSPS Autumn Meeting, 2018	7 papers
The 6th Alliance Young Researchers' workshop	1 paper
The 66th JSAP Spring Meeting, 2019	3 papers
The 4th material science week	2 papers
Jvss2018	2 papers

Academic Degrees

Master Degree for Engineering Y. Anzai	Fabrication of VO2 field effect transistor with h-BN gate Insulator
Master Degree for Engineering D. Kawamoto	Wide-range resistance modulation on the strongly correlated Ni oxide chemical transistor
Master Degree for Engineering Y. Tsuji	Creation of electric field-comverged transistors using VO2 and control in the metal-insulator trantition
Master Degree for Engineering K. Muraoka	Creation of protonic transistors using VO2 and their huge resistance modulation
Bachelor degree for Engineering S. Nonaka	Fabrication of SmNiO3 FET with hBN gate insulator
Bachelor degree for Engineering T. Suzuki	Fabrication of NdNiO3 thin films using NdNiO3(1:1:3) targets

Grant-in-Aid for Scientific Research

H. Tanaka	3D nanostructured oxides for nano-electric phase controlled devices.	¥13,780,000
H. Tanaka	Constraction of ferroelectric nano-dots and investigation of the dependence of physcial properites on thier size, shape.	¥400,000
T. Kanki	Dreation of oxide nano-transistor and control of metal-insulator	¥2,340,000

	phases in single domain		
A. Hattori	The study of the origin of the nano-phase separation phenomena in the nanoconfined strongly correlated metal oxide		¥9,230,000
M. Yamamoto	Correlated oxides/atomically thin semiconductors heterostructures for steep-slope transistors applications		¥780,000
Entrusted Research			
H. Tanaka	International Joint Research Promotion, Osaka University	Nanoscale hybrid correlated oxide devices and their application	¥500,000
A. Hattori	Japan Science and Technology Agency（JST)	Realization of the power saving functional phase switching device utilizing nano-confinment effect for the strongly correlated metal oxide	¥7,410,000
Contribution to Research			
H. Tanaka	The Murata foundation		¥2,100,000
A. Hattori	The Futaba Foundation		¥2,000,000
Cooperative Research			
H. Tanaka	Murata Manufacturing Co., Ltd		¥0,000
H. Tanaka	National Institute for Materials Science (NIMS)		¥0,000
M. Yamamoto	National Institute for Materials Science (NIMS)		¥850,000
Other Research Fund			
H. Tanaka	National Institutes of Natural Sciences / Institutes for Molecular Sciences		¥33,540,000
T. Kanki	Japan Society for the Promotion of Science		¥1,130,000

Department of Advanced Nanofabrication

Original Papers

[1]Development of 100fs-1nm resolution MeV-energy electron microscopy, J. Yang, Y. Yoshida: Radiation & industries, 144 (2018) 29-32.

[2]Ultrafast electron microscopy with relativistic femtosecond electron pulses, Jinfeng Yang, Yoichi Yoshida, Hidehiro Yasuda: Microscopy, 67 (2018) 291-295.

[3]Relativistic Ultrafast Electron Microscopy: Single-Shot Diffraction Imaging with Femtosecond Electron Pulses, Jinfeng Yang and Yoichi Yoshida: Advances in Condensed Matter Physics, 2019 (2019) 1-6.

[4]Terahertz Radiation from Combined Metallic Slit Arrays, Dazhi Li, Makoto Nakajima, Masahiko Tani, Jinfeng Yang, Hideaki Kitahara, Masaki Hashida, Makoto Asakawa, Wenxin Liu, Yanyu Wei, Ziqiang Yang: Scientific Reports, 9 (2019) 1-8.

International Conferences

[1]Activities of Research and Application on adiation Chemistry in Japan (invited), Yoichi Yoshida: THE 7TH ASIA PACIFIC SYMPOSIUM ON RADIATION CHEMISTRY.

[2]Ultrafast electron microscopy for observation of chemical reactions (poster), Jinfeng Yang, Hiromi Shibata, Yoichi Yoshida: THE 7TH ASIA PACIFIC SYMPOSIUM ON RADIATION CHEMISTRY.

[3]Attosecond/Femtosecond Pulse Radiolysis (invited), Yoichi Yoshida: The 4th Osaka Univ. - KAERI Joint Workshop on Radiation Research.

[4]Ultrafast Electron Microscopy with Femtosecond Electron Pulses (invited), Jinfeng Yang: The 4th Osaka Univ. - KAERI Joint Workshop on Radiation Research.

[5]Relativistic-pulse Electron Microscopy (poster), Jinfeng Yang, Yoichi Yoshida, Hidehiro Yasuda: The 22st SANKEN International Symposium.

[6]Generation of low emittance femtosecond pulsed electron beam (invited), Jinfeng Yang: Indo Japan Accelerator School 2019.

[7]Electron microscopy with femtosecond pulses (invited), Jinfeng Yang: Indo Japan Accelerator School 2019.

[8]Fundamentals of PSCAR and Overcoming the Stochastics Problems of EUV Lithography (Keynote lecture), Seiichi Tagawa: EUVL Workshop 2018.

[9]Nanospace radiation chemistry and radiation-induced effects on polymers open huge industrial applications such as EUV and EB lithography (invited), Seiichi Tagawa: IRaP 2018.

[10]New Approach of Overcoming Shot Noise Problems, the Most Critical Item of EUV Lithography Now (oral), Seiichi Tagawa and Akihiro Oshima: The 35th International Conference of Photopolymer Science and Technology.

[11]Fundamental aspects of CAR, PSCAR and new PSCAR for overcoming problems of RLS trade-off and stochastic defects (invited), Seiichi Tagawa: IEUVI Resist TWG meeting.

[12]New PSCAR Concept Promising High Sensitivity Resist Overcoming Problems of RLS Trade-off, LER and Stochastic Defects (oral), Seiichi Tagawa: SPIE Advanced Lithography.

Books
[1]Ultrafast electron microscopy with relativistic femtosecond electron pulses(M. Arita, N. Sakaguchi) Jinfeng Yang, “Electron microscopy – Novel microscopy trends”, IntechOpen, 1 (1-20) 2019.

Patents
[1]K20180033, 2018-113560

[2]G20130085USDIV, 15/956214

[3]KP2016031, 2016-521152

[4]K20140298, 2015-028423

[5]G20140104KR, 10-2016-7034483

[6]G20140054US, 15/117686

[7]G20130085US, 14/769410

[8]G20140033US, 15/106915

[9]G20130085CN, 201480009687.29999

Publications in Domestic Meetings

Workshop of High-brightness Radio-frequency Electron Gun	2 papers
Annual Meeting of RadioIsotope and Radiation Research	3 papers
Annual Meeting of Particle Acceleratior Society Japan	2 papers
Annual Meeting of Atomic Energy Society of Japan	4 papers

Annual Meeting of The Physical Society of Japan		2 papers
Annual Meeting of Japanese Society of Radiation Chemistry		3 papers
Grant-in-Aid for Scientific Research		
Y. Yoshida	Study of thermalization and relaxation process after ionization using attosecond pulse radiolysis	¥15,080,000
J. Yang	Electron crystallography using femtosecond electron pulses	¥11,700,000
M. Gohdo	Study of electronic state of solvated electrons by electron beam-photon double excitation pulse radiolysis technique	¥2,470,000
Contribution to Research		
Y. Yoshida	Nissan Steel Industry Co., Ltd.	¥500,000
J. Yang	Institute for Laser Technology	¥400,000
Cooperative Research		
Y. Yoshida	Daikin Industries, Ltd.	¥2,250,000
Y. Yoshida	Japan Atomin Energy Agency	¥0,000
S. Kawakami	Meiwa Sangyo Co. Ltd.	¥0,000
S. Kawakami	Meiwa Sangyo Co. Ltd.	¥0,000
S. Kawakami	NISSIN GIKEN Co., LTD.	¥0,000
S. Kawakami	SAKATA SEED CORPORATION, NISSIN GIKEN Co., LTD.	¥2,000,000
S. Kawakami	Evertron Inc.	¥1,000,000

Department of Nanocharacterization for Nanostructures and Functions

Original Papers

[1]Self-activated surface dynamics in gold catalysts under reaction environments, Naoto Kamiuchi, Keju Sun, Ryotaro Aso, Masakazu Tane, Takehiro Tamaoka, Hideto Yoshida, Seiji Takeda: Nat. Commun., 9 (2018) 2060.

[2]Impact of the electron beam on the thermal stability of gold nanorods studied by environmental transmission electron microscopy, Wiebke Albrecht, Arjen van de Glind, Hideto Yoshida, Yusuke Isozaki, Arnout Imhof, Alfons van Blaaderen, Petra E. de Jongh, Krijn P. de Jong, Jovana Zečević, Seiji Takeda: Ultramicroscopy, 193 (2018) 97-103.

[3]Oxidation and hydrogenation of Pd: suppression of oxidation by prolonged H_2 exposure, Takehiro Tamaoka, Hideto Yoshida, Seiji Takeda: RSC Advances, 9 (2019) 9113-9116.

[4]Rational method to monitor molecular transformations on metal oxide nanowire surfaces, Chen Wang, Takuro Hosomi, Kazuki Nagashima, Tsunaki Takahashi, Guozhu Zhang, Masaki Kanai, Hao Zeng, Wataru Mizukami, Nobutaka Shioya, Takafumi Shimoaka, Takehiro Tamaoka, Hideto Yoshida, Seiji Takeda, Takao Yasui, Yoshinobu Baba, Yuriko Aoki, Jun Terao, Takeshi Hasegawa, and Takeshi Yanagida: , 19 (2019) 2443-2449.

International Conferences

[1]In Situ TEM Characterization of Dynamic Processes During Materials Synthesis and Processing (oral), Takehiro Tamaoka, Ryotaro Aso, Hideto Yoshida, Seiji Takeda: The 2018 MRS Spring Meeting & Exhibit .

[2]Atomic resoiution environmental TEM of metal surface dynamics in gas environment (invited), Seiji Takeda, TakehiroTmaoka, Ryotaro Aso, Naoto Kamiuchi, Kentaro Soma, Hideto Yoshida: The 3rd International Conference Microstructure and Property of Materials.

[3]Phase-locked Transmission Electron Microscopy for Detecing Dynamic Responses of Heterogeneous Materials and Electrochemical Devices under an Alternating Electric Potential (invited), Seiji Takeda, Kentaro Soma, Ryotaro Aso, Naoto Kamiuchi and Hideto Yoshida: The Microscopy and Microanalysis 2018 meeting.

[4]Time resolved and atomic resolution environmental TEM of metal surface in gas environment (invited),

Seiji Takeda, Kentaro Soma, Hideto Yoshida, Naoto Kamiuchi, Ryotaro Aso, TakehiroTmaoka: 256th ACS National Meeting & Exposition.
[5]Dynamic Active Structure of Nanoporous Gold Catalyst under Reaction Environment (oral), Naoto Kamiuchi, Keju Sun, Hideto Yoshida and Seiji Takeda: ACSIN-14 & ICSPM26 .

[6]Atomic scale study of oxidation and reduction process of palladium surface scale (oral), Takehiro Tamaoka, Hideto Yoshida, Seiji Takeda: THE AVS 65th INTERNATIONAL SYMPOSIUM & EXHIBITION 2018.

[7]In situ characterization of Metal Surface Dynamics in Reaction Gas by Atomics Scale and Millisecond Resolution Environmental TEM (invited), Seiji Takeda, Naoto Kamiuchi, TakehiroTmaoka, Ryotaro Aso, Hideto Yoshida,: The 2018 MRS Fall Meeting & Exhibit .

[8]Visualization of coadsorption of CO and hydrogen on Ni(111) single crystal (oral), Naoto Kamiuchi: SANKEN JSPS Symposium for the Circulation of Talented Researchers, Osaka University.

[9]In-situ ETEM study of iron oxide during redox processes in atmospheric pressure gas environments (poster), Ryotaro Aso: SANKEN JSPS Symposium for the Circulation of Talented Researchers, Osaka University.

Publications in Domestic Meetings

The 8th Network joint research center for materials and devices	1 paper
The 122rd CASJ meeting	1 paper

Academic Degrees

Master Degree for Engineering T. Mizobuchi	In-situ ETEM observation of Pt/CeO_2 catalysts under the reaction conditon by controlled electron beam irradiation
Master Degree for Engineering K. Yoshimoto	Measurement of the thermoelectric properties of Bi_2Te_3 nanobelts in TEM

Grant-in-Aid for Scientific Research

S. Takeda	Analysis of dynamic active structure of gold catalyst	¥4,940,000
N. Kamiuchi	Study on redispersion for regeneration of environmental catalysts	¥2,860,000

Entrusted Research

S. Takeda	Program for Fostering Globally Talented Reseachers	Global Networking on Molecular Technology Research	¥0,000

Cooperative Research

R. Aso, S. Takeda	Institute of Multidisciplinary Research for Advanced Materials, Tohoku University	¥0,000
S. Takeda, H. Yoshida	Institute for Materials Research (IMR), Tohoku University	¥165,000

Other Research Fund

R. Aso, S. Takeda	Institute of Multidisciplinary Research for Advanced Materials, Tohoku University	¥,000

Department of Theoretical Nanotechnology

Original Papers

[1]First-Principles Study on Cathode Properties of Li2MTiO4 (M = V, Cr, Mn, Fe, Co, and Ni) with Oxygen Deficiency for Li-Ion Batteries, M. Hamaguchi, H. Momida and T. Oguchi: J. Phys. Soc. Jpn, 87 (2018) 044805/1-8.

[2]Magnetic and transport properties of equiatomic quaternary Heusler CoFeVSi epitaxial films, S. Yamada, S. Kobayashi, F. Kuroda, K. Kudo, S. Abo, T. Fukushima, T. Oguchi and K. Hamaya: Phys. Rev.

Materials, 2 (2018) 124403/1-8.

[3]A-cation control of magnetoelectric quadrupole order in A(TiO)Cu4(PO4)4 (A = Ba, Sr, and Pb), K. Kimura, M. Toyoda, P. Babkevich, K. Yamauchi, M. Sera, V. Nassif, H. M. Rønnow and T. Kimura: Phys. Rev. B, 97 (2018) 134418/1-6.

[4]Ultrathin Bismuth Film on 1T-TaS2: Structural Transition and Charge- Density-Wave Proximity Effect, K. Yamada, S. Souma, K. Yamauchi, N. Shimamura, K. Sugawara, Chi Xuan Trang, T. Oguchi, K. Ueno, T. Takahashi and T. Sato: Nano Lett., 18 (2018) 3235-3240.

[5]Ultrathin Bismuth Film on High-Temperature Cuprate Superconductor Bi2Sr2CaCu2O8+δ as a Candidate of a Topological Superconductor, N. Shimamura, K. Sugawara, S. Sucharitakul, S. Souma, K. Iwaya, K. Nakayama, Chi Xuan Trang, K. Yamauchi, T. Oguchi, K. Kudo, T. Noji, Y. Koike, T. Takahashi, T. Hanaguri and T. Sato: ACS Nano, 12 (11) (2018) 10977-10983.

[6]Magnetic structural unit with convex geometry: A building block hosting an exchange-striction-driven magnetoelectric coupling, K. Kimura, Y. Kato, K. Yamauchi, A. Miyake, M. Tokunaga, A. Matsuo, K. Kindo, M. Akaki, M. Hagiwara, S. Kimura, M. Toyada, Y. Motome and T. Kimura: Phys. Rev. Materials, 2 (2018) 104415/1-12.

[7]Elucidation of discharge mechanism and evaluation of Na-ion battery performance of tin sulfide (SnS) electrode by using first principles calculation, H. Kotaka, H. Momida, A. Kitajou, S. Okada and T. Oguchi: J. Comput. Chem. Jpn., 18 (2019) 78-83.

[8]Symmetric and asymmetric exchange stiffnesses of transition-metal thin film interfaces in external electric field, K. Nakamura, A.-M. Pradipto, T. Akiyama, T. Ito, T. Oguchi and M. Weinert: J. Mag. Magn. Mater., 457 (2018) 97-102.

[9]Fine-grained optimization method for crystal structure prediction, K. Terayama, T. Yamashita, T. Oguchi and K. Tsuda: npj Computational Materials, 4 (2) (2018) 1-8.

International Conferences

[1]Ab-initio Calculation of Magnetic Stability and Electric Property in BiFeO3 and BiCoO3 (poster), H. Katsumoto, K. Yamauchi, and T. Oguchi: The first International Joint Symposium of CEFMS-NCTU, RCAS-AS (Taiwan) and 5-Star Alliance (Japan) , May 18-20, 2018, Taiwan.

[2]First-Principles Study on Multiferroic Transition-Metal Oxides (invited), K. Yamauchi: 5th International Conference of Asian Union of Magnetics Societies (IcAUMS2018), June 3-7, 2018, Jeju, Korea.

[3]First-Principles Study on Structural Stability and Magnetism in Equiatomic Quaternary Heusler Alloys (poster), F. Kuroda, H. Fujii, T. Fukushima, T. Oguchi: 5th International Conference of Asian Union of Magnetics Societies (IcAUMS2018), June 3-7, 2018, Jeju, Korea.

[4]Tuning Atomic-Layer Alignment for Perpendicular Magnetocrystalline Anisotropy of Co/Ni multilayers (poster), N. T. P. Thao, K. Nakamura, T. Oguchi: 5th International Conference of Asian Union of Magnetics Societies (IcAUMS2018), June 3-7, 2018, Jeju, Korea.

[5]Ab-initio Calculation of Magnetism and Polarization in BiCoO3 (poster), H. Katsumoto, K. Yamauchi, and T. Oguchi: 7th International Symposium on Structure-Property Relationship in Solid State Materials (SPSSM-2018), June 8-12, 2018, Italy.

[6]First-Principles Study on Cathode Properties of Li-excess Rock-Salt Type Li2+2xMn1-XTi1-XO4 (poster), M. Hamaguchi, H. Momida, and T. Oguchi: The 19th International Meeting on Lithium Batteries,

June 17-22, 2018, Kyoto, Japan.

[7]First-Principles Study on Magnetism and Phase Stability of Antiferromagnetic V2 Based Heusler Alloys (poster), F. Kuroda, H. Fujii, T.Fukushima, T. Oguchi: 21st International Conference on Magnetism (ICM2018), July 15-20, 2018, SF, USA.

[8]First-principles Study of Perpendicular Magnetocrystalline Anisotropy on Co/Ni Multilayers (poster), N. T. P. Thao, K. Nakamura, T. Oguchi: 21st International Conference on Magnetism (ICM2018), July 15-20, 2018, SF, USA.

[9]Order-Disorder Phase Transition from a-T to d-O boron (oral), K. Shirai and N. Uemura: Joint 18th International Conference on High Pressure Semiconductor Physics & 2nd International Workshop on High Pressure Study of Superconductors(HPSP18 & WHS2), July 23-27, 2018, Barcelona, Spain.

[10]Isotope shift of zero-phonon photoluminescence emission of Cu4 complex in Si (poster), K. Shirai and T. Fujimura: 34th International Conference on the Physics of Semiconductors, July 29-August 3, 2018, France.

[11]Carrier doping effect on all-Heusler giant-magnetoresistance junctions with semimetallic Fe2VAl studied by first-principles calculations (poster), F. Kuroda, T Fukushima, and T. Oguchi: The 21st Asian Workshop on First-Principles Electronic Structure Calculations(ASIAN-21), Oct. 29-31, 2018, Korea.

[12]A first-principles study on the magnetism of Fe/Bi/MgO multilayers (poster), K. Hiraoka and T.Oguchi: The 21st Asian Workshop on First-Principles Electronic Structure Calculations(ASIAN-21), Oct. 29-31, 2018, Korea.

[13]DFT-based engineering of Dirac surface states in topological insulator multilayers (poster), T. Kosaka, K Yamauchi, and T. Oguchi: The 21st Asian Workshop on First-Principles Electronic Structure Calculations(ASIAN-21), Oct. 29-31, 2018, Korea.

[14]Guiding principles for enhancing piezoelectricity in wurtzite materials: First-principles calculations (poster), H. Momida, T. Oguchi: The 21st Asian Workshop on First-Principles Electronic Structure Calculations(ASIAN-21), Oct. 29-31, 2018, Korea.

[15]Effects of structure parameters on piezoelectricity in wurtzite materials: First-principles and statistical-learning calculations (poster), H. Momida, T. Oguchi: 2018 MRS Fall Meeting & Exhibit, Nov. 25-30, 2018, Boston, USA.

[16]Sparse Model Construction for Elucidating Physical Mechanisms (oral), Y. Kanda, H. Fujii, and T. Oguchi: The 2nd IMS-INSD Joint Workshop on Frontier Nanomaterials, Nov. 26, 2018, Hanoi, Vietnam.

[17]First-principles study of topological interface states in the natural heterostructure (PbSe)5(Bi2Se3)6 (poster), H. Momida: 2nd SANKEN JSPS Symposium for the Circulation of Talented Researchers "Global Networking on Molecular Technology Research", Jan 15-16, 2019, Osaka, Japan.

[18]Perpendicular Magnetocrystalline Anisotropy on 3d Transition-Metals Multilayers – A First-principles Study (poster), T. P. T. Nguyen, K. Nakamura, T. Oguchi: American Physical Society March Meeting 2019, Mar 4-8, 2019, Boston, USA.

[19]First-principles study of the carrier doping effect on all-Heusler GMR junctions (poster), F. Kuroda, T. Fukushima, T. Oguchi: American Physical Society March Meeting 2019, Mar 4-8, 2019, Boston, USA.

[20]First-principles Study on Piezoelectricity in Bi(Fe,Co)O3 (oral), H. Katsumoto, K. Yamauchi, and T. Oguchi: American Physical Society March Meeting 2019, Mar 4-8, 2019, Boston, USA.

[21]Exploration of Heusler Alloys for Spintronics (invited), T. Oguchi: 5th International Conference of Asian Union of Magnetics Societies (IcAUMS2018), June 3-7, 2018, Jeju, Korea.

Contributions to International Conferences and Journals

T. OGUCHI	Asian Workshop on First-Principles Electronic Structure Calculations (International Organizing Committee)
T. OGUCHI	The 22nd Asian Workshop on First-Principles Electronic Structure Calculations (ASIAN-22) (Local Organizing Committee, Co-Chair)

Publications in Domestic Meetings

The Physical Society of Japan 2018 Autumn Meeting	5 papers
The 59th Battery Symposium in Japan	2 papers
CSRN-OSAKA Annual Workshop 2018	1 paper
Spin-RNJ Symposium 2018	1 paper
Topological Materials Science: The 4th Annual Meeting (TMS2019)	1 paper
Dynamic Alliance for Open Innovation Bridging Human, Environment and Materials, G1 meeting	1 paper
The 79th JSPS Autumn Meeting 2018	1 paper
2019 The Physical Society of Japan 74th Annual Meeting	1 paper
Workshop of ISSP, "Glass transition and Glass Physics"	1 paper
13th Meeting of the Japanese Society of Boron and Borides	1 paper
The 66th JSAP Spring Meeting, 2019	1 paper

Academic Degrees

Doctor Degree for Science M. Fukuichi	First-Principles Calculations on the Origin of Mechanical Properties and Electronic Structures of 3d, 4d, and 5d Transition Metal Monocarbides
Master Degree for Science M. Kumakura	First-Principles Calculations on Magnetic Properties and Structures of Cubic Mn-based Heusler Alloys
Master Degree for Science K. Hiraoka	First-Principles Calculations of Magneto Crystalline Anisotropy of Fe/Bi/MgO Multilayers
Master Degree for Science S. Yamashita	Application of Current Density Functional Theory to First-Principles Calculations
Master Degree for Engineering S. Kanehira	Development of Descriptors for Crystal Structure Prediction using Deep Learning
Master Degree for Engineering Y. Kanda	Elucidation of Physical Mechanism by Sparse Modelling
Master Degree for Engineering T. Kosaka	Theoretical Design of Stacked Topological Insulator Thin Films based on Density Functional Method
Master Degree for Engineering T. Hiraiwa	Stability of Electronic Structure and Magnetism of Pyrochlore-Type Compounds based on First-Principles Calculations
Master Degree for Engineering Tran Ba Hung	Thermoelectric Property of Metal Chalcogenides and Heusler Compounds: A First-Principles Study

Grant-in-Aid for Scientific Research

K. Yamauchi	First-principles understanding of mechanism and materials design of topological matter	¥1,950,000
H. Momida	Design of piezoelectric device materials by controlling nano-structures: First-principles calculations	¥1,040,000

K. Yamauchi	Understanding of electronic structure in excitonic insulator by means of orbital physics		¥900,000
T. Oguchi	Chemistry in selective intercalation of metal element in layered inorganic compounds		¥800,000
T. Oguchi	Development of L10 ordered phase for next generation rare-earth free magnets		¥1,000,000
Entrusted Research			
T. Oguchi	International Joint Research Promotion Program (Type B)	Materials Design for Solving Energy and Environmental Issues	¥500,000
K. Yamauchi	Japan Science and Technology Agency (JST)	First-principles functional design of topological interfaces	¥1,300,000
Contribution to Research			
T. Oguchi	General Director of MCL/V.P.of ITRI Dr.Yu-Min Peng		¥2,000,000
Cooperative Research			
T. Oguchi	DAIKIN INDUSTRIES, Ltd.		¥3,780,000
T. Oguchi	Sumitomo Electric Industries, Ltd.		¥2,835,000
T. Oguchi	FUJITSU LABORATORIES LTD.		¥1,000,000
T. Oguchi	Nitto Denko Corporation		¥1,000,000
Other Research Fund			
T. Oguchi	National Institute for Materials Science		¥25,973,000
T. Oguchi, H. Momida	Kyoto University		¥5,000,000

Department of Soft Nanomaterials

Original Papers

[1]Antiaromatic Character of Cycloheptatriene-bis-Annelated Indenofluorene Framework Mainly Originated from Heptafulvene Segment, K. Yamamoto, Y. Ie, N. Tohnai, F. Kakiuchi, Y. Aso: Sci. Rep., 8 (2018) 17663-1-11.

[2]Creating Elastic Organic Crystals of pi-Conjugated Molecules with Bending Mechanofluorochromism and Flexible Optical Waveguide, S. Hayashi, S.-y. Yamamoto, D. Takeuchi, Y. Ie, K. Takagi: Angew. Chem. Int. Ed., 57 (2018) 17002-17008.

[3]A Thiazole-Fused Antiaromatic Compound Containing an s-Indacene Chromophore with a High Electron Affinity, Y. Ie, C. Sato, K. Yamamoto, M. Nitani, Y. Aso: Chem. Lett., 47 (2018) 1534-1537.

[4]Fluorinated Naptho[1,2-c:5,6-c']bis[1,2,5]thiadiazole-Containing pi-Conjugated Compound: Synthesis, Properties, and Acceptor Application in Organic Solar Cells, S. Chatterjee, Y. Ie, T. Seo, T. Moriyama, G.-J. A. H. Wetzelaer, P. W. M. Blom, Y. Aso: NPG Asia Mater., 10 (2018) 1016-1028.

[5]Synthesis and Field-Effect Transistor Application of pi-Extended Lactam-Fused Conjugated Oligomers Obtained by Tandem Direct Arylation, K. Takagi, S.-y. Yamamoto, K. Tsukamoto, Y. Hirano, M. Hara, S. Nagano, Y. Ie, D. Takeuchi: Chem. Eur. J., 24 (2018) 14137-14145.

[6]Oligothiophene Quinoids Containing a Benzo[c]thiophene Unit for the Stabilization of the Quinoidal Electronic Structure, K. Yamamoto, Y. Ie, M. Nitani, N. Tohnai, F. Kakiuchi, K. Zhang, W. Pisula, K. Asadi, P. W. M. Blom, Y. Aso: J. Mater. Chem. C, 6 (2018) 7493-7500.

[7]Naphtho[1,2-c:5,6-c']bis[1,2,5]thiadiazole-Based Nonfullerene Acceptors: Effect of Substituents on the Thiophene Unit on Properties and Photovoltaic Characteristics, S. Chatterjee, Y. Ie, Y. Aso: ACS Omega, 3 (2018) 5814-5824.

[8]Synthesis, Properties, and Photovoltaic Characteristics of Donor–Acceptor Copolymers Based on

Tetrafluoro-Substituted Benzodioxocyclohexene-Annelated Thiophene, Y. Ie, Y. Kishimoto, K. Morikawa, Y. Aso: J. Photopolym. Sci. Technol., 31 (2018) 145-150.

Books

[1]Anchoring of Molecules Towards Electrodes(Chemical Society of Japan) Y. Ie, "Molecular Architectonics New Functions Based on Single-molecule Technologies", Kagaku Dojin, 31 (103-109) 2018.

Patents

[1]K20180161 Compounds and their production methods, andorganic semiconductors based on these compounds, 2018-203735

[2]K20180227 Production methods for composite solid electrolyte, 2018-218472

[3]K20180322 Conjugated polymers and their production methods, and organic semiconductors and organic semiconductor devices based on these polymers, 2019-017463

[4]K20180228 Compounds and organic semiconductors based on these compounds, 2019-061484

[5]G20180040TW Polymers and their production methods, its-containing organic semiconductors and organic solar cells, 107128967

[6]G20170126WO Compounds or its unified compounds, and organic semiconductors, PCT/JP2018/037394

[7]G20180142WO n-Type organic semiconductors composites for organic semiconductor thin films, organic semiconductor thin films, and their production methods, organic thin-film transistors and their fabrication method, and production methods for compounds, PCT/JP2019/008533

[8]G20180052WO Compounds. precursors for compounds, organic semiconductors containing compounds, and organic electronic devices containing organic semiconductors, PCT/JP2019/009978

[9]G20180053WO Polymers and organic semiconductiors containing polymers, and organic electronic devices containing organic semiconductiors, PCT/JP2019/009979

[10]G20180040WO Polymers and their production methods, and organic semiconductors and organic sola cells containing these polymers, PCT/JP2018/030387

[11]G20170126TW Compounds or unified compounds, and organic semiconductors, 107136257

[12]G20180142TW n-Type organic semiconductiors and its-containing thin films, and organic thin-filmtransistors, 108108130

[13]G20170125WO Compounds and organic semiconductors based on these compounds, PCT/JP2018/033769

Grant-in-Aid for Scientific Research

Y.Ie	Development of n-type organic semiconductors based on operation mechanism and establishment of ratrional molecular design	¥6,370,000

Cooperative Research

Y.Ie	Ishihara Sangyo kaisha, Ltd.	¥2,684,000
Y.Ie	Toyobo Co.,Ltd	¥1,000,000

Y.Ie	Toyota Motor Co.	¥1,200,000
Y.Ie	Daikin Industries,Ltd.,	¥525,000

Department of Bio-Nanotechnology

Original Papers

[1]Quantitative analysis of DNA with single-molecule sequencing, Takahito Ohshiro, Makusu Tsutsui, Kazumichi Yokota, Masateru Taniguchi: SCIENTIFIC REPORTS, 8 (1) (2018) 8517-.

[2]Measuring Single-Molecule Conductance at An Ultra-Low Molecular Concentration in Vacuum, Bo Liu, Makusu Tsutsui, Masateru Taniguchi: MICROMACHINES, 9 (6) (2018) 282-.

[3]Remote heat dissipation in atomsized contacts, Makusu Tsutsui, Takanori Morikawa, Kazumichi Yokota, Masateru Taniguchi: SCIENTIFIC REPORTS, 8 (2018) 7842-.

[4]Quantitative Evaluation of Dielectric Breakdown of Silicon Micro- and Nanofluidic Devices for Electrophoretic Transport of a Single DNA Molecule, Mamiko Sano, Noritada Kaji, Qiong Wu, Toyohiro Naito, Takao Yasui, Masateru Taniguchi, Tomoji Kawai, Yoshinobu Baba: MICROMACHINES, 9 (4) (2018) 180-.

[5]Atomically flat platinum films grown on synthetic mica, Hiroyuki Tanaka, Masateru Taniguchi: JAPANESE JOURNAL OF APPLIED PHYSICS, 57 (4) (2018) 48001-.

[6]Identifying Single Viruses Using Biorecognition Solid-State Nanopores, Akihide Arima, Ilva Hanun Harlisa, Takeshi Yoshida, Makusu Tsutsui, Masayoshi Tanaka, Kazumichi Yokota, Wataru Tonomura, Jiro Yasuda, Masateru Taniguchi, Takashi Washio, Mina Okochi, Tomoji Kawai: JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, 140 (48) (2018) 16834-16841.

[7]Selective detections of single-viruses using solid-state nanopores, Akihide Arima, Makusu Tsutsui, Ilva Hanun Harlisa, Takeshi Yoshida, Masayoshi Tanaka, Kazumichi Yokota, Wataru Tonomura, Masateru Taniguchi, Mina Okochi, Takashi Washio, Tomoji Kawai: SCIENTIFIC REPORTS, 8 (2018) 16305-.

[8]Temporal Response of Ionic Current Blockade in Solid-State Nanopores, Makusu Tsutsui, Kazumichi Yokota, Akihide Arima, Wataru Tonomura, Masateru Taniguchi, Takashi Washio, Tomoji Kawai: ACS APPLIED MATERIALS & INTERFACES, 10 (40) (2018) 34751-34757.

[9]Electrical Nucleotide Sensor Based on Synthetic Guanine-Receptor-Modified Electrodes, Takahito Ohshiro, Rajiv Kumar Verma, Kazumichi Yokota, Makusu Tsutsui, Sanjukta Mukherjee, Tomoji Kawai, Kazuhiko Nakatani, Masateru Taniguchi: ChemistrySelect, 3 (13) (2018) 3819-3824.

[10]Quadrupole-electrode-integrated micropores for selective single-particle detections, Tomoki Hayashida, Takahito Ohshiro, Makusu, Tsutsui, Masateru Taniguchi: 2018 IEEE Electron Devices Technology and Manufacturing Conference, (2018) 307-.

[11]Particle Capture in Solid-State Multipores, Makusu Tsutsui, Kazumichi Yokota, Tomoko Nakada, Akihide Arima, Wataru Tonomura, Masateru Taniguchi, Takashi Washio, Tomoji Kawai: ACS Sensors, 3 (12) (2018) 2693-2701.

[12] New Year Roundtable, Discussions on Japanese Chemistry Entering a New Era, Naoki Sugimoto, Michinori Suginome, Masateru Taniguchi: Chemistry, 74 (1) (2019) 12-17.

[13]PM2.5 Particle Detection in a Microfluidic Device by Using Ionic Current Sensing, Taisuke Shimada, Hirotoshi Yasaki, Takao Yasui, Takeshi Yanagida, Noritada Kaji, Masaki Kanai, Kazuki Nagashima, Tomoji Kawai, Yoshinobu Baba: Analytical Sciences, 34 (12) (2018) 1347-1349.

[14]Biomolecular recognition on nanowire surfaces modified by the self-assembled monolayer, Taisuke Shimada, Takao Yasui, Asami Yokoyama, Tatsuro Goda, Mitsuo Hara, Takeshi Yanagida, Noritada Kaji, Masaki Kanai, Kazuki Nagashima, Yuji Miyahara, Tomoji Kawai, Yoshinobu Baba: Lab on a Chip, 18 (21) (2018) 3225-3229.

[15]A real-time simultaneous measurement on a microfluidic device for individual bacteria discrimination, Hirotoshi Yasaki, Takao Yasui, Takeshi Yanagida, Noritada Kaji, Masaki Kanai, Kazuki Nagashima, Tomoji Kawai, Yoshinobu Baba: Sensors and Actuators B-Chemical, 260 (2018) 746-752.

[16]Atomic force microscopy analysis of SasA-KaiC complex formation involved in information transfer from the KaiABC clock machinery to the output pathway in cyanobacteria, Reiko Murakami, Hitomi Hokonohara, Dock-Chil Che, Tomoji Kawai, Takuya Matsumoto, Masahiro Ishiura: Genes to Cells, 23 (4) (2018) 294-306.

International Conferences
[1]Smart Nanopores to Identify Single Viruses and Bacteria (invited), Masateru Taniguchi: The First International Joint Symposium of CEFMS-NCTU, RCAS-AS (Taiwan) and 5-Star Alliance (Japan).

[2]Smart nanopores to identify bacteria and viruses (invited), Masateru Taniguchi, Takashi Washio, Tomoji Kawai: 10th International Symposium on Organic Molecular Electronics(ISOME2018).

[3]Smart Biosensing Technologies (invited), Masateru Taniguchi: 7th imec Handai International Symposium.

[4]MULTIMODAL RESISTIVE PULSE ANALYSIS USING A LOW-ASPECTRATIO NANOPORE (oral), Makusu Tsutsui, Takeshi Yoshida, Masayoshi Tanaka, Kazumichi, Yokota, Akihide Arima, Wataru Tonomura, Masateru Taniguchi, Mina Okochi, Takashi Washio, Tomoji Kawai: The Twenty Second International Conference on Miniaturized Systems for Chemistry and Life Sciences (μTAS 2018).

[5]CHARACTERIZATION OF SINGLE-VIRUSES AT A SINGLE-PARTICLE LEVEL USING A NANOPORE MODIFIED WITH SUGAR CHAINS (oral), Akihide Arima, Yukichi Horiguchi, Makusu Tsutsui, Wataru Tonomura, Kazumichi Yokota, Masateru Taniguchi, Yuji Miyahara, Tomoji Kawai: The Twenty Second International Conference on Miniaturized Systems for Chemistry and Life Sciences (μTAS 2018).

[6]Multimodal Resistive Pulse Analysis (oral), Makusu Tsutsui, Kazumichi Yokota, Akihide Arima, Wataru Tonomura, Masayoshi Tanaka, Mina Okochi, Masateru Taniguchi, Takashi Washio and Tomoji Kawai: 2018 MRS Fall Meeting & Exhibit.

Patents
[1]K20180453 Current measurement method, 2019-063813

[2]K20170400 PU classification device, PU classification method, and PU classification program, 2018-087641

[3]K20180050 Flow path, 2018-131885

[4]K20180200 Electrode substrate, 2018-208860

[5]K20180049 Channel, method of manufacturing channel, electrode structure, and method of manufacturing electrode structure, 2018-131884

[6]K20180201 Electrode adjustment method and electrode adjustment apparatus, 2018-208861

[7]K20170356 Sequencing method and sequencing apparatus, 2018-086934

[8]K20180025 Stress determination method, virus counting method and stress determination device, 2018-135961

[9]K20170355 Current value data acquisition method and current measurement device, 2018-081704

[10]K20180265 Sample identification method, sample identification device, and sample identification device, 2018-241363

[11]G20170182WO Identification method, classification analysis method, identification device, classification analysis device and storage medium, PCT/JP2018/014926

[12]G20180084WO Calibration method of electrode pair, PCT/JP2019/004864

[13]G20170194WO How to make electrode, PCT/JP2018/017002

[14]G20180085WO Current measurement method, PCT/JP2019/004865

[15]G20180164WO PU classification device, PU classification method, and PU classification program, PCT/JP2019/013650

[16]G20170173TW Channel device and particulate concentration method, 107116514

[17]G20170173WO Channel device and particulate concentration method, PCT/JP2018/017992

[18]G20170193WO substrate, PCT/JP2018/017001

Grant-in-Aid for Scientific Research

M. Taniguchi	Single molecule sequencing method by tunneling current	¥31,980,000
M. Tsutsui	Creation of single molecule shape analysis method in liquid using ultrathin nanopore	¥8,450,000
M. Tsutsui	Creation of single molecule tunneling current discrimination method applying molecular orientation control by dielectrophoresis	¥1,430,000
Y. Komoto	Construction of quantitative evaluation method of structural change of single molecule junction using MCBJ method	¥1,560,000
A. Arima	Creation of comprehensive single-cell analysis method using nanopore trap method	¥1,300,000

Entrusted Research

M. Taniguchi	(National Research Institute) Japan Science and Technology Agency	Development of improved solid nanogap nanopores for fourth generation DNA sequencing and single molecule resolution quantitative analysis	¥16,250,000
T. Kawai	(National Research Institute) Japan Science and Technology Agency	Development of InSECT system using nano / micropore	¥187,692,000

Contribution to Research

M. Tsutsui	Asahi Glass Foundation Executive Director Kazuhiko Ishimura	¥1,500,000

Cooperative Research

M. Taniguchi	Daikin Industries Ltd.	¥0,000
M. Taniguchi	Daikin Industries Ltd.	¥16,590,000
M. Taniguchi	Joint company Miraka Central Research Institute	¥0,000

M. Taniguchi	Kirin Corporation	¥0,000
M. Taniguchi	SCREEN Holdings Co., Ltd.	¥0,000
M. Taniguchi	SCREEN Holdings Co., Ltd.	¥24,600,000
M. Taniguchi	ADVANTEST CORPORATION	¥0,000
M. Taniguchi	Toshiba Memory Corporation	¥950,000
M. Taniguchi	NOK Corporation	¥600,000
M. Taniguchi	Kirin Co., Ltd.	¥0,000
M. Taniguchi	National Institute of Advanced Industrial Science and Technology "	¥0,000

Other Research Fund

M.Taniguchi	Kyoto University	¥29,700,000

Department of Nanotechnology for Environmental and Energy Applications

Original Papers

[1]Resist image quality control via acid diffusion constant and/or photodecomposable quencher concentration in the fabrication of 11 nm half-pitch line-and-space patterns using extreme-ultraviolet lithography, T. Kozawa, J. J. Santillan, and T. Itani: Jpn. J. Appl. Phys., 57 (2018) 056501.

[2]Electron-hole pairs generated in ZrO2 nanoparticle resist upon exposure to extreme ultraviolet radiation, T. Kozawa, J. J. Santillan, and T. Itani: Jpn. J. Appl. Phys. , 57 (2018) 026501.

[3]Analysis of dissolution factor of line edge roughness formation in chemically amplified electron beam resist, Takahiro Kozawa: Jpn. J. Appl. Phys. , 57 (2018) 126502.

[4]Dependence of relationship between chemical gradient and line width roughness of zirconia nanoparticle resist on pattern duty, acid generator, and developer, T. Kozawa, A. Nakajima, T. Yamada, Y. Muroya, J. J. Santillan, and T. Itani: Jpn. J. Appl. Phys. , 58 (2019) 036501.

[5]Relationship between Resolution Blur and Shot Noise in Line Edge Roughness Formation of Chemically Amplified Resists Used for Extreme-Ultraviolet Lithography, Takahiro Kozawa, Julius Joseph Santillan, Toshiro Itani: J. Photopolym. Sci. Technol., 31 (2018) 183-188.

International Conferences

[1]Stochasticity in EUV lithography (oral), T. Kozawa, J.J.Santillan, T. Itani: 16th FRAUNHOFER IISB.

[2]Material design for the improvement of ZEP520A performance (oral), T. Kozawa, A. Nakajima, M. Hoshino, M. Hashimoto: SPIE Photomask Technology and Extreme Ultraviolet Lithography.

[3]Pattern formation mechanism of zirconia nanoparticle resist used for extreme-ultraviolet lithography, (oral), T. Kozawa, T. Yamada, S. Ishihara, H. Yamamoto, Y. Muroya, J. J. S. Santillan, Toshiro Itani: SPIE Photomask Technology and Extreme Ultraviolet Lithography.

[4]Analysis of line-and-space patterns of ZrO2 nanoparticle resist on the basis of EUV sensitization mechanism (oral), T. Kozawa, T. Yamada, Y. Muroya, J. J. Santillan, T. Itani: SPIE ADVANCED LITHOGRAPHY 2019.

Contributions to International Conferences and Journals

Takahiro Kozawa	31st International Microprocesses and Nanotechnology Conference (Organaizing Committtee)
Takahiro Kozawa	31st International Microprocesses and Nanotechnology Conference (Steering Committtee Chair)
Takahiro Kozawa	32nd International Microprocesses and Nanotechnology Conference (Organizing Committee Vice Chair)
Takahiro Kozawa	2018 International Symposium on Extreme Ultraviolet Lithography (Steering

Committee)

Publications in Domestic Meetings

NGL2018 1 paper

2018 Academic Lecture of The Japan Society of Vacuum and Surface Science 1 paper

Department of Nano-Intelligent Systems

Original Papers

[1]Highly biocompatible super-resolution fluorescence imaging using the fast photoswitching fluorescent protein Kohinoor and SPoD-ExPAN with Lp-regularized image reconstruction, T. Wazawa, Y. Arai, Y. Kawahara, H. Takauchi, T. Washio and T. Nagai: Microscopy, 67 (2) (2018) 89-98.

[2] Elucidation of the Strongest Predictors of Cardiovascular Events in Patients with Heart Failure, H. Fukuda, K. Shindo, M. Sakamoto, T. Ide, S. Kinugawa, A. Fukushima, H. Tsutsui, S. Ito, A. Ishii, T. Washio, M. Kitakaze: EBioMedicine, 33 (-) (2018) 185-195.

[3] Analysis of nanomechanical sensing signals; physical parameter estimation for gas identification, G. Imamura, K. Shiba, G. Yoshikawa and T. Washio: AIP (American Institute of Physics) Advances, 8 (-) (2018) 075007.

[4]Lowest probability mass neighbour algorithms: relaxing themetric constraint in distance-based neighbourhoodalgorithms, K. M. Ting, Y. Zhu, M. Carman, Y. Zhu, T. Washio and ZH Zhou: Machine Learning, 108 (2) (2019) 331–376.

[5]Selective detections of singleviruses using solid-state nanopores, A. Arima, M. Tsutsui, I. H. Harlisa, T. Yoshida, M. Tanaka, K. Yokota, W. Tonomura, M. Taniguchi, M. Okochi, T. Washio, and T. Kawai: Scientific Reports, 8 (-) (2018) 16305.

[6]Identifying Single Viruses Using Biorecognition Solid-State Nanopores, A. Arima, I. H. Harlisa, T. Yoshida, M. Tsutsui, M. Tanaka, K. Yokota, W. Tonomura, J. Yasuda, M. Taniguchi, T. Washio, M. Okochi and T. Kawai: J. Am. Chem. Soc., 140 (-) (2018) 16834−16841.

[7]Analysis of cause-effect inference by comparing regression errors, P. Blobaum, D. Janzing, T. Washio, S. Shimizu and B. Scholkopf: PeerJ Comput. Sci., 5 (-) (2019) e169.

[8]Identifying Single Particles in Air Using a 3D-Integrated Solid-State Pore, M. Tsutsui, K. Yokota, T. Yoshida, C. Hotehama, H. Kowada, Y. Esaki, M. Taniguchi, T. Washio, and T. Kawai: ACS Sens., Article ASAP, 4 (3) (2019) 748–755.

International Conferences

[1]Cause-Effect Inference by Comparing Regression Errors, Patrick Bloebaum, Dominik Janzing, Takashi Washio, Shohei Shimizu, Bernhard Schoelkopf: Proc. AISTATS2018:The 21st International Conference on Artificial Intelligence and Statistics, Proc. 2018 (-) (2018) No.298.

Review Papers

New Development of Analysis Method on Olfactory Sensing Data, G. Imamura, G. Yoshikawa and T. Washio, Journal of Japan Association on Odor Environment, Journal of Japan Association on Odor Environment, 49[5] (2018), 315-322.

Patents

[1]K20170400 PU classification equipment, PU classification method, and PU classification program, 2018－87641

[2]K20180050 Flow path, 2018-131885

[3]G20170182WO Identification method, classification analysis method, identification equipment, classification analysis equipment and storage medium, WO2018/207524

[4]G20180164WO PU classification equipment, PU classification method, and PU classification program, PCT/JP2019/013650

Publications in Domestic Meetings

The 66th JSAP Spring Meeting	1 paper
The 99th CSJ Annual Meeting	1 paper
139th Annual Meeting of the Pharmaceutical Society of Japan	1 paper

Grant-in-Aid for Scientific Research

T. Washio	Study on Principles and Methods for Large Scale Causal Inference Based on Nonlinearity	¥1,300,000

Entrusted Research

T. Washio	Japan Science and Technology Agency	Exploration of Novel Measurement and Analysis Approaches by Deep Synthesis and Investigation of Machine Learning and Advanced Measurement Technologies	¥28,730,000

Cooperative Research

T. Washio	National Institue for Materials Science	¥0,000

Department of Nanodevices for Medical Applications

Original Papers

[1]Automated Single-Cell Analysis and Isolation System: A Paradigm Shift in Cell Screening Methods for Bio-medicines., K. Tatematsu, S. Kuroda: Adv Exp Med Biol, 1068 (2018) 7-17.

[2]Oriented immobilization to nanoparticles enhanced the therapeutic efficacy of antibody drugs., M. Iijima, K. Araki, Q. Liu, M. Somiya, S. Kuroda: Acta Biomater, 86 (2019) 373-380.

[3]Robo2 contains a cryptic binding site for neural EGFL-like (NELL) protein 1/2, N. Yamamoto M. Kashiwagi, M. Ishihara, T. Kojima, A. D. Maturana, S. Kuroda, T. Niimi: J Biol Chem, 294 (12) (2019) 4693-4703.

International Conferences

[1]Development of Macrophage-targeting and Phagocytosis-inducing Bio-nanocapsule-based DDS Nanocarrier (poster), H. Li, M. Somiya, S. Kuroda: 2018 Annual Meeting of Controlled Release Society.

[2]Identification of hepatitis B virus-derived heparin-binding domain: application for liposomal drug delivery. (poster), Q. Liu, M. Somiya, S. Kuroda: 2018 Annual Meeting of Controlled Release Society.

Review Papers

[1]細胞・生体分子の固定化と機能発現, CMC Publishing Co.,Ltd, 1, 2018, .

[2]ドラッグデリバリーシステム-バイオ医薬品創成に向けた組織，細胞内，核内送達技術の開発-, CMC Publishing Co.,Ltd , 2, 2018, .

[3]CSJ カレントレビュー　生命機能に迫る分子化学, KAGAKUDOJIN, 30, 2018, .

Patents

[1] 核酸を内封してなる中性又はアニオン性リポソーム及びその製造方法, P6404034

[2] Method for quantification of odor, the cell used therefor and method for producing the cell JP2017-157492

Grant-in-Aid for Scientific Research

S. Kuroda	Development of neo-bionanocapsule for various in vivo targets	¥35,490,000
S. Kuroda	Development of human olfactory receptor-expressing cell array for quantification of all odorant molecules	¥18,200,000

Entrusted Research

S. Kuroda	University of the Ryukyus (OSTC)	Establishment of human-derived antibody against human T-cell leukemia virus	¥990,000
S. Kuroda	University of the Ryukyus (OSTC)	Development of human olfactory receptor-based sensor for sensing shochu flavors	¥351,000
S. Kuroda	University of the Ryukyus (AMED)	Development of antibody drug aiming prevention of HTLV-1 mother-to-child infection and evaluation its medicinal effect using primate model	¥1,950,000

Contribution to Research

S. Kuroda	Nippon Bartenders' Association	¥30,000
S. Kuroda	Suntory Global Innovation Center Limited	¥700,000
S. Kuroda	Prof. Shuji Hinuma	¥300,000

Cooperative Research

S. Kuroda	Soda Aromatic Co., Ltd.	¥2,431,000
S. Kuroda	Maruho Hatsujyo Kogyo Co., Ltd.	¥10,400,000
S. Kuroda	Toshiba Co., Tokyo University of Agriculture	¥1,080,000
S. Kuroda	Meiji Seika Pharma Co., Ltd.	¥2,606,000
S. Kuroda	University of the Ryukyus	¥762,000
S. Kuroda	Kyoto Prefectural Police	¥0,000

Other Research Fund

S. Kuroda	Suntory Global Innovation Center Limited	¥278,000

Nanotechnology Open Facilities

Comprehensive Analysis Center

Original Papers

[1]Optimization of sucrose 1'-position modification with 3-(trifluoromethyl)diazirinyl benzylbromide derivatives for photoaffinity labelling, L. Wang, Z. P. Tachrim, N. Kurokawa, F. Ohashi, H. Wakasa, Y. Sakihama, Y. Hashidoko, T. Suzuki and M. Hashimoto: ARKIVOC, (2018) 58-65.

[2]Synthesis of [6]helicene-based sulfonic acid, sulfonamide and disulfonimides, T. Tsujihara, S. Endo, T. Takehara, T. Suzuki, S. Tamura and T. Kawano: Tetrahedron Lett, 59 (2018) 2450-2453.

[3]N,N-Dimethylformamide-stabilized palladium nanoclusters as a catalyst for Larock indole synthesis, K. Onishi, K. Oikawa, H. Yano, T. Suzuki and Y. Obora: RSC Adv., 8 (2018) 11324-11329.

[4]pH Stability and Antioxidant Power of CycloDOPA and Its Derivatives, S. Nakagawa, Z. Tachrim, N. Kurokawa, F. Ohashi, Y. Sakihama, T. Suzuki, Y. Hashidoko and M. Hashimoto: Molecules, 23 (2018) 1943.

[5]Solution Synthesis of N,N-Dimethylformamide-Stabilized Iron-Oxide Nanoparticles as an Efficient and Recyclable Catalyst for Alkene Hydrosilylation, R. Azuma, S. Nakamichi, J. Kimura, H. Yano, H. Kawasaki, T. Suzuki, R. Kondo, Y. Kanda, K.-i. Shimizu, K. Kato and Y. Obora: ChemCatChem, 10 (2018) 2378-2382.

[6]Reusable Immobilized Iron(II) Nanoparticle Precatalysts for Ligand-Free Kumada Coupling, T. Akiyama, Y. Wada, K. Jenkinson, T. Honma, K. Tsuruta, Y. Tamenori, H. Haneoka, T. Takehara, T. Suzuki, K. Murai, H. Fujioka, Y. Sato, A. E. H. Wheatley and M. Arisawa: ACS Appl. Nano Mater., 1 (2018) 6950-6958.

International Conferences

[1]Catalytic Asymmetric Synthesis of Cedarmycins Using Chiral Iridium Complex (poster), T. Suzuki, Ismiyarto,T. Doi, N. Kishi, D. Zhou, K. Asano, Y. Obora, H. Sasai: Tetrahedron symposium.

[2]N,N-dimethylformamide-stabilized Palladium Nanoparticles (poster), M. Nakatsuji, S. Itoh, T. Suzuki, Y. Obora: IKCOC14.

[3]Catalytic Asymmetric Synthesis of Cedarmycins using chiral Ir complex (poster), T. Suzuki, Ismiyarto,T. Doi, N. Kishi, D. Zhou, K. Asano, Y. Obora, H. Sasai: 22ICOS.

[4]Asymmetric Synthesis of Catalponol Using Chiral Iridium Catalyst (invited), T. Suzuki, Ismiyarto, D. Zhou, K. Asano, H. Sasai: 18ICOC.

[5]DMF-protected Fe-Pt bimetallic nanoparticles catalyst for olefin hydrosilylation (poster), T. Tanaka, R. Azuma, X. Lin, R. Kondo, T. Suzuki, Y. Obora: Catalysis and Fine Chemicals 2018.

Review Papers

Recent advances in the desymmetrization of meso-dials, T. Suzuki, J. Synth. Org. Chem., Jpn., 76, 810-819 , 2018.

Publications in Domestic Meetings

138th annual meeting of the pharmaceutical soceity of Japan	1 paper
68th Kinki branch meeting of the pharmaceutical soceity of Japan	1 paper
98th annual meeting of the chemicall soceity of Japan	3 papers
Molecular Chirality 2018	1 paper
22th silicon chemistry society symposium	1 paper
8th CSJ Chemistry Festa	1 paper

Grant-in-Aid for Scientific Research

T.Suzuki	Development and application of asymmetric redox cascade reaction using iridium catalyst	¥1,430,000

Cooperative Research

T.Suzuki	Nitto Kasei Corporation	¥600,000
T.Suzuki	Panasonic Corporation	¥552,000

Other Research Fund

T.Suzuki	Institute o Molecular Science (Inter-University Network for Common Utilization of Research Equipments)	¥1,887,000

Reserch Laboratory for Quantum Beam Science

Original Papers

[1]Influence of Charge Distribution on Structural Changes of Aromatic Imide Derivatives upon One-Electron Reduction Revealed by Time-Resolved Resonance Raman Spectroscopy during Pulse Radiolysis, Zhuang, Bo, M. Fujitsuka, S. Tojo, D. W. Cho, J. Choi, T. Majima: Journal of Physical Chemistry A, 122 (44) (2018) 8738-8744.

[2]Donor-Donor'-Acceptor Triads Based on [3.3]Paracyclophane with a 1,4-Dithiafulvene Donor and a Cyanomethylene Acceptor: Synthesis, Structure, and Electrochemical and Photophysical Properties, K. Sako, T. Hasegawa, H. Onda, M. Shiotsuka, M. Watanabe, T. Shinmyozu, S. Tojo, M. Fujitsuka, T. Majima, T.Hirao: Chemistry - A European Journal, 24 (44) (2018) 11407-11416.

[3]Pulse Radiolysis of TIPS-Pentacene and a Fluorene-bridged Bis(pentacene): Evidence for Intramolecular Singlet-Exciton Fission, J. K. G. Karlsson, A. Atahan, A. Harriman, S. Tojo, M. Fujitsuka, T. Majima: Journal of Physical Chemistry Letters, 9 (14) (2018) 3934–3938.

Publications in Domestic Meetings

28th Annual Meeting of MRS-J	1 paper

Grant-in-Aid for Scientific Research

S.Tojo	New function expression and mechanism of quantum beam induced reactions in heterogeneous system	¥2,600,000

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