Strategic Basic Research Programs

CREST

Core Research for Evolutional Science and Technology

2011-2012

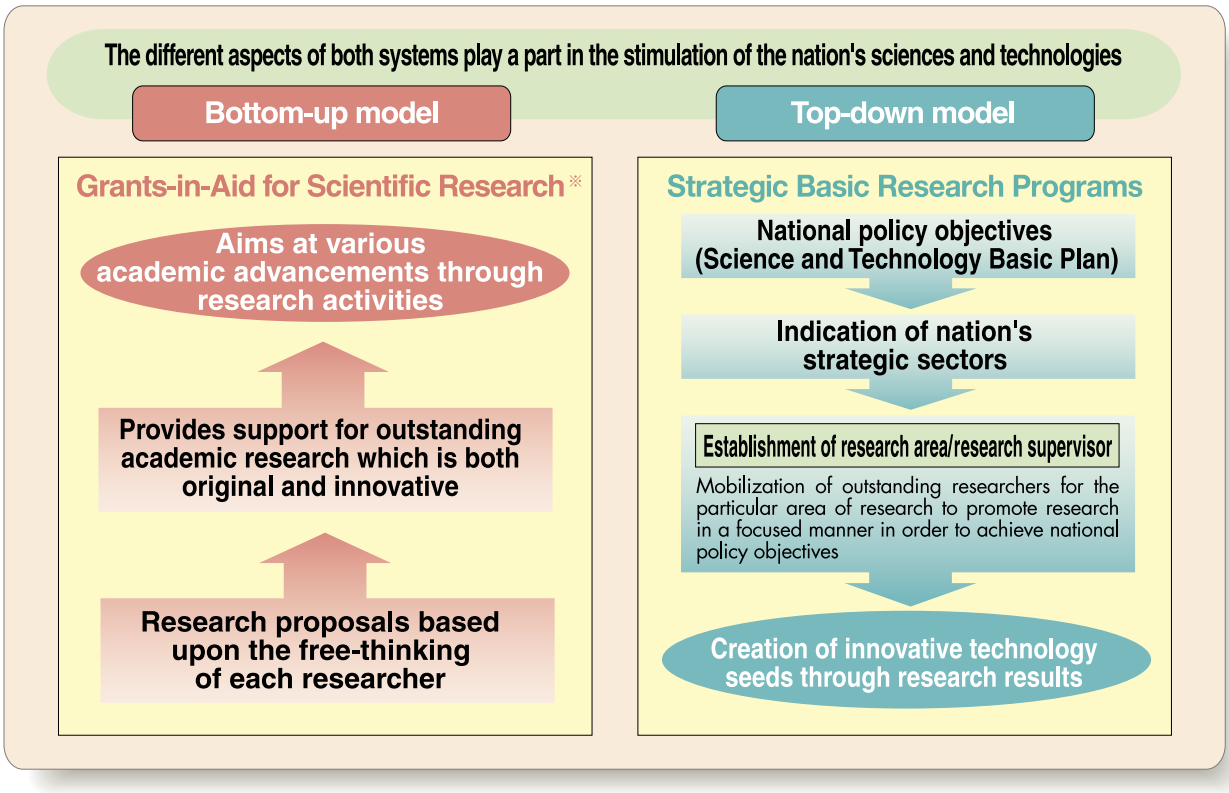
Japan Science and Technology Agency

■ http://www.jst.go.jp/EN/ ■ http://www.jst.go.jp/kisoken/crest/en/

Strategic Basic Research Programs

– Carry out basic researches, as top-down program, with a view to achieving the national government policy objectives.
– Aim to bring out the seeds of new technology, which can contribute to the development of industry and society. The participants in each research are selected from a variety of organizations such as universities, public research institutes and industry, and then the research community work together to achieve the goal beyond the affiliation for a limited period of time.
– Are a counterpart to Grants-in-Aid for Scientific Research as bottom-up model, places value on the voluntary proposals from individual researchers.

Top-down and Bottom-up Research Programs



※Grants-in-Aid for Scientific Research : The grants are allocated by MEXT and Japan Society for the Promotion of Science (JSPS).

CONTENTS

What is CREST?

Gist

Given Japan's ambition to become a nation of science and technology innovation, creative research is subject to ever-growing expectation. In CREST team-based research, JST forms research teams and promotes research with a view to meeting strategic sectors established by the government.

Outline

Strategic sectors

In line with national science and technology policies, as well as social and economic needs, the government (MEXT) sets targets that are expected to have a major social impact (strategic sectors). These strategic sectors show the forms in which future research results will be useful to society.

Research areas

JST establishes research areas that are to be promoted under the strategic sectors.

Research supervisors

Acting as heads of "virtual institutes", research supervisors manage their respective research areas in a number of ways, to promote research aimed at meeting the strategic sectors. This includes deciding the projects to be selected, coordinating research plans (including research budgets and research team composition), exchanging opinions with researchers, giving advice for research, and evaluating research projects.

From invitation of proposals to the start of the research

Research proposals are invited for each research area. With the assistance of research area advisors, research supervisors select research projects through a combination of documentary and interview selection.

Research directors and research teams

The directors of the selected research organize the most suitable research team (a group of researchers, research assistants and others needed to conduct the research). They may consist of up to around 20 researchers, whether from the industrial, academic or public sector, who carry out the research project. Research directors have overall responsibility for the research (such as carrying out the research, administering and managing funds, and handling results) throughout the research period.

Research period

The research period is up to 5 years.

Research agreements

As a rule, JST concludes a research agreement with the research institute to which the respective researchers belong.

Research budgets

Research budgets for 5-year projects are on a scale of around 40 to 120 million yen per year. This covers the cost of equipment, materials and travel, as well as the cost of holding workshops and symposia, etc. In research areas launched up to FY2003, JST mainly administered these research budgets by purchasing materiel, which it then delivered to the research institutes. For research areas launched from FY2004 onwards, however, purchasing is basically commissioned to the research institutes, which then administer the whole amount of the research budget. Indirect costs are limited to 30% of the budget administered by the research institute.

Intellectual property rights

Intellectual property rights arising from research based on research agreements basically belong to the research institutes.

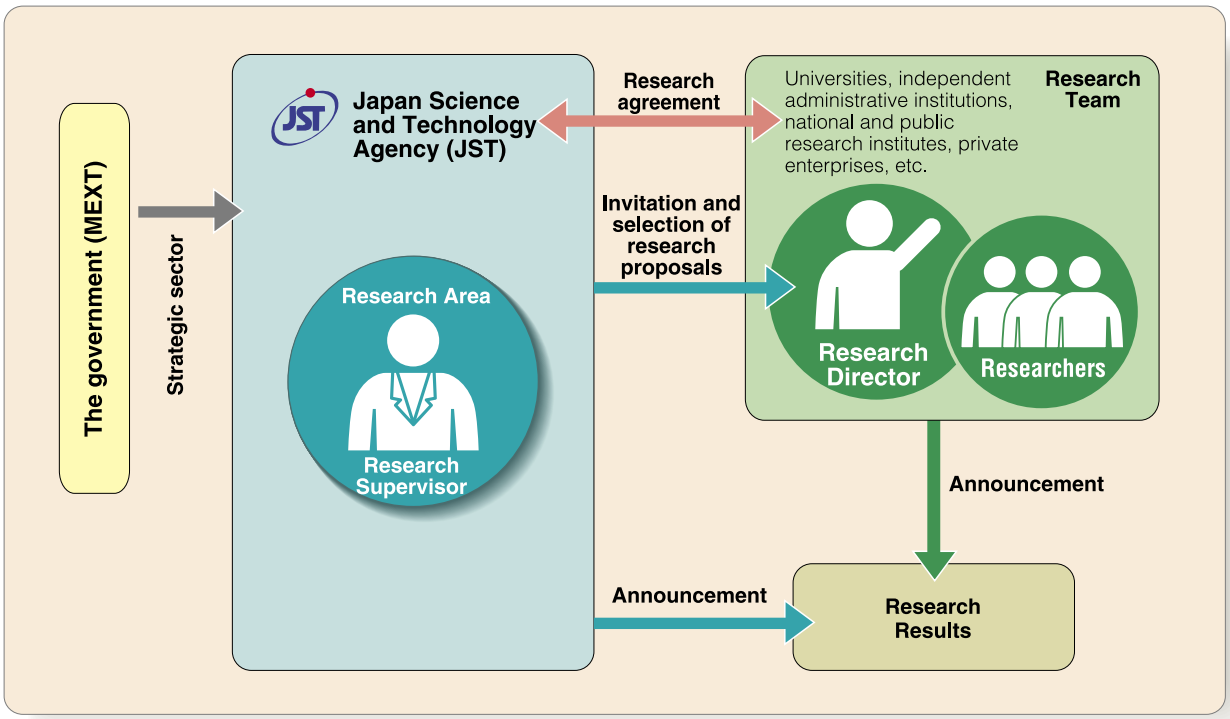
Research results and evaluation

The research results arising from this system are publicly disclosed with a view to making them useful to society.

About three years after the beginning of the research period, research is subjected to midterm evaluation. For this, research supervisors, research area advisors and others evaluate the progress of the research, as well as the ongoing situation and future prospects for the research results. Post-evaluation is undertaken on completion of the research, and follow-up evaluation is also carried out. The evaluation results are also disclosed.

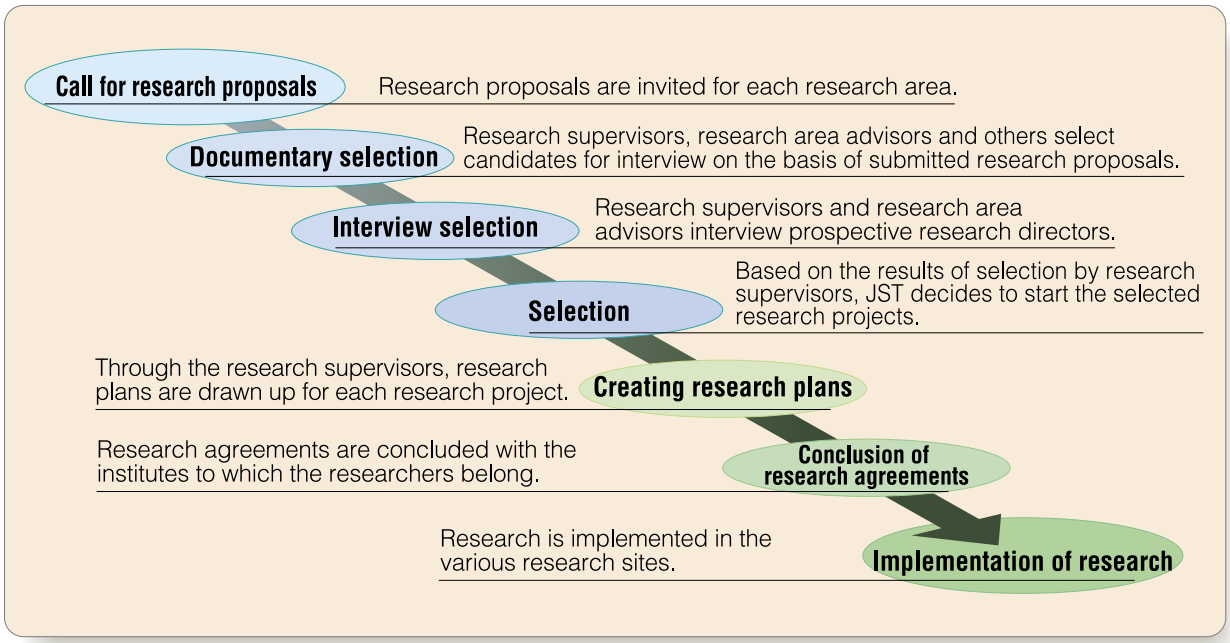
Flow of CREST

Research proposals are invited and selected, research agreements are concluded with the institutes to which the researchers belong, and the research is promoted.



From research proposals to the start of the research

Details of Information about the deadline for proposals, and an outline of the invitation are published on the JST website (http://www.jst.go.jp/EN/index.html).



Introduction of Research Area

Ongoing Research Areas: 35 Research Areas, 460 Research Projects(397(on-going) + 63(completed))

First Year	Research Area	Research Supervisor
FY 2011	Phase Interface Science for Highly Efficient Energy Utilization	Nobuhide KASAGI Deputy Research Supervisor Kazuhito HASHIMOTO
	Creation of Essential Technologies to Utilize Carbon Dioxide as a Resource through the Enhancement of Plant Productivity and the Exploitation of Plant Products	Akira ISOGAI
	Establishment of Core Technology for the Preservation and Regeneration of Marine Biodiversity and Ecosystems	Isao KOIKE
	Development of Fundamental Technologies for Diagnosis and Therapy Based upon Epigenome Analysis	Masayuki YAMAMOTO Deputy Research Supervisor Toshikazu USHIJIMA
	Creation of Fundamental Technologies for Understanding and Control of Biosystem Dynamics (※)	Tadashi YAMAMOTO
FY 2010	The Creation of Basic Medical Technologies to Clarify and Control the Mechanisms Underlying Chronic Inflammation	Masayuki MIYASAKA
	Development of System Software Technologies for Post-Peta Scale High Performance Computing	Akinori YONEZAWA
	Creation of Innovative Functions of Intelligent Materials on the Basis of the Element Strategy	Kohei TAMAO
	Creation of Basic Technology for Improved Bioenergy Production through Functional Analysis and Regulation of Algae and Other Aquatic Microorganisms	Tadashi MATSUNAGA
FY 2009	Creation of Human-Harmonized Information Technology for Convivial Society	Yoh'ichi TOHKURA
	Creative Research for Clean Energy Generation Using Solar Energy	Masafumi YAMAGUCHI
	Elucidation of the Principles of Formation and Function of the Brain Neural Network and Creation of Control Technologies	Seiji OZAWA
	Innovative Technology and System for Sustainable Water Use	Shinichiro OHGAKI Deputy Research Supervisor Mikio YODA
FY 2008	Fundamental Technologies for Medicine Concerning the Generation and Regulation of Induced Pluripotent Stem (iPS) Cells	Toshio SUDA
	Enhancing Applications of Innovative Optical Science and Technologies by Making Ultimate Use of Advanced Light Sources	Tadashi ITOH
	Creation of Nanosystems with Novel Functions Through Process Integration	Jun'ichi SONE
	Development of High-performance Nanostructures for Process Integration	Masahiro IRIE
	Creation of Innovative Technologies to Control Carbon Dioxide Emissions	Itaru YASUI
	Etiological Basics of and Techniques for Treatment of Allergic and Autoimmune Diseases	Kazuo SUGAMURA
FY 2007	Alliance for Breakthrough between Mathematics and Sciences (ABMS)	Yasumasa NISHIURA
	Creation of a Novel Technology towards Diagnosis and Treatment Based on Understanding of Molecular Pathogenesis of Psychiatric and Neurological Disorders	Teruhiko HIGUCHI
	Fundamental Technologies for Dependable VLSI System	Shojiro ASAI
	Research of Innovative Material and Process for Creation of Next-generation Electronics Devices	Hisatsune WATANABE
FY 2006	The Dynamic Mechanism of and Fundamental Technology for Biological System	Shigetada NAKANISHI
	Dependable Operating Systems for Embedded Systems Aiming at Practical Applications	Mario TOKORO Deputy Research Supervisor Yoichi MURAOKA
	Development of the Foundation for Nano-Interface Technology	Seiji SHINKAI
	Establishment of Innovative Manufacturing Technology Based on Nanoscience	Yasuhiro HORIIKE
FY 2005	Advanced Integrated Sensing Technologies	Kiyoshi ITAO
	Technology Innovation and Integration for Information Systems with Ultra Low Power	Takashi NANYA
	High Performance Computing for Multi-Scale and Multi-Physics Phenomena	Genki YAGAWA
	Basic Technologies for Controlling Cell Functions Based on Metabolic Regulation Mechanism Analysis	Masahiro NISHIJIMA
	Photonics and Quantum Optics for the Creation of Innovative Functions	Tatsuo IZAWA
FY 2004	Novel Measuring and Analytical Technology Contributions to the Elucidation and Application of Material	Michiyoshi TANAKA
	Novel Measuring and Analytical Technology Contributions to the Elucidation and Application of Life Phenomena	Toshio YANAGIDA
	Foundation of Technology Supporting the Creation of Digital Media Contents	Hiroshi HARASHIMA

Completed Research Areas(37 Research Areas, 533 Research Projects) are listed on page 76.

※Research projects of the Research Area "Creation of Fandamental Technologies for Understanding and Control of Biosystem Dynamics" will be selected from FY2012

The reported research affiliations are as of Oct. 1, 2011.

	Project	Strategic Sector	Call for Proposals	Page
	5	To realize breakthroughs in phase-interface phenomena and create basic technologies for high-functionality interface that will result in dramatic advancements in highly-efficient energy utilization	Open	P.8
	4	Creation of basic technologies for utilizing plant photosynthetic functions and biomass that will enable the actualization of efficient carbon dioxide utilization		P.9
	5	Creation of basic technologies for understanding marine ecology highly efficiently and forecasting marine life changes to conserve and regenerate the marine biodiversity required for sustainable usage of ocean resources		P.10
	9	Creation of the basic technologies for disease analysis and elucidation of stem cell differentiation mechanisms by using epigenomic comparison toward the realization of treatments and regenerative medicine used to prevent, diagnose, and treat diseases		P.11
	0	Creation of the technology systems to have absolute control of cells and cell populations by reproducing cell kinetics in silico/in vitro in order to achieve an integrated understanding of life phenomena and realize safe and highly effective treatments among other benefits		——
	13	Creation of basic medical technologies for the prevention, diagnosis and treatment of cancer, arteriosclerotic diseases, and autoimmune disorders by the elucidation of the mechanisms underlying chronic inflammation	Open	P.13
	10	Creation of Basic Technologies for System Software Essential to Massive Parallel Processing (MPP) Computation with Manycore and other Processors		P.15
	9	Creation of innovative function of materials by application of nanoscale material structural control technologies, such as controlling the atomic arrangement, towards the practical use of rare-metal-free materials and new targeted functions, such as ultra-high coercivity and ultra-high fracture toughness		P.17
	10	Establishment of basic technologies to create bioenergy from algae and other aquatic microorganisms, including growth rate control and metabolic network construction based on genome analysis and function modification		P.19
	17	Creation of basic technology that enables an information environment that is in harmony with people	Closed	P.21
	15	Creation of natural light energy conversion material and utilization basic technology through the fusion of different fields		P.23
	19	Clarification of the control mechanisms of neural circuit operation and its formation		P.25
	17	Development of innovative technologies for realizing sustainable water management by mitigating water problems intensified by climate change		P.27
	23	Creation of innovative basic medical technologies by stem cell manufacturing and control based on cell reprogramming	Closed	P.29
	16	Enhancing advanced materials science and life science toward innovations using new light sources, including state-of-the-art laser technology		P.32
	16	Creation of next-generation nanosystems through process integration		P.34
	16			P.36
	15	Creation of innovative technologies related to reducing global warming in an effort to realize a sustainable society		P.38
	15	Development of medical technology using immunoregulation to overcome allergic and autoimmune diseases including pollinosis		P.40
	13	Search for breakthrough by mathematical / mathematical sciences researches toward the resolution of issues with high social needs (Focusing on collaboration with wide research fields in science and technology)	Closed	P.42
	14	Creation of innovations toward the development of diagnosis and treatment of psychiatric and neurological disorders based on elucidation of complex and higher brain functions		P.44
	11	Development of fundamental technologies for the large-scale integrated-circuit system that can guarantee high reliability and high security		P.46
	18	Exploitation of materials and nanoprocesses for the realization of novel electronic devices with novel concepts, novel functions and novel structures		P.48
	9	Elucidation of the dynamic mechanism of biological system and establishment of fundamental technology	Closed	P.50
	9	Creation of next-generation basic technology achieving high security, hHigh reliability and high performance for embedded systems		P.52
	15	Creation and application of innovative nano-interface technology that achieves high performance from materials and substances in different state		P.54
	16	Development of technologies for highly-efficient manufacturing of nanodevices and nanomaterials, and innovation in manufacturing technology based on nanoscale science		P.56
	15	Creation of advanced integrated sensing technologies for realizing safe and secure societies	Closed	P.58
	12	Creation of ultra-low power technologies to cope with explosive increase in electric power consumption in the future society		P.60
	21	Development of next-generation high-accuracy and high-resolution simulation technology		P.62
	15	Establishment of basic technologies for controlling of cell functions based on metabolic regulation mechanism analysis		P.65
	16	Ultimate and local control of photon and applications		P.67
	16	Creation of basic technology for the realization of leading edge measuring and analytical equipment through the development of new techniques, etc.	Closed	P.68
	14			P.71
	12	Creation of an advanced science and technology which supports the raising of the level of creation of media art		P.73

Promoting Gender Equality

To assure diversity in the field of science and technology, create intellectual property, enhance international competitiveness, etc., promoting gender equality in science and technology has been incorporated in the 3rd Science and Technology Basic Plan and the 2nd Basic Plan for Gender Equality. In this context, JST is also promoting gender equality. As one principle for such activity, JST has declared the aim of "endeavoring to build a society in which a diversity of research personnel, including female researchers, will be given the opportunity to manifest their abilities".

Policy of action

- JST will present role models* for female researchers and technicians as desirable professions.
- JST will encourage people who are trying to pursue a career in science.
- JST will attempt to make a comprehensive response in all of its projects.

* What is a "role model"?
"A person who projects a future vision, and makes use of it when planning his or her own career."
(from "Glossary of Gender Equality Terms" by the Gender Equality Bureau, Cabinet Office)

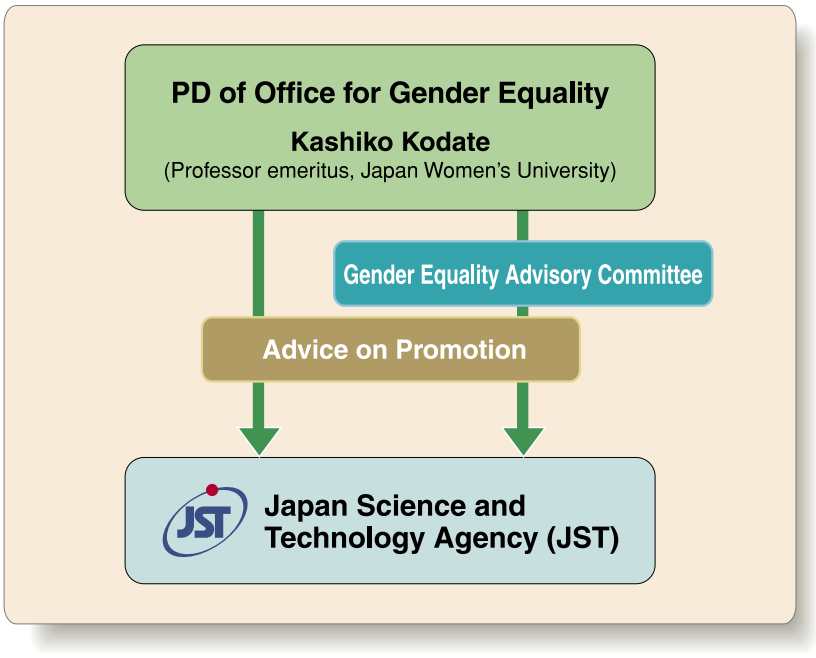
Efforts by JST as a whole

- Formulation of a Gender Equality Promotion Plan concerning JST operations
- Efforts to increase women's involvement in various programs
- Efforts to raise interest in science and technology among young people

Efforts in Basic Research Programs

- Efforts to increase the number of female researchers taking part in Basic Research Programs
- Promotion of measures to support the balance between research and life events (childbirth, childcare and nursing)

System of Promotion



http://www.jst.go.jp/gender/

CREST

CORE RESEARCH FOR EVOLUTIONAL SCIENCE AND TECHNOLOGY

Research Area

Phase Interface Science for Highly Efficient Energy Utilization

Research Supervisor:
Nobuhide KASAGI
Professor, The University of Tokyo

Deputy Research Supervisor:
Kazuhito HASHIMOTO
Professor, The University of Tokyo

FY2011

Interface-region Engineering of High-temperature Electrodes based on in-situ Measurements under Real Operation Conditions

Tatsuya KAWADA
Professor, Tohoku Univerfsity

Solid Oxide Fuel Cell (SOFC) is a flexible and expedient energy conversion system for achieving stable energy supply with low carbon emission. A key technology towards commercialization is the optimization of the electrodes, which, however, is not an easy task because of the complicated processes taking place around the interfaces. The goal of this study is to develop measurement and analysis methods for understanding nano-, micro-, and macro-scale behaviors of the interface region under real operation conditions, and to establish an engineering approach to design the optimum interface for high temperature electrodes.

Multi-Scale and Multi-Physics Approach for Designing Materials and Microstructure of Solid Oxide Fuel Cell Electrodes

Michihisa KOYAMA
Professor, Kyushu University

Reduction of irreversible losses associated with reaction and mass transport is important for higher efficiency of the solid oxide fuel cell (SOFC). This project aims at improving SOFC efficiency by designing better materials and microstructure of electrodes. Toward this goal, intensive collaborations of experimental and simulation approaches will be performed. Drastic performance improvement of SOFC electrodes is challenged from both materials and microstructural aspects by integrating chemistry, mechanical engineering, materials engineering, etc.

Interfacial Meta-Fluidics

Yasuyuki TAKATA
Professor, Kyushu University

Heat and mass transfer at solid-gas-liquid interface, such as evaporation, condensation and adsorption, strongly influences the performance of various energy systems. The present study proposes a new scientific discipline Meta-Fluidics pursuing transcendence of conventional performance of the systems by making use of nanostructures of interface. Optimum design of complex nanosturucture with the aid of knowledge from the meta-fluidics will be capable of creating innovative high-efficiency heat/mass transfer surfaces, which goes beyond the conventional macroscale measure of interface characteristics.

Nanocycle at Nano-in-Macro Interface

Kunio TAKAYANGI
Professor, Tokyo Institute of Technology

Contacts of nano and macro structures, "nano-in-macro", can form specific phases which should govern cyclic transport of ions and electrons moving into and out from the contact phase, "nanocycle". The nanocycle at nano-in-macro is the key issue to be unveiled in order to make devices of a higher efficiency, i.e., lithium ion batteries and catalysts. Nano-in-macro structures and nanocycles are studied by the 50pm electron microscopy of the world best resolution.

Interface Science Inspired Nanoporous Composites for Next-generation Energy Devices

Mingwei CHEN
Professor, Tohoku University

In this study we will develop innovative nanoporous metals and composites for next-generation energy storage/conversion devices that possess both high power density and high energy density, superior to current energy devices, for a wide range of practical applications. The advanced functions of these devices will be achieved by optimizing and manipulating the surfaces and interfaces inside the porous nanoarchitecture on the basis of experimental and theoretical investigations of the unique surface/interface phenomena in the nanoporous materials. By utilizing high-resolution electron microscopy, in-situ Raman spectroscopy and ab-initio simulation, we will pursuit new discoveries in surface/interface science for the improved performances of the energy devices.

Research Area

Creation of Essential Technologies to Utilize Carbon Dioxide as a Resource through the Enhancement of Plant Productivity and the Exploitation of Plant Products

Research Supervisor:
Akira ISOGAI
President, Nara Institute of Science and Technology

Since FY2011

FY2011

Modeling of robust and flexible photosynthesis on the basis of basic research

Toshiharu SHIKANAI
Professor, Kyoto University

Recently Japanese scientists have contributed to the considerable development of the photosynthetic research. The progresses were in the understanding of fundamental mechanism of the light reaction at the level of crystal structure and also in that of the evolutional strategy of terrestrial plants to adapt to the severe environments. On the basis of the progress in the basic science, we try to develop the innovative technology to improve the photosynthesis and also modify the scenario of evolutional strategy of plants. The goal is the modeling of robust and flexible machinery of photosynthesis.

Develpment of stay-green plants through genetic modification of chloroplast functions

Ayumi TANAKA
Professor, Hokkaido University

Genetic modification of plant and organelle genomes sometimes results in retained greeness during leaf senescence in plants. These phenomena are referred to as stay-green. Now that our knowledge on photosynthesis and chloroplast functions is significantly increased, it is possible to explore new strategies to develop new types of stay-green plants. In this project, we aim to produce new stay-green plants that have prolonged photosynthetic activity through the modificatin of the photosythetic machinery, the genetic control of the chloroplast quality, and the improvement of the chloroplast function. In addition, we will attempt to understand the fundamental mechanisms pertaining to the biogenesis, the maintenance and the degradation of the chloroplasts.

Creation of plants having optimal photosynthetic production system in the future global environment

Kouki HIKOSAKA
Professor, Tohoku University

The aim of the present study is to create plants that have optimal photosynthetic production system in the future global environment. We try to identify plant traits and related genes that improve future plant production, from natural variations and artificial mutations showing the highest adapation abilities to the future environmental conditions. Furthermore, we develop a new procedure to select lines with optimal traits without using transgenic techniques.

Development of lignin-derived functional polymers from plants by catalytic reactions responsive to electromagnetic waves

Takashi WATANABE
Professor, Kyoto University

We synthesize new catalysts having affinity to lignin in plant cell walls and absorption properties of electromagnetic waves. We analyze hyperfine molecular structures of whole lignified plant tissues and develop highly efficient lignin-degrading reaction systems using the catalysts and a newly developed electromagnetic wave irradiator, thereby producing linear type lignin and polymerizable monomers. The isolated molecules are purified and converted to functional aromatic polymers with high level of physical strength, solvent tolerance, dispersibility, shock resistance or ultraviolet absorption properties.

Research Area

Establishment of Core Technology for the Preservation and Regeneration of Marine Biodiversity and Ecosystems

Research Supervisor:
Isao KOIKE
Auditor, University of the Ryukyu

FY2011

Development of Remote Species Identification Technologies for Marine Organisms

Tomonari AKAMATSU
Chief researcher, Fisheries Research Agency

Sustainable use of marine bio-resources and protection of environment will be realized if distribution and movement of each aquatic species will be provided on the Internet like a weather forcast. We will develop remote identification technologies of species and numbers of organisms without catching or viewing them. Identification of species and counting number of individuals will be conducted by passive and active sonar systems. The goal of this project is to develop remote identification method for every aquatic species including planktons and whales in the ocean echo system as well as the environmental factors such as human impacts and earthquakes using cutting-edge acoustic technologies.

Synthesis of an Autonomous Underwater vehicle (AUV) Fleet for Bio-sampling Using 3D Reconstructions of the Seafloor

Tamaki URA
Professor, The University of Tokyo

The primary goal of this research is to quantitatively map the volume and the diversity of marine life in the benthic zones near gas hydrates and hydrothermally active sites. By using high performance autonomous underwater vehicles (AUVs) to obtain sub-centimeter order resolution image and bathymetric data from wide areas of the seafloor, the aim is to generate accurate 3D reconstructions of seafloors and their benthos. Furthermore, by performing systematic and regular surveys in this manner, we hope to deepen understanding into the role played by these mineral oases as a habitat for marine life, and through this form a basis for accurate prediction changes in both the volume and diversity of marine life. In order to achieve this, it is necessary to develop a fleet of diverse autonomous underwater systems, each specializing in a particular aspect of each mission, for example performing in situ chemical analysis and sampling of deep-sea macro and micro biology as well as components of their environment. The proposed systems will be deployed in a series of missions in oceanographic regions of interest that are subject to temporal change, such as the hydrothermally active sites in Hatoma and Kagoshima bay, and the results and experience gained from these missions will be fed-back into engineering developments to redefine the state of the art for AUVs, and contribute a new, quantitative method for surveying deep sea marine ecology.

Development of Marine Ecosystem Evaluation Methods in the High Throughput Sequencing Era

Kazuhiro KOGURE
Professor, The University of Tokyo

Recent remarkable progresses in the DNA sequencing and bioinformatics technologies have made it possible to collect and analyze huge sequence data within short time. The present project aims at developing new analytical methods for DNA and RNA obtained from marine environments. The methods should reveal community structures and functions of organisms together with their environmental parameters, thus offering a promising new approach to evaluate environmental status.

Evaluation of Biodiversity and Prediction of Environmental Changes by Digital DNA Chip

Takashi GOJOBORI
Vice-Director and Professor, National Institute of Genetics

In the present study, with the aim of understanding the effects of the gigantic earthquake and its resulting tsunami in Tohoku area on marine biodiversity and ecosystem, we develop a meta-genomic method of observing a variety of marine microorganisms at once and its practical application to environmental monitoring. Utilizing the methods developed, we make assessment of marine environments by comparing the diversity of microorganisms in spots along the sea coasts between Tohoku area and other areas. The outcome of the present study is expected to make contributions to deeper understanding of marine ecosystem of microorganisms.

Development of Simulation Techniques to Nowcast The Biodiversity of Marine Phytoplankton

Yasuhiro YAMANAKA
Professor, Hokkaido University

The aim of this research is to provide scientific basis for marine biodiversity management and prediction of fishery resources. Towards this end, we investigate biodiversity mechanisms of phytoplankton groups, such as a formation, maintenance and decay, in the western North Pacific, by using (1) numerical modeling, (2) satellite remote sensing and (3) in situ observation. Especially, we will develop basic techniques of a real-time simulation of the biodiversity by assimilating satellite observations of marine physical conditions and phytoplankton groups to an ecosystem model.

Research Area

Development of Fundamental Technologies for Diagnosis and Therapy Based upon Epigenome Analysis

Research Supervisor:
Masayuki YAMAMOTO
Dean / Professor, Tohoku University

Deputy Research Supervisor:
Toshikazu USHIJIMA
Chief of Division, National Cancer Center Research Institute

Type A "Research teams aiming to clarify the mechanism of biological phenomenon and disease, which targets specific diseases, stem cell or cell differentiation and combine the epigenome research and function analysis approach."

Since FY2011

Molecular mechanisms underlying direct reprogramming of fibroblasts to hepatocytes and applications thereof

Atsushi SUZUKI
Assosiate Professor, Kyushu University

We have identified specific combinations of transcription factors that can directly convert mouse fibroblasts into cells that closely resemble hepatocytes in vitro. Based on this finding, we next aim to elucidate molecular mechanisms underlying conversion of fibroblasts to hepatocytes and induce hepatocytes from human fibroblasts. Knowledge obtained from this study may lead us to not only discover new principles linking the role of transcription factors to epigenome reconstruction but also develop innovative approaches to treatment of liver diseases.

FY2011

Elucidating epigenomeloops of cell differentiation using quantitative ChIP-Seq method

Kazuhiko IGARASHI
Professor, Tohoku University

Cell differentiation is based on the processes of selective gene expression. Transcription factors and chromatin, which packages the genome DNA, generate mutual regulatory loops (i.e., epigeome loops), directing specific changes in both transcription factor binding and chromatin structures during cell differentiation. The aim of this project is to understand the structure and function of epigenome loops for cell differentiation.We will focus on the differentiation of plasma cells, which produce antibody, as a model system and apply a new quantitative chromatin immunoprecipitation-sequence (Q-ChIP-Seq) method to compare transcription factor binding and modification of chromatin during their differentiation. This project is expected to reveal fundamental mechanisms of the plasma cell differentiation and immune responses.

Mechanism of higher-order epigenome regulation and its medical significance

Mitsuyoshi NAKAO
Professor, Kumamoto University

In addition to DNA methylation and histone modification, this study focuses on higher-order epigenome mechanism, especially chromatin loop and nuclear domain formation for essential gene control. From this viewpoint, we will present the spatiotemporal models of disease-related gene loci, leading to the generation of new technologies of cell identification for medical diagnosis and therapy.

Epigenome analysis of mental disorders using advanced technologies

Tadafumi KATO
Head, Riken

When DNA is methylated by the effect of environment, gene expression changes. This might be one of mechanisms underlying mental disorders. However, little is known about the possible role of such epigenetic changes in mental disorders. Because the brain is made from many types of cells, analysis of DNA methylation status of neurons is difficult. In this study, we will develop advanced technologies to analyze epigenome in neurons and examine the neural epigenome in the postmortem brains of patients with mental disorders. In addition, the results are compared with the data in animal models, and causal relationship between epigenomic changes and mental disorders will be elucidated.

Epigenetic drug development to prevent pervasive developmental disorders

Masatoshi HAGIWARA
Professor, Kyoto University

Pervasive developmental disorders (PDDs) are characterized by varying degrees of impairment in communication skills, social interactions, and restricted, repetitive and stereotyped patterns of behavior. The preventive measures to reduce the incidence or severity of any type of PDD are not known at this time. In this project, we will make mice models and iPS cells of PDDs, and try to develop the biological markers and therapeutics.

Study of the molecular mechanism in the pluripot ency maintenance of stem cells and three-dimensional mapping of the epigenome structure.

Masahiro SHIRAKAWA
Professor, Kyoto University

Pluripotent cells, such as ES and iPS cells, have unique and characteristic epigenome structure, which is dynamically altered during cell differentiation. The alternation of the entire epigenome structure is facilitated by the modulation of spatial arrangement of DNA methylation/demethylation sites in certain genome region. In this project, we reveal the molecular mechanism underlying the maintenance and alteration of the epigenome structure by studying the structure basis of DNA demethylation and mapping the distribution of DNA methylation/demethylation sites in intranuclear space. We also develop a novel in-cell technique for analyzing maturation and ordering of the cytoskeleton as phenotypic markers reflecting dynamic epigenetic status.

New diagnostic and therapeutic tools targeting epigenetic modulation for lifestyle-related disease

Toshiro FUJITA
Professor, University of Tokyo

Hemodialysis patients increases year by year and their main causes are diabetes and hypertension. Furthermore, deterioration of kidney function leads high mortality in cardiovascular diseases. It is the urgent issue to establish novel therapeutics to inhibit the progression of renal disease. In the present study, we aim to clarify the involvement of epigenomic abnormality in the diabetic nephropathy and hypertensive renal damage. Based upon the data obtained, we propose new diagnostic and therapeutic tools targeting epigenomic regulatory factors in lifestyle-related diseases.

Type B "Research teams aiming to conduct the standard epigenome analysis on a large scale to contribute the International Human Epigenome Consortium(IHEC.)"

Reference epigenome analysis in normal epithelial cells of human digestive system and development of analysis technology

Yae KANAI
Deputy Director, National Cancer Center Research Institute

The aim of this study is to reveal the reference epigenome profiles, the whole picture of mechanisms regulating gene expression, e.g. DNA methylation, chromatin modifications, positions of nucleosomes and variants, and abundance of each RNA species, of human normal cells and contribute to the International Human Epigenome Consortium.We are attempting to make international contributions by epigenome analysis in normal epithelial cells of the digestive system, e.g. the stomach, colon and liver, and development of innovative technologies. Reference epigenomedatabase will be accessible worldwide and promote the innovation of diagnosis and therapy of human diseases through the efficient identification of disease-specific epigenome profiles.

Development of genomic technologies to explore human epigenetic regulation

Katsuhiko SHIRAHIGE
Professor, University of Tokyo

Our body consists of more than 250 cell types. While each cell has the same DNA sequence, protein modifications and their binding pattern (so called epigenetic information) defines the specificity of each cell type. The aim of this study is to develop the new standard method to analyze whole picture of epigenetic information and use the method to explore whole-genome epigenetic information of various endothelial cell species. Our ultimate goal is to contribute to the International Human Epigenome Consortium through both epigenomics data and technology development. These data and methods are expected to contribute to basic research and drug discovery as well.

Research Area

The Creation of Basic Medical Technologies to Clarify and Control the Mechanisms Underlying Chronic Inflammation

Research Supervisor:
Masayuki MIYASAKA
Professor, Osaka University

Since FY2010

FY2010

Regulation of inflammatory time axis at the RNA level

Hiroshi ASAHARA
Professor, Tokyo Medical and Dental University

Chronic inflammation causes many diseases, including arthritis and autoimmune diseases. However, the precise molecular mechanisms involved in termination of disturbed inflammatory response remain unclear. We will address this question by examining the role of microRNA in the pathogenesis of inflammation and arthritis. Using high-throughput sequencing and cell-based functional screening systems, we will uncover novel molecular cascades regulating the inflammatory time signal at the RNA level. This may provide novel treatment strategies for inflammatory diseases such as rheumatoid arthritis.

The role of microenvironmental niches for hematopoiesis in chronic inflammation

Takashi NAGASAWA
Professor, Kyoto University

For the study of chronic inflammation, in which innate and adaptive immune cells play crucial roles, it is important to understand the functions of the special microenvironments known as "niches". These niches enable hematopoietic stem cells and progenitor cells to provide appropriate numbers of blood cells, including immune cells, in the bone marrow. Although the nature of the niches has been a long-lasting unresolved issue, we found that a small population of bone marrow nonhematopoietic cells with long processes that express high amounts of the chemokine CXCL12, termed CXCL12-abundant reticular (CAR) cells, function as niches for hematopoiesis. Our aim is to clarify the role and molecular regulatory mechanism of CAR cells in controlling hematopoiesis in chronic inflammation. This would provide a new insight and form the basis for developing novel niche-based therapies.

Next-generation imaging technology to ascertain the in vivo mode of action of chronic inflammatory macrophages

Masaru ISHII
Professor, Osaka University

Chronic inflammation has been shown to cause various adult diseases such as metabolic syndrome and cancer. By exploiting biological imaging technologies, this study will analyze the crucial roles of tissue-resident macrophages in chronic inflammation. Several novel methodologies, such as those for detecting phenotypical changes in situ and for manipulating cell function using light at single-cell levels, would be developed. This will help to ascertain the in vivo mode of action of macrophages under pathophysiological conditions. This study will lead to the discovery of new concepts for controlling chronic inflammation, which is conducive for the development of revolutionary therapeutics against diverse common diseases.

Prostaglandin-mediated mechanisms of initiation and progression of chronic inflammation

Shuh NARUMIYA
Professor, Kyoto University

Prostaglandins (PGs) are bioactive substances mediating fever, swelling, and pain in acute inflammation. Our studies have not only elucidated the mechanisms of how PGs elicit these acute inflammatory responses, but also suggested a possibility that PGs also mediate certain chronic inflammatory processes such as allergy, fibrosis, and formation of cerebral aneurysms through regulation of gene expression. In this study, we aim to clarify the molecular mechanisms of how PGs, in collaboration with cytokines and innate-immunity substances, initiate and maintain chronic inflammatory processes. We also aim to evaluate their role in cancer, metabolic diseases and depression. We would also determine the three-dimensional structures of PG receptors to facilitate drug development against these diseases.

The research for the mechanism of chronically intractable pain based on the functions of microglia as brain immunocompetent cell

Kazuhide INOUE
Professor, Kyushu University

Intractable pain (including neuropathic pain) typically develops if peripheral nerves are damaged by surgery, if bone is compressed due to a tumor, or because of diabetes or infection. It does not abate even though tissue damage or inflammation has healed. The pain is frequently resistant to non-steroidal anti-inflammatory drugs and opioids, because of which more than 20 million patients in the world are in distress. We have discovered that microglia (immunocompetent cells in the brain) play a very important role in evoking intractable pain. In this project, we clarify the mechanism of pain based on the functions of microglia and also contribute to the development of agents against intractable pain.

Molecular and cellular bases of chronic inflammation-associated organ fibrosis

Kouji MATSUSHIMA
Professor, The University of Tokyo

Chronic inflammation-associated organ fibrosis causes serious functional impairment. In this project, we will examine the source of the myofibroblasts that play a key role in organ fibrosis. Regulation of the trafficking and differentiation of these cells by chemokines and other inflammatory mediators will be analyzed. In addition, we will clarify the changes in the epigenome and transcriptome that accompany fibrosis. Based on the information obtained from these studies, by conducting experiments in a murine model of fibrotic disease and testing human clinical samples, we aim to develop novel approaches for the prevention and treatment of human fibrotic diseases.

Understanding of chronic inflammation for the development of new therapeutic strategies for intestinal inflammatory diseases

Hiroshi KIYONO
Professor, The University of Tokyo

A healthy intestinal tract is maintained by the highly sophisticated homeostatic mechanism operating between symbiotic bacteria and mucosal immune cells. Collapse of this symbiotic and bidirectional interaction system leads to the development of refractory chronic inflammatory bowel diseases such as Crohn's disease and ulcerative colitis. In this project, we investigate the cellular and molecular mechanisms of homeostasis and pathological inflammation occurring within the intestine. This will be achieved by evaluation of the contribution made by the symbiotic microflora, carbohydrate chains on epithelial cells, and the innate immune cells at the intestinal mucosa. We subsequently plan to develop diagnostic methods, treatments, and preventative strategies for intestinal inflammatory diseases.

FY2011

Pathophysiological role of chronic inflammation in aging-associated diseases

Issei Komuro
Professor, Osaka University

Chronic inflammation is associated with aging-associated diseases, such as heart failure, diabetes, and atherosclerosis: however, its pathophysiological role is currently unknown. We recently found an increase in the C1q component of the complement system in multiple tissues of aged animals that contributed to the onset of heart failure, diabetes, and atherosclerosis. The objective of this study is to identify the mechanisms by which C1q encourages the onset of aging-associated diseases and to develop novel therapeutic strategies for these diseases associated with chronic inflammation.

Regulation of chronic inflammation and the development of new strategies for treating airway inflammatory diseases

Toshinori NAKAYAMA
Professor, Chiba University

Many Japanese people suffer from chronic inflammatory diseases of the upper and lower respiratory tracts, such as chronic rhino-sinusitis and chronic bronchial asthma. These diseases are generally resistant to steroids, and no effective treatment has yet been developed. Chronic allergic airway inflammation is thought to be induced and maintained by allergen-specific memory CD4+ helper T (Th) cells (Th1, Th2, and Th17 cells), although the precise roles of these Th subsets in chronic inflammatory diseases remain unknown. In this project, we clarify the cellular and molecular bases for induction and maintenance of chronic airway inflammation, and propose therapeutic strategies that may be used for chronic airway inflammatory diseases.

Structural basis for the pathogenic disease mechanisms caused by chronic inflammation

Osamu NUREKI
Professor, The University of Tokyo

Chronic inflammation results from excessive physiological responses, which are intrinsically essential for maintaining normal life, or by disturbances of physiological responses triggered by viral and bacterial infections. Chronic inflammation can cause adult-onset diseases, such as cancers, diabetes, arterial sclerosis, and others. We primarily focus on the following three areas: 1. Lipid mediators and the enzymes that produce them, which cause chronic inflammation via GPCR; 2. Toll-like receptors (TLRs) and signal transducers involved in natural inflammation downstream of TLR activation; 3. Transcriptional regulators that control cellular signaling in the nucleus, particularly NF-κB. We determine the three-dimensional structures of the target proteins and their complexes by X-ray crystallography, and provide evidence for the working hypothesis by mutant analyses, that identifies the mechanisms of chronic inflammation causing various diseases, from atomic to individual levels.

Control of chronic inflammation through elucidation of organ-specific autoimmune disease mechanisms

Mitsuru Matsumoto
Professor, Tokushima University

The human immune system normally distinguishes between microorganisms (non-self) and components of the body (self), thereby providing protection against invasion by numerous pathogens. However, an intractable autoimmune disease in which the immune system tends to attack the body itself can develop due to unknown mechanisms. With the aim of developing novel therapeutic approaches for chronic inflammation caused by autoimmunity, we study the mechanisms underlying the development of organ-specific autoimmune disease caused by the abnormal function of AIRE, a gene that plays an essential role in establishing self-tolerance in the thymus.

Identification of critical genes involved in the pathogenesis of human chronic inflammatory diseases

Kouji YASUTOMO
Professor, Tokushima University

The aim of this study is to identify critical genes, which are involved in the onset or progression of chronic inflammation, using genetic analysis of familial inflammatory diseases. If successful, these studies would aid in revealing previously unappreciated molecular mechanisms of chronic inflammation, and thereby, contribute to establish innovative therapeutic strategies for human inflammatory diseases.

Protective mechanisms against environmental stresses leading to therapeutic strategies for chronic inflammation

Masayuki YAMAMOTO
Professor, Tohoku University

We are constantly exposed to various environmental stresses in our daily life, including chemicals, ultra-violet light, pathogenic microorganisms, and dietary toxicants. Cellular detoxification is crucial for the maintenance of health by providing protection against these environmental stresses. The aim of this study is to clarify how dysregulation of stress responses exacerbates chronic inflammatory diseases and also, to evaluate the effectiveness of intervention into the cytoprotection mechanisms to prevent and alleviate these pathologic conditions. Our research aims to identify novel relationships between environmental stresses and chronic inflammation and provide advances in therapeutic strategies for chronic inflammatory diseases.

Research Area

Development of System Software Technologies for Post-Peta Scale High Performance Computing

Research Supervisor:
Akinori YONEZAWA
Co-director, RIKEN Advanced Institute for Computational Science

Since FY2010

FY2010

Development of an Eigen-Supercomputing Engine using a Post-Petascale Hierarchical Model

Tetsuya SAKURAI
Professor, University of Tsukuba

The aim of this research is to develop a massively parallel eigenvalue analysis engine using a hierarchical parallel structure, which is a defining characteristic of post-petascale architecture. The developed engine is based on newly designed algorithms created to address issues of scalability and fault tolerance that have plagued conventional eigenvalue solution methods. This analysis engine will open new doors for cutting-edge science and engineering simulations on scales that have never been feasible in the past, and then create a potential for stimulating technological innovation across a broad range of areas in science and industry.

Highly Productive, High Performance Application Frameworks for Post Petascale Computing

Naoya MARUYAMA
Assistant Professor, Tokyo Institute of Technology

Concurrency, reliability, and power are the most critical challenges for future high performance computing. We solve these problems in a highly productive way by developing vertically-integrated high performance software stack, which transparently implements advanced HPC technologies such as automatic parallelization, automatic tuning, fault tolerance, power optimization. This project will present two instantiations of the vision, namely a framework for computational fluid dynamics and another for molecular dynamics. Our research outcome will represent an important step towards future software architecture for exascale computing.

System Software for Post Petascale Data Intensive Science

Osamu TATEBE
Associate Professor, University of Tsukuba

Rapid improvement of experimental devices such as next-generation DNA sequencer and accelerator requires large-scale data intensive computing whose data size does not fit in the memory footprint. Current supercomputer technology cannot meet the required I/O performance in the near future. This project aims at research and development of distributed file system, operating system, and runtime system for data intensive computing, and promotes data intensive science in the post Petascale era.

FY2011

Development of a Numerical Library based on Hierarchical Domain Decomposition for Post Petascale Simulation

Ryuji SHIOYA
Professor, Toyo University

We have been developing an open source system software, ADVENTURE, which is a general-purpose parallel finite element analysis system and can simulate a large scale analysis model with supercomputer like the Earth Simulator or K-computer. In the system, HDDM (hierarchical domain decomposition method), which is a very effective technique to large-scale analysis, was developed. The aim of this project is to develop a numerical library based on HDDM that is extended to pre and post processing parts, including mesh generation and visualization of large scale data, for the Post Petascale simulation.

ppOpen-HPC: Open Source Infrastructure for Development and Execution of Large-Scale Scientific Applications on Post-Peta-Scale Supercomputers with Automatic Tuning (AT)

Kengo NAKAJIMA
Professor, The University of Tokyo

We propose an open source infrastructure for development and execution of optimized and reliable simulation codes on post-peta (pp) scale parallel computers with heterogeneous computing nodes which consist of multicore CPU's and accelerators., named "ppOpen-HPC". ppOpen-HPC consists of various types of libraries, which covers various types of procedures for scientific computations. Source code developed on a PC with a single processor is linked with these libraries, and generated parallel code is optimized for post-peta scale system. Capability of automatic tuning is important and critical technology for further development on new architectures and maintenance of the framework.

An evolutionary approach to construction of a software development environment for massively-parallel heterogeneous systems

Hiroyuki TAKIZAWA
Associate Professor, Tohoku University

Postpeta-scale computing systems are expected to become more complex with more parallelism and heterogeneity. This project will develop an environment to efficiently and effectually use such a massively-parallel heterogeneous system. We will especially work in research and development of abstraction technologies to enable application users and developers to exploit the performance of a postpeta-scale computing system without considering the underlying hardware complexities. We will also develop a framework combined with the abstraction technologies in order to support software evolution for adapting to system changes.

Parallel System Software for Multi-core and Many-core

Atsushi HORI
Researcher, RIKEN

Assuming the post-petaflops parallel architecture will be the combination of general purpose multi-core CPUs and specialized many-core CPUS, a scalable system software for that architecture will be studied and developed. A newly developed lite OS running on the many-core CPUs and a general purpose OS running on the multi-core CPUs will communicate with the other to provide efficient and optimized communication, efficient parallel I/O including MPI-IO, ultra lite threads, and fault resilience functions.

Software development for post petascale super-computing — Modularity for Supercomputing

Shigeru CHIBA
Professor, Tokyo Institute of Technology

A single general programming language or framework that covers any subject will not be feasible for post petascale supercomputing. The goal of this project is to apply mordern techniques for software modularity to supercomputing. The progress in software modularity techniques for web applications is significant in this decade. By applying these techniques, the project enables domain experts to develop frameworks specific to computing platforms and algorithms and therby improves the efficiency of software development in supercomputing.

Development of Scalable Communication Library with Technologies for Memory Saving and Runtime Optimization

Takeshi NANRI
Associate Professor, Kyushu University

Within a decade, the number of processing cores on supercomputers is predicted to be more than 100 million. This project researches technologies for memory saving and runtime optimizations to implement a scalable communication library that will be required on such large scale computers. In addition to that, the project also develops methods for building scalable applications by utilizing facilities of the communication library.

Advanced Computing and Optimization Infrastructure for Extremely Large-Scale Graphs on Post Peta-Scale Supercomputers

Katsuki FUJISAWA
Associate Professor, Chuo University

We immediately need to draw up evacuation plans and make decisions regarding infrastructure restoration, when serious disasters happened. It is known that technologies for gathering massive information, making large-scale graph data as mathematical models and applying optimization algorithms to them are very important in such situations, however, existing technologies are not so powerful. The objective of this project is to develop an advanced computing and optimization infrastructure for extremely large-scale graphs on post peta-scale supercomputers and contribute to realize safe and robust social infrastructures.

Research Area

Creation of Innovative Functions of Intelligent Materials on the Basis of the Element Strategy

Research Supervisor:
Kohei TAMAO
Director, RIKEN Advanced Science Institute

FY2010

Development of Innovative Technologies Using Diamond Electrodes for Improving Environment

Yasuaki EINAGA
Professor, Keio University

This project aims to develop innovative technologies using conductive diamond electrodes as next generation functional materials for improving global environment. Our research continuously proceeds from studies on the fundamentals of the functional interfaces to the development of the devices such as electrochemical sensors, wastewater treatment systems, and carbon dioxide reduction systems.

Creation of Materials Science for Advanced Ferroelectrics of Organic Compounds

Sachio HORIUCHI
Team Leader, National Institute of Advanced Industrial Science and Technology（AIST）

Exclusion of toxic lead and rare metallic elements in ferroelectrics is still one of the most important issues of element strategy. This research team aims at paradigm shift on ferroelectrics on the basis of the molecular compounds of C, H, O, and N elements, the ferroelectricity of which has been lately discovered by the team leader. Materials science for advanced ferroelectrics will be constructed by clarifying the microscopic/mesoscopic mechanisms of ferroelectricity specific to the molecular system, and by developing new materials and processes for improvement of the performance, endurance, and thin-film device fabrications.

Since FY2010

Exploring for New Functional Materials with Unusual Ionic States and Coordinations

Yuichi SHIMAKAWA
Professor, Kyoto University

We are seeking new materials with new functional properties. New functional materials are strongly demanded for electronic devices in future information technology. Also, science on new materials will give some solutions for the problems in energy- and environment-related issues we face, and will develop our sustainable society. We are thus focusing on new materials containing ubiquitous 3d transition metals. With characteristic synthesis techniques we will be able to make such new functional materials with unusual ionic states and coordinations.

FY2011

Creation of the Functional Materials on the Basis of the Inter-Element-Fusion Strategy

Hiroshi KITAGAWA
Professor, Kyoto University

In this project, we will establish the inter-element-fusion science to create innovative functional materials where the immiscible metallic elements in the bulk state are mixing at the atomic level using nanotechnology. We promote ambitious and challenging materials research with a multidisciplinary integration of physics, chemistry, engineering, and materials science.

Development of New Fe-based Magnetic Materials by Controlling Crystal Structure

Satoshi SUGIMOTO
Professor, Tohoku University

We aim to develop new Fe-based magnetic materials with high magnetocrystalline anisotropy for saving rare earth content in permanent magnets. To realize our objective, we study on the possibility for controlling crystal structure of materials by thin film technique, nanoparticle technology that uses substitutional or interstitional elements and composites, and high pressure synthesis. Phase equilibria in the systems are also clarified by First-principles calculations and thermodynamic analyses.

Development of Iron Catalysts for Advanced Organic Synthesis

Hideo Nagashima
Professor, Kyushu University

Homogeneous catalysis using rare metal complexes plays an important role in fine chemical processes producing pharmaceuticals, agricultural chemicals, and plastics. Now rare metals have faced problems of shortage as the resource, high cost, and environmental issues in usage. Their replacement by common metals is a solution of this project pursuing, and iron is the key element for us. The project is aimed at establishing design of the iron catalyst and developing the most suitable reaction media for iron catalysis, which are achieved by two concepts, "ligand field control" and "reaction governed by the reaction media". The final goal of this project is development of highly active and selective iron catalysts, which should be recoverable from the reaction mixture and reusable. These are accomplished by two scientific fields, science of the element and process chemistry.

Creation of New Principles in the Multi-scale Design of Steels Based on Light Element Strategy

Tadashi FURUHARA
Professor, Tohoku University

In this research project, the interactions of light elements, which can improve or degrade the properties of steels significantly by a small addition, with nanostructures of iron are studied. By understanding the fundamental functions of alloying elements, we aim to create new principles in the multi-scale design of high-strength and high ductility/toughness in steels with the minimum use of rare-metals.

Development of Novel Electronic Materials Utilizing Light Elements

Tetsuya HASEGAWA
Professor, University of Tokyo

We develop novel electronic materials without rare metals or toxic elements by utilizing light elements, such as B, C, N and F, which would substantially modify the crystal structures and band structures of solids. In order to accelerate the element substitution in a strategic manner, we attain new functionalities which are not accessible by conventional materials. Our special focus is on In-free transparent conductors whose work functions and refractive indices are well controlled and Pb- or rare earth-free ferroelectric materials which respond to visible light.

Coercivity Mechanism of Nd-Fe-B Permanent Magnets

Kazuhiro Hono
Fellow, National Institute for Materials Science（NIMS）

The microstructure-property relationships of Nd-Fe-B permanet magenets will be studied by multiscale structural analysis. Combining with ab-initio calculations and micromagnetic simulations, we will predict the ideal microstructure to achieve the highest coercivity. Based on these experimental and modeling results, we will develop high coercivity Nd-Fe-B magnets without using Dy.

Research Area

Creation of Basic Technology for Improved Bioenergy Production through Functional Analysis and Regulation of Algae and Other Aquatic Microorganisms

Research Supervisor:
Tadashi MATSUNAGA
President, Tokyo University of Agriculture and Technology

Since FY2010

FY2010

Enhancing and fusing archaeal metabolism: a new approach towards bioenergy production

Haruyuki ATOMI
Professor, Kyoto University

This project focuses on the Archaea, the third domain of life distinct from the Bacteria and Eucarya. We first aim to understand and enhance the various metabolic mechanisms of the Archaea involved in bioenergy production and biomass degradation. With the aim to develop microorganisms with novel bioenergy-producing capabilities, we will further explore the possibilities of fusing these functions via genome-scale DNA recombination.

The Cyanofactory

Koji SODE
Professor, Tokyo University of Agriculture and Technology

Our research team is creating a novel cyanobacterial system, designated as "Cyanofactory", for the production of biofuel-related compounds. The Cyanofactory is composed of 1) a synthetic cyanobacterial host strains, 2) synthetic operons for the production of biofuel-related compounds, and 3) the employment of ion-liquids for downstream processing. The Cyanofactory realizes the sustainable production of biofuel-related compounds based on synthetic cyanobacterial processes with minimal energy and waste.

Characterization of hydrocarbon biosynthesis and secretion mechanisms by the green microalga, Botryococcus braunii to control biofuel production

Shigeru OKADA
Associate Professor, The University of Tokyo

The green microalga Botryococcus braunii produces unusually large amounts of liquid hydrocarbons from carbon dioxide and photosynthesis, and secretes these hydrocarbons outside of cells. These hydrocarbons are promising as an alternative fuel source since they are chemically very similar to petroleum. The objective of this research project is to understand "why and how" those hydrocarbons are produced and secreted by this alga at not only the cellular but also the molecular level. The unique hydrocarbon production and secretion mechanisms in this alga will be genetically engineered using the basic information obtained through this project in order to establish more effective technology for biofuel production.

FY2011

Focused biotechnologies suitable for complete utilization of marine macroalgae

Mitsuyoshi UEDA
Professor, Kyoto University

For "bioproduction of fuels and useful compounds" as resourses of abundant marine macroalgae, we will find out useful enzymes degrading cell wall components of marine macroalgae from metagenome libraries and genomic information of cellulose-utilizing microorganisms. Demonstration of their functions of identified genes by cell surface engineering and construction of high functional and expert whole-cell biocatalysts will be carried out. By our focused biotechnologies, production of biofuels, fuel cells, and useful compounds from marine macroalgae will be challenged. Finally, we will construct fundamental and focused biotechnologies and realize "Biorefinery establishment" of marine macroalgae.

Establishment of innovative technology to create new microalgal strains increasing biofuel production by polyploidization and heavy-ion beam irradiation

Shigeyuki KAWANO
Professor, The University of Tokyo

To make the biofuel production using microalgae practicable, it is necessary to breed their strains which can be mass-produced just like grains and horticultural crops. However, there was no conception of breeding in the microalgae so far, or their genomes have not been decoded in most of species. In the present study, the microalgae irradiated with the heavy-ion beams, which have the successful results by the selective breeding of horticultural crops, will be selected and bred based on the quantitative data concerning their forms. We aim for the establishment of the breeding scheme, which is innovative, advanced and specialized in microscopic algae, based on complete genome information.

Strategic construction of algal lipid production system utilizing plant vegetative organs as a model

Hiroyuki OHTA
Professor, Tokyo Institute of Technology

Algae generally do not have organs to accumulate storage compounds such as lipids and carbohydrates. They rather accumulate these storage compounds specifically when suffering from some stress such as nutrient starvation. We recently found that plant vegetative organs including leaves and roots also accumulate these storage lipids under nutrient shortage conditions. In this project, we strategically construct systems to produce very large amount of lipids in algal cells utilizing plant vegetative organs as a model. To perform this, we will primarily establish a research platform for several useful algae, which covers overall information of genome, transcriptome and lipid metabolome, and subsequently construct algal systems to accumulate large amount of lipids useful for chemical materials and biofuels.

Research on the metabolic pathway of alkenones in marine haptophte algae and the development of new algal oil production technology

Yoshihiro SHIRAIWA
Professor, University of Tsukuba

The haptophyte algae, especially coccolithophorids, are thought to had played major role for the production of petrolium and limestones in geological era. The algae still produce huge blooms and biomass by fixing carbon dioxide photosynthetically even in the present ocean. The long-chain lipids, named alkenones, produced by the algae can be one of important candidates for algal biofuel production. This research focuses on the elucidation of metabolic pathway of biosynthesis of alkenones and the development of biotechnology for the mass production of biofuels using marine haptophycean microalgae and seawater.

Development of an efficient system for free fatty acid production using cyanobacterial mutants affected in nitrate assimilation.

Tatsuo OMATA
Professor, Nagoya University

We aim at increasing the efficiency of free fatty acid production by cyanobacteria. To reduce the cost of fertilizers and to increase the light use efficiency, we develop a method to regulate cell growth by nitrogen limitation during the production and excretion of free fatty acid. Our goal is to achieve a ten-times higher level of fatty acid production per unit of cellular nitrogen than the present level, which would correspond to production of four-times greater mass of the product than that of the cell dry matter.

Research on the efficient biosynthesis of nitrogenous substances using artificially optimized nitrogen fixing cyanobacteria

Toru HISABORI
Professor, Tokyo Institute of Technology

Nitrogen fixing cyanobacteria synthesize nitrogenous substances such as amino acids in the cell using atmospheric nitrogen gas as a major material. On this process they first produce ammonia and use them for the biosynthesis of amino acids. Our research goal is the establishment of the new technology to produce nitrogenous substances using nitrogen fixing cyanobacteria. For the purpose we will optimize the metabolic pathway of the bacteria for the production and invent the new technology to obtain objective compounds from the cell culture.

Creation of heat and acid tolerant algae toward high biomass production

Shin-ya MIYAGISHIMA
Associate Professor, National Institute of Genetics

Red algae are one of the major groups of eukaryotic algae in aquatic biomass. We have determined the complete genomic sequence of the red alga *Cyanidioschyzon merolae* which represents major biomass in acidic hot spring. In addition, we have developed procedures for genetic modification of this alga. In this project, we will chracaterize mechanisms of carbon fixation and carbohydrate production in extreme conditions to create heat and acid tolerant algae for high biomass production by genetical modification.

Research Area

Creation of Human-Harmonized Information Technology for Convivial Society

Research Supervisor:

Yoh'ichi TOHKURA

Professor / Deputy Director General, National Institute of Informatics

FY2009

Life Log Infrastructure for Food

Kiyoharu AIZAWA
Professor, The University of Tokyo

"Food" is one of the most important and regularly consumed factor in our daily life. However, so far, this has rarely been viewed as an object of information processing. In this research, we aim at developing an infrastructure for life log, with emphasis on food and food-related activities in our daily life. We investigate capture, analysis, visualization and interfacing of multimedia logs of food and related experiences. Making use of this data collection, we further investigate potential community discovery, support for communications, standardization of life log data, and privacy control issues. We also investigate applications such as healthcare.

Elucidation of Perceptual Illusion and Development of Secse-centered Human Interface

Yasuharu KOIKE
Professor, Tokyo Institute of Technology

Tele-existence is trying to replicate physically plausible information by providing with a real sensation of presence. In this project, we aim to elucidate the mechanisms of the perceptual illusion for visco-elastic function in the brain. Perceptual illusion would realize new human interface without elaborate system.

Since FY2009

Dynamic Information Space based on High-speed Sensor Technology

Masatoshi ISHIKAWA
Professor, The University of Tokyo

We attempt construction of a new information space allowing humans to recognize phenomena exceeding the limitations of the human senses.
Crucial to this effort are: (1) perfect detection of underlying dynamics and (2) a new model of sensory-motor integration drawn from work with kHz-rate sensor and display technologies. Within the information space the sampling rate is matched with the dynamics of the physical world; so humans are able to deterministically predict attributes of the surrounding, rapidly-evolving environment. This leads to a new type of interaction, where the learning rate and capacity of our recognition system are augmented.

Sensing and Controlling Human Gaze in Daily Living Space for Human-harmonized Information Environments

Yoichi SATO
Professor, The University of Tokyo

The goal of this project is to develop novel technologies for sensing and controlling human gaze non-invasively in daily living space. Such technologies are the key to realize human-harmonized information environments which can provide us various kinds of supports more effectively without distracting our activities.

Developing a Communication Environment by Decoding and Controlling Implicit Interpersonal Information

Makio KASHINO
Executive Manager, NTT Corporation

Smooth and effective interpersonal communication depends strongly on implicit, non-symbolic information that emerges from the interaction between partners (Implicit InterPersonal Information, IIPI). Our goal is to develop new methods to improve the quality of communication by (1) decoding IIPI from brain activities, physiological responses and body movements, and (2) controlling IIPI by sensorimotor stimulation and non-invasive brain stimulation.

Modeling and Detecting Overtrust from Behavior Signals

Kazuya TAKEDA
Professor, Nagoya University

Based on large signal corpora, this project studies the mathematical modeling of human behaviors through mapping the behaviors onto two discrete-continuous hybrid systems, i.e., the cognition-decision process and the decision-action process. This research aims at building such a behavior model that can relate the human internal state and the observed behavior signals. Research results will be applied to and evaluated through detecting overtrust caused by misunderstandings between human and machines in real environments.

Smart Seminar Room baesd on Multi-modal Recognition of Verbal and Non-verbal Information

Tatsuya KAWAHARA
Professor, Kyoto University

Based on a multi-modal analysis and modeling of speech communication used for human intellectual activities, we design IT-enhanced environments for seminars and meetings, which provide real-time supports to participants and make their effective archive for later reference. In addition to the conventional approach to process main speaker's utterances, a novel indexing approach focusing on audience reaction is incorporated.

Construction and Utilization of Human-harmonized "Tangible" Information Environment

Susumu TACHI
Professor, Keio University

This project aims to construct an intelligent information environment that is both visible and tangible, where real-space communication, human-machine interface and media processing are integrated. The goal is to create a human-harmonized "tangible information environment" that allows human beings to obtain and understand haptic information in the real space, to transmit thus obtained haptic space, and to actively interact with other people using the transmitted haptic space. The tangible environment enables telecommunication, tele-experience, and pseudo-experience with the sensation of working as though in a natural environment. It also enables humans to engage in creative activities such as design and creation as though they were in the real environment.

FY2010

Studies on Cellphone-type Teleoperated Androids Transmitting Human Presence

Hiroshi ISHIGURO
Visiting Group Leader, Advanced Telecommunications Research Institute International

This project will realize cellphone-type teleoperated androids "Elfoid" (the common name is "Geminoid cellphone"). It is a new communication method that can transmit human presence anytime and anywhere. The user can transmit his/her presence to the distant place by the Elfoid and the conversation partner in the place can talk to the Elfoid as if it is the user. In addition to the personal computers and smartphones, the Efloid will be new information media that harmonize information technologies with people.

Behavior Understanding based on Intention-Gait Model

Yasushi YAGI
Professor, Osaka University

The main purpose of this project is to develop technologies for estimating intention, a mental and physical condition, and human relations from gait patterns.We also investigate how human-harmonized information environments can be built using the technologies.

Pedagogical Machine: Developmental Cognitive Science Approach to Create Teaching/teachable Machines

Kazuo Hiraki
Professor, The University of Tokyo

This project aims to construct a pedagogical machine-an artifact that can help and enhance human learning. To that end, we adopt a developmental cognitive science approach revealing the mechanism of real human learning in communicative situations (e.g. mother-infant interaction). Multiple and integrative methods-behavioral experiments, brain imaging, internet research-are used to specify the features that the machine must have. The machine will be tested in a realistic situation accumulating scientific knowledge for the future education.

Development of a Sound Field Sharing System for Creating and Exchanging Music

Shiro ISE
Associate Professor, Kyoto University

The purpose of this study is to build an information communication environment that supports the exchange of music, a universal language, with high fidelity. We develop a sound field sharing system that will help music professionals such as musicians, acoustic engineers, music educators, and music critics to enhance their skills and further explore their creativity by providing them with the means to experience 3D sound in a telecommunication environment. This innovative form of music production using communication technology also provides the general public a platform for a new experience of entertainment.

FY2011

Building a Similarity-aware Information Environment for a Content-Symbiotic Society

Masataka GOTO
Prime Senior Researcher, National Institute of Advanced Industrial Science and Technology (AIST)

The purpose of this project is to develop fundamental technologies for building a similarity-aware information environment in which people are able to know similarities among vast amounts of media content. This environment will help establish a ``content-symbiotic society'' in which media content such as music and video can be created and used in innovative, but ethical ways. Furthermore, by developing technologies for enhancing content creation and appreciation, we aim to promote a society in which anyone can actively engage in content creation and appreciation, and a content culture that respects past content and emphasizes experiencing emotion.

Enabling a Mobile Social Robot to Adapt to a Public Space in a City

Takayuki KANDA
Senior Research Scientist, Advanced Telecommunication Research Institute International

This project is aimed to realize a future city environment in which a social robot roams in a public space and offers useful services, such as information-providing and physical assistance. In order to realize this project, two kinds of research will be conducted. The first one will be aimed at achieving a technique based on a sensor network that will be able to understand how the humans use a public place. The second investigation will be aimed at enabling a robot to roam the environment without hindering the movement of people, while talking kindly to walking people.

User Generated Dialogue Systems: uDialogue

Keiichi TOKUDA
Professor, Nagoya Institute of Technology

In developing spoken dialogue systems, it is important to construct attractive content that gives users positive motivation to talk to a system. Recently, user-generated content has been successfully used in many web services such as Wikipedia and YouTube. In this project, we apply the idea of user-generated content to spoken dialogue systems, and empirically clarify the mechanism and conditions that the systems work in practical situations.

Development of Fundamental Technologies for Innovative Use of Character/Document Media and Their Application to Creating Human Harmonized Information Environment

Koichi KISE
Professor, Osaka Prefecture University

This project is to transfigure traditional media of characters and documents to new active media by using technologies such as high-speed character recognition and document image retrieval. The new media allow us to navigate the user based on the description of signboards and posters, as well as to retrieve and display necessary information based on a log of reading (reading lifelog) and the part the user is reading.

Harmonized Inter-Personal Display Based on Position and Direction Control

Takeshi NAEMURA
Associate Professor, The University of Tokyo

The aim of this study is to implement harmonized inter-personal display technology based on the premise that it will be used in gathering places frequented by several people. This technology will be geared toward facilitating face-to-face communication while superimposing a world of information on the real world. Hitherto, superposition techniques (augmented reality) have mainly been used within the information terminal displays of individual users. In this study, we go beyond this framework by embedding information in light and sound which is presented to users while controlling the locality and directionality for the real world, thereby allowing people to freely access information that is spread out spatially rather than being held within the confines of a display screen.

Research Area

Creative Research for Clean Energy Generation Using Solar Energy

Research Supervisor:
Masafumi YAMAGUCHI
Principal Professor, Toyota Technological Institute

Since FY2009

FY2009

Efficient Visible Light-Sensitive Photocatalysts for Water Splitting

Hiroshi IRIE
Professor, University of Yamanashi

This study will contribute to creative technology for obtaining clean and renewable energy through hydrogen evolution using a water-splitting photocatalyst upon irradiation with visible portion of solar light. The photocatalysts will be created on the basis of a novel material design and mechanistic approach, and not a mere extension of previous studies. In addition, to enhance the ability of hydrogen evolution, the nano-scale structure of the photocatalysts will be strictly controlled to achieve efficient charge separation, i.e., spatial separation of the redox reaction sites and optimization of the hetero-junctions.

Bandgap Science for Organic Solar Cells

Masahiro HIRAMOTO
Professor, National Institutes of Natural Sciences

Target of this research project is the realization of organic solar cells showing conversion efficiency of 15%. In order to accomplish this target, we establish the bandgap science for organic semiconductors, such as eleven nines (11N) high purification, pn-control by doping, built-in potential formation, ohmic junction formation, precise evaluation of semiconductor parameters, together with the science of excitons and organic/inorganic heterointerfaces.

Hydrogenated Amorphous Silicon Free from Light-indueced Degradation

Hiroaki OKAMOTO
Professor, Osaka University

This program is aimed to pursuing novel growth and post-treatment technologies that make hydrogenated amorphous silicon be free from light-induced degradation. The scientific knowledge and technologies established would contribute largely not only to the evolution of practical thin-film photovoltaics but also to the reformative progress in the science & technology of thin-film silicon materials and related devices.

High Efficiency Thin Film Solar Cells with Enhanced Optical Absorption by Excitons

Yoshiji HORIKOSHI
Professor, WASEDA University

Thin film structures are essential for achieving low cost solar cells. However, thinning the active regions of solar cells often reduces the optical absorption efficiency. Enhancement of optical absorption in thin films is therefore required to keep the bulk efficiency and also to improve the total efficiency of solar cells. In this project, we pursue the ways to enhance optical absorption in thin films and to develop high efficiency solar cells. Exciton absorption is one of the promising candidates, because it can be added to the normal band-to-band absorption. Semiconductors with high exciton binding energy such as ZnO, GaN and CdAlSe2 are important materials in the shorter wavelength regions. The semiconductors sensitive to the main part of the solar spectrum exhibit rather lower binding energies, but by constructing superlattice and/or quantum dot structures, the exciton absorption can be considerably enhanced even in these materials. These investigations are based on the high quality thin films and heterostructures with wide areas grown by MBE, MEE and magnetron sputtering.

Complete Utilization of "Light"and "Carrier" by the Control of Interface between Surface Layer and Photovoltaic Materials

Shin-ichi SATOH
Professor, University of Hyogo

It is necessary to utilize incident "light" and generated "carrier" completely for the ultimate benefit of the photovoltaic potential. In this study, we establish a novel physical model for the losses of light and carriers at the interface between surface layer and photovoltaic materials. We also explore novel materials for the surface layer by using combinatorial technique. Our aim is to promote a high convergent efficiency photovoltaic based on the novel physical model and materials.

New Formation Process of Solar-Grade Si Material Based on Atmospheric-Pressure Plasma Science

Kiyoshi YASUTAKE
Professor, Osaka University

In this research, a new manufacturing process of solar-grade Si directly from low-cost, low-purity Si materials is developed using high-pressure H2 plasma generated at near atmospheric pressure. By clarifying fundamental phenomena occurring in the high-pressure plasma and on the Si surface at an atomic level, we establish a technique to control plasma and surface reactions, and enhance the silane generation reaction from low-purity Si materials. It is expected that this process significantly contributes to the solution against the shortage problem of solar-grade Si, and to the large reduction of the manufacturing cost of solar cells.

Device Physics of Dye-sensitized Solar Cells

Liyuan HAN
Managing Director, National Institute for Materials Science

There has been an increasing interest in dye-sensitized solar cells DSCs owing to a potential for low-cost production. However, the energy conversion efficiency is still lower than that of bulk silicon solar cells. In this study, we try to find out the new methods for elevating efficiency to 15 % by clarifying the performance principle of dye-sensitized solar cells and the properties of constituent materials (dye, metal oxide semiconductor and electrolyte) through collaboration with different research fields such as electrochemistry, organic chemistry, semiconductor physics, surface science and computational science.

FY2010

Improvement of Performance of Thin Film Compound Semiconductor Photovoltaic Cells towards the after Next Generation

Hironori KATAGIRI
Professor, Japan Nagaoka National College of Technology

Aiming to supply of renewable energy stably at the after next generation, we will improve the performance of rare-metal free thin film photovoltaic (PV) cells. In order to stop the global warming and to spread the PV cells for the low-carbon society, we should aim at both the stable supply of raw material of PV cells and the increase in the conversion efficiency. This project aims to develop a new type PV cell that can be supplied steadily in the market place. This project includes the following three stages: increase in the conversion efficiency of In-free CZTS-based thin film PV cells, development of new materials for PV cells and buffer layer, and development of a new nano-structure for PV cells.

R&D on Nitride-based Heterogeneous Tandem Solar Cells on Si Substrates

Naoteru SHIGEKAWA
Professor, Osaka City University

We target realization of heterogeneous tandem solar cells made of group-III nitrides and Si, which are assumed to be highly familiar with concentrator photovoltaic systems and likely to be promising for bringing about low-cost, high-efficient, and low-environment-load solar cells. We explore technologies for growing group-III nitrides with bandgap energies corresponding to visible and infrared lights on Si substrates and technologies for designing, fabricating, and hybridizing solar cells composed of nitrides. We also advance researches related to growth, characterization, and device fabrication of In-rich nitrides.

FY2011

Evaluation of Nonradiative Carrier Recombination Loss in Concentrator Heterostructure Solar Cells.

Yoshihiko KANEMITSU
Professor, Kyoto University

By using time- and space-resolved laser spectroscopy, we evaluate nonradiative carrier recombination loss, such as bulk recombination, interface and surface recombination, and Auger recombination, in concentrator solar cells consisting of multi-junction heterostructures and nanostructures, and find ways to high efficiencies of light energy conversion. In addition, we study multiexciton generation rate, Auger recombination rate, and carrier extraction rate, which compete in nanostructure solar cells, in order to examine experimentally a long-standing issue whether one-photon to multi-electron conversion processes can be effectively utilized.

Si-based Thin-film Solar Cells using a Semiconducting Silicide pn Junction

Takashi SUEMASU
Professor, University of Tsukuba

We develop a pn junction solar cell using semiconducting BaSi2, which is composed of abundant chemical elements of Si and Ba. Energy conversion efficiencies exceeding 25% will be expected for only a 1um-thick pn junction diode with this material. We focus on the formation technique for a high-quality BaSi2 pn junction, which influences the solar cell performance, and aim to show the potential of this new material as a thin-film solar cell.

Development of New Optical Management Technology for Solar Cells based on Photonic Nanostructures

Susumu NODA
Professor, Kyoto University

In this project, we aim to develop a new optical management technology for solar cells based on photonic nanostructures (or photonic crystals). We will investigate broad-area resonant effects at band-edges of photonic crystals in order to enhance the absorption at the wavelength regime (600-1,000nm) where the magnitude of the absorption in thin film silicon (such as a-Si or micro-crystalline Si) reduces significantly.

High Efficiency Crystalline Silicon Solar Cells Fabricated by Cat-CVD Technology

Hideki MATSUMURA
Professor, JAIST (Japan Advanced Institute of Science and Technology)

Fabrication technology of crystalline silicon (c-Si) solar cells with energy conversion efficencies over 25 % is studied, based on Cat-CVD (Hot-Wire CVD) technology. Cat-CVD preparation of high-quality thin films without damages can realize extremely low surface recombination velocity, and dopant radicals generated in Cat-CVD system can make p-n junction only at 200℃ or less. They contribute to dramatic improvement of c-Si solar cell efficiency.

Development of Novel Process for Producing High-purity Silicon through Designing Solid/liquid Interfacial Reactions

Takayuki HOMMA
Professor, Waseda University

Production of solar-grade silicon conventionally requires extremely high reaction temperature with long duration, which causes considerable drawbacks. In this research, we focused upon electrochemical approaches which take place at solid/liquid interfaces to directly reduce silica to silicon, and by detailed analysis and understanding from atomistic viewpoint, we optimize the reactions to develop comprehensive process for producing high-purity silicon material for solar cell applications. We also attempt to utilize diatomaceous earth as reliable source for producing high-purity silica for such an application.

Construction of Organic thin-film Solar Cells with Innovative Solution-processible Organic Materials

Hiroko YAMADA
Associate Professor, Nara Institute of Science and Technology

We develop solution-processable small molecular materials, such as photochemically convertible precursors and supramolecular building blocks, to construct tailor-made p/n nanostructures for organic thin-film solar cells. We also establish novel device-manufacturing techniques which realize "the increase of the p/n interface for charge separation" and "the efficient carrier-collection to the electrodes" simultaneously. This leads to the creation of next-generation organic solar cells.

Research Area

Elucidation of the Principles of Formation and Function of the Brain Neural Network and Creation of Control Technologies

Research Supervisor:
Seiji OZAWA
Professor, Takasaki University of Health and Welfare

FY2009

Study on the regulatory mechanisms for behavioral and learning choices by the habenula

Hitoshi OKAMOTO
Deputy Director/ Senior Team Leader, RIKEN

The habenula occupies bilatelally the most dorsal part of the diencephalon and relays the telencephalic limbic system with the monoaminergic neurons in the midbrain and the hindbrain. Taking advantage of the conservation of the habenula from fish to mammals, we use zebrafish, rat and mouse to reveal the functional roles of the habenula as a switchboard for the choices of behaviors based on the judgement of the emotional values of given situations. Our research may lead to the understanding of the etiology of psychiatric disorders such as the post-traumatic stress disorder (PTSD) and the savant syndrome which abnormally enables memorization of objects irrespective of their values.

Analysis of the synapse formation and the functional networks in the vertebrate retina

Takahisa FURUKAWA
Head, Osaka Bioscience Institute

We focus on the retina, a part of the central nervous system (CNS), to understand molecular and functional mechanisms underlying specific synaptic connections and neuronal networks. Toward this end, by generating various genetically engineered mice including selective neuron-disrupted mouse, we will investigate synapse formation at the molecular level, electrophysiological properties at the cell and tissue levels, and visual function at the individual level. Through these studies, we attempt to elucidate how elaborate neural networks are formed and visual information is processed in the retina.

Since FY2009

Integrative analysis of inter-region and local circuit connections in the cerebral cortex

Yasuo KAWAGUCHI
Professor, National Institute for Physiological Sciences

Neurons from discrete neocortical areas send axons near and far to numerous subcortical and cortical targets. The great diversity of neocortical neurons allows some neuron subtypes to specialize in specific projection pathways. Our research will characterize the connection specificity between cortical neuron subtypes and their projection targets. Furthermore, we will test the hypothesis that the local synaptic connectivity between inhibitory and excitatory neurons depends upon the projection targets.

Spatio-temporal representation of the motor information in the brain revealed by cutting-edge techniques

Masanori MATSUZAKI
Professor, National Institute for Basic Biology

The aim of this study is to reveal how voluntary movement is represented in cortical circuits. We will combine a number of cutting-edge techniques to clarify the activity, distribution, and connections of the cortical neurons that are involved in sequential motor phases. The activities of the cortical neurons will be modulated by using 'optogenetic' tools to clarify the direction of flow of motor information. Our results will provide insights into the principles of circuit operation and the cellular basis for recovery from brain cortical damage.

Production of various neural cell types by regulation of neural stem cells

Yukiko GOTOH
Professor, The University of Tokyo

In the cerebral cortex, different neuronal cell types are generated in a temporally defined sequence and constitute the cortical layers; neural stem cells then switch off neuron production to make glial cells. We will study epigenetic mechanisms that underlie this temporal regulation of neural stem cell fate during development. We will also study the origin of adult neural stem cells, and try to find a way to activate this population and incorporate them into the neuronal network.

Neural mechanisms underlying dynamic representations of information in the brain: state transitions in local circuits

Hajime MUSHIAKE
Professor, Tohoku University

Higher cognitive functions represent and dynamically transform multiple kinds of information in the brain to achieve behavioral goals. As the highest level in the hierarchical organization of the brain, the prefrontal cortex, in particular, is involved in representing and transforming behaviorally relevant information in coordination with cortical and sub-cortical structures. We hypothesized that a dynamic representation of information in the brain is dependent on a balance between excitatory and inhibitory activities that play important roles in maintaining and transforming the state of local neural circuits. To test this hypothesis, we will evaluate the state of neural circuits by measuring multiple cellular activities and developing a new research technique combining electrophysiology and optogenetics.

Presynaptic regulatory mechanism in neuronal communication and its postnatal development

Tomoyuki TAKAHASHI
Professor, Doshisha University

By introducing molecular tools and manipulations to giant presynaptic terminals and glia, visualized in slices and cultures, we investigate dynamic changes of electrical/Ca signals and movements of intracellular organella in association with neuronal activity, thereby clarifying how presynaptic molecules regulate transmitter release, and how they are involved in developmental and activity-dependent changes of synaptic function. Through this study, we aim at providing a novel basic insight into the molecular mechanism underlying neuronal communication, thereby contributing to clinical studies pursuing new treatments for neuronal diseases.

Neuronal circuit mechanisms underlying odor-induced motivational and emotional behaviors

Kensaku MORI
Professor, The University of Tokyo

With the goal of understanding neuronal circuit logic that translates sensory inputs into motivational and emotional behaviors, we study the function of central olfactory neuronal circuits underlying food odor-induced appetitive motivation and positive emotion and that underlying predator odor-induced fearful motivation and negative emotion. We study also the information processing mode of central olfactory neuronal circuits during the off-line periods when olfactory sensory inputs are gated, such as during sleeping and resting.

Role of C1q family signaling in regulation of synapse formation in mature brain

Michisuke YUZAKI
Professor, Keio University

Neuronal activities induce morphological changes at synapses throughout adulthood. This process is considered as a basis for long-lasting memory. In this study, we will elucidate roles of C1q family proteins in regulation of synapse formation and maintenance in adult brain. Furthermore, we will develop a method to modify neuronal circuits and its associated behaviors in vivo by regulating the C1q family signaling. The findings of these studies will have therapeutic potentials against synapse losses, which are known to occur during aging and under certain pathological conditions.

Roles of cell adhesion molecules in the formation of hippocampal neuronal circuitry

Yoshimi TAKAI
Professor, Kobe University

The critical role of the hippocampus in long-term memory formation has been well established. Mossy fibers in the hippocampus extend from granule cells to form specialized synapses with the dendrites of CA3 pyramidal neurons and a variety of inhibitory interneurons. This interconnection of excitatory and inhibitory neurons regulates neuronal activities. We will focus on the roles of the cell adhesion molecules nectins and their associated protein afadin to elucidate the molecular and cellular mechanisms of (1) target cell recognition, (2) synapse formation, and (3) neuronal plasticity. Our results will contribute to the understanding of molecular mechanisms in the formation of neuronal circuits and to the development of novel strategies for treatment of neuronal diseases.

Modes of motor information processing in primate cerebro–cerebello–basal ganglia networks

Eiji HOSHI
Project Leader, Tokyo Metropolitan Institute of Medical Science

This study aims to elucidate the neural mechanisms that underlie voluntary motor control driven by networks linking the motor-related areas in the cerebral cortex, cerebellum, and basal ganglia. To address this issue, we adopt three distinct approaches in primates. For structural analyses, we investigate the network architecture surrounding the primary motor cortex using novel anatomical methods, such as transneuronal labeling with rabies virus. For functional analyses, we examine the neuronal activity pattern simultaneously recorded from multiple brain regions in monkeys performing motor tasks, thereby elucidating the functional framework of the brain in which a final motor command is synthesized. For pathophysiological analyses, we investigate the relationship between behavioral changes in motor execution and dysfunction of each brain region or inter-regional connection.

FY2010

System analysis of the structure and function of higher order neural circuits integrating sensory information

Kei ITO
Associate Professor, The University of Tokyo

The brain combines sensory information from multiple system including vision, smell, taste, hearing, and somatosensation, to control behavior. However, the mechanisms behind the comparison and integration of different sensory modalities are not well understood. To address this issue, we will utilize the brain of the fruit fly Drosophila, a convenient model organism for visualizing and manipulating neurons at the single-cell level. By systematically analyzing the brain regions that integrate signals sent from different sensory centers, and by combining diverse experimental techniques to reveal the functions of identified neural circuits, we aim to reveal the processes underlying integration of sensory information.

Elucidation of the molecular basis of signaling cascades underlying plastic neuronal circuits via development of new probing and control technologies

Haruhiko BITO
Associate Professor, The University of Tokyo

Previous work has established that neuronal circuits comprise two kinds of connections: hardwired circuits that are genetically programmed and plastic circuits whose connectivity is strengthened in an experience-dependent manner. In this project, we will investigate the molecular basis of the activity dependence of plastic circuits at both the synapse and system levels using novel imaging techniques. Based on these findings, we will further develop new molecular tools to deconstruct, reconstruct, and control the function of plastic circuits.

Neurophysiological investigation of mechanisms of cognitive memory network in the cerebral cortex of macaques

Yasushi MIYASHITA
Professor, The University of Tokyo

Cognitive memory is based on the integrity of the widely distributed network in the brain, and the cognitive memory system provides a flexible basis for mental operations in primates. In this study, we develop novel electrophysiological approaches to examine the network functioning. We aim to reveal the mechanism by which memory neurons (e.g., pair-coding neurons and pair-recall neurons) emerge from the network of temporal and frontal association cortices and are orchestrated for cognitive function by simultaneous recording of multiple single neurons combined with coherence and Granger causality analyses.

Architecture of functional neural circuits in the cerebral cortex

Kenichi OHKI
Professor, Kyushu University

The cerebral cortex is composed of several tens of billions of neurons and is divided into tens of areas. Each area is further divided into many smaller modules, i.e., functional neural circuits. In this project, we will investigate the structure and function of unitary functional circuits in the cerebral cortex, using in vivo two-photon calcium imaging with single-cell resolution. We will explore how the unitary circuits develop and work, and elucidate the basic architecture of functional neural circuits in the cerebral cortex.

Elucidation of mechanisms of neural network reorganization and functional recovery after brain injury

Toshihide YAMASHITA
Professor, Osaka University

Initial behavioral deficits resulting from brain injury are frequently followed by spontaneous recovery of function. The basis of this behavioral plasticity is not fully understood, although neural network reorganization is expected to contribute to this resilience. It has been noted that synaptic plasticity within pre-existing pathways and formation of new circuits through collateral sprouting of both lesioned and unlesioned fibers are important components of the spontaneous recovery process, although the molecular mechanisms of these phenomena are poorly understood. We aim to elucidate the mechanisms underlying this plasticity, knowledge of which will contribute to enhancement of functional recovery after injury to the central nervous system.

Neuronal individuality providing neural circuit formation and cell assembly

Takeshi YAGI
Professor, Osaka University

The brain contains an enormous number of neurons, which are assembled into functional neural networks and also retain individuality. Clustered protocadherin (cPcdh) molecules are candidates for the molecular codes that provide neuronal individuality and specific neural network formation. In this study, we investigate the molecular mechanisms responsible for generating local neural networks and functional cell assembly in the brain by using molecular tools and manipulations to control the expression and function of cPcdh molecules. We aim to reveal the biological basis of sparse parallel-distributed processing of neural information in the brain.

Elucidation of working principles within neural networks controlling language

Kuniyoshi L. SAKAI
Associate Professor, The University of Tokyo

We aim to integrate clinical knowledge of language disorders and theoretical knowledge of language into systems neuroscience research of language. Our goal is to elucidate the computational principles underlying functional modules (i.e., syntactic and semantic processing, etc.) from the standpoint of functional differentiation and localization of language in the human brain. Our focus will be on elucidation of working principles within neural networks from the standpoint of the neural connections among modules within these networks. Furthermore, we will explore mechanisms of neural network reorganization during the sensitive period of language acquisition as well as after development of language disorders.

FY2011

Neuron–glia interaction in long-term remodeling of synapses *in vivo*

Junichi NABEKURA
Professor, National Institute for Physiological Sciences

The brain dynamically adapts its function in response to changes in the internal and external environment. Reorganization of neural circuits and synaptic connections between neurons are the key processes that underlie changes in brain function. It has been technically difficult to observe these changes in circuits and synapses in living animals. Therefore, in this study, we utilize two-photon microscopy, a technique that allows imaging of neurons and synapses in living animals over time. We specifically focus on the role of microglia and astrocytes in reorganization of synapses and neural circuits. We aim to reveal the underlying mechanisms by which the brain adapts to its environment and the role of the neuron–glia interactions in this neuronal plasticity.

Research Area

Innovative Technology and System for Sustainable Water Use

Research Supervisor:

Shinichiro OHGAKI

President, National Institute for Environmental Studies

Deputy Research Supervisor:

Mikio YODA

Senior Chief Engineer, Information & Control Systems Company, Hitachi Limited

FY2009

Development of Innovative Water and Wastewater Treatment Systems for Sustainable Urban Water Metabolism

Satoshi OKABE
Professor, Hokkaido University

In order to improve the sustainability of safe water supply, it is essential to establish new water metabolic systems that incorporate advanced water and wastewater treatment systems. In this project, we will integrate nano- and bio-technologies such as membrane separation and toxicogenomics to develop autonomous decentralized water and wastewater treatment systems as well as health risk assessment technologies for micropollutants and pathogenic microorganisms. In addition, we will evaluate the feasibility of practical use of newly developed water and wastewater treatment systems.

Application of Integrated Intelligent Satellite System (IISS) to Construct Regional Water Resources Utilization System

Shin-ichi NAKAO
Professor, Kogakuin University

In this research, we will develop a revolutionary water treatment system integrating multiple membrane technologies, distribute it within a region, and integrate it with mature technologies for using natural energy and information management technology to organically connect individual facilities, thereby constructing a completely new original regional water resources utilization system "Integrated Intelligent Satellite System (IISS)." In researching membrane technology as the basis, we will develop a new low-fouling NF/RO membrane at the molecular level, namely the water structure of the membrane surface. We will also develop an MBR system to control fouling.

Since FY2009

Development of Innovative Technologies for Increasing in Watershed Runoff and Improving River Environment by the Management Practice of Devastated Forest Plantation

Yuichi ONDA
Professor, University of Tsukuba

We develop innovative management technologies of water resources which can induce leveling and maximizing water supply by increasing droughty water discharge. Our innovate approaches also promote improving issues around water quality and quantities in order to resolve intensified water problems in the next generation. Specifically, we conduct comprehensive field observation to monitor the effects of intensive thinning practices on runoff and water quality remediation in devastated forest plantations. Based on the field investigation and obtained data matrix, we apply water resources management model which quantifying the effectiveness of forest plantation management on water supply capacity of catchment.

Development of an Innovative Water Management System with Decentralized Water Reclamation and Cascading Material-cycle for Agricultural Areas under the Consideration of Climate Change

Taku FUJIWARA
Professor, Kochi University

The goal of the present study is to develop an innovative water management system with decentralized water reclamation and cascading material-cycle applicable to agricultural areas. The perspective of climate change mitigation and adaptation is also incorporated into the development. This project is subdivided into four research areas: 1) development of an agricultural non-point source pollution control technology using catch crops, 2) development of a decentralized water/ bio-resource reclamation system, 3) construction of a cascading water/ bio-resource recycling system, 4) integrated evaluation of the novel water management system. We will contribute to guaranteeing the safety and security of water and food both in Japan and world wide by bringing this innovative water management system into fruition through our research.

Long-term Vision for the Sustainable Use of the World's Freshwater Resources

Shinjiro KANAE
Associate Professor, Tokyo Institute of Technology

The establishment of the critical level of climate change based on future projections was indispensable to setting up greenhouse gas reduction targets. Similarly, the establishment of the critical level of freshwater use based on future projections must be indispensable to avoiding and/or mitigating world water crisis. Therefore, this study tries to make future projections of the supply and demand of freshwater resources under various future scenarios, to establish the critical level of freshwater use, and to present a vision for sustainable use of freshwater resources of the world. One of the currently most advanced numerical simulation models of world freshwater resources will make these procedures possible. This study ultimately aims to contribute to "water security" of the world and Japan.

Development of Well-balanced Urban Water Use Systems Adapted for Climate Change

Hiroaki FURUMAI
Professor, The University of Tokyo

Reexamination of the use of ubiquitous water resources such as rain water, ground water, and reclaimed water is required to cope with the further localized water resources due to climate change. We develop novel evaluation approaches for risk and stability of water quality and devise methods for water use design by considering environmental cost evaluation and preferences of various users. In order to create innovative strategies for urban water use under climate change conditions, comprehensive predictions is carried out to evaluate changes in weather and hydrological conditions in watersheds resulting in dynamic variations of water quantity and quality. Finally, we propose well-balanced urban water use systems in which the equilibrium between water supply and demand is maintained.

Development and Evaluation of Water Reuse Technologies for the Establishment of 21st Century Type Water Cycle System

Hiroaki TANAKA
Professor, Kyoto University

In order to establish a novel urban water cycle system appropriate for the 21st century, we are going to develop innovative water reclamation technologies for cascade use of river water, sewage, treated wastewater, etc. The developed technologies will be assessed from the viewpoint of energy consumption for treatment, as well as control ability of risk agents in the reclaimed water. The applications of the reclaimed water by the developed technologies will be characterized in consideration of safety levels of the water, and the novel urban water cycle system with the developed technologies will be evaluated from the viewpoint of integrated water resources management including water availability, water safety, energy consumption including water transportation and treatment, and environmental effects. Finally, the novel urban water cycle systems applying the developed reclamation technologies will be compared with the conventional systems and a custom-made system applicable for specific areas will be proposed.

FY2010

Development of Innovative Regulatory Techniques of Microbes for Wastewater Treatment with Nanotechnology and Biotechnology

Tsukasa IKEDA
Professor, Utsunomiya University

This project aims to develop the innovative techniques for wastewater treatment systems with nanotechnology and biotechnology. For this purpose, new regulatory techniques of communication systems in microbes will be developed using nanomaterials. These technologies should be beneficial not only for improvement wastewater treatment systems with activated sludge, but also for prohibit biofouling and biofilm formation.

New Water Reuse System using Urban Aquifer with Advanced Risk Management

Sadahiko ITOH
Professor, Kyoto University

The primary goal of this project is the development of a new urban water reuse system aided by the conversion process of water quality in subsurface environment for the adaptation to climate change in the near future. In this system, after wastewater treatment to a suitable level for subsurface infiltration process, urban wastewater is converted into a source of drinking water in the subsurface environment. In this project, we focus on the subsurface infiltration process and address the following issues: 1) Acceptable wastewater quality for subsurface infiltration process, 2) Conversion process of water quality in subsurface environment, 3) Sustainability of this water reuse system. We also propose the technical requirements of this subsurface infiltration process with advanced risk management based on quantitative microbiological risk assessment (QMRA) and high-sensitivity monitoring of micropollutants.

Development of Integration and Installation Technologies for Monitoring Network System of Water-quality based on Model-based design Technique

Ryo MIYAKE
Professor, Hiroshima university

Monitoring network system of water-quality for regional water-circulation is essential to provide an environment in which the customers can use water in more safety and in more carefree manner. We develop integration and installation technologies of the system based on the model-based design technique, which allows us to check the performance quickly without building prototypes from their elements level to the network level. Through the use of the technologies, some sorts of on-site monitors are built experimentally.

Development of ROBUST Reverse osmosis (RO) / Nanofiltration (NF) Membranes for Various Types of Water Resources

Toshinori TSURU
Professor, Hiroshima University

Membrane separation is one of the most important technologies for water-reuse and water-reclamation with health and sustainability. Japan has been proud of its advanced manufacturing technologies and showing the largest share of membranes on the global market, but there are still challenges, including membrane fouling and difficulties in membrane cleaning. In this project, our team will develop ROBUST reverse osmosis (RO)/nanofiltration (NF) membranes which can be used for waters containing chloride, in a wide pH range and/or at high temperatures. Moreover, ROBUST membrane will be examined with various types of water resources to demonstrate the applicability. Through the present developments, we expect Japan will be continuously one of the leading-countries in membrane technologies and membrane-treatment systems.

Sustainable Groundwater Management Systems under Enhanced Geo-Thermal Energy Usage

Toshiko KOMATSU
Professor, Saitama University

Recent studies suggest that the temperature rise in shallow groundwater is caused by global warming and/or heat-island phenomena. Further, with the recent increase in Geo-Heat Pump (GHP) system utilization, there is a high possibility that subsurface thermal disturbances will affect both groundwater quality and microbial ecosystems. In this research project, an environmental assessment tool for evaluating effects of thermal disturbances on microorganisms and their biodiversity, geo-mechanical properties, and the fate and transport of environmental impact chemicals in the geo-sphere will be established. This tool will be used to develop sustainable groundwater management systems with optimal protection of the groundwater environment.

FY2011

Innovation of Water Monitoring System with Rapid, Highly Presice and Exhaustive Pathogen Detection Technologies

Tatsuo OMURA
Professor, Tohoku University

Current measures against the spread of infectious diseases transmitted via water circulation system are vulnerable, and bring social unrest to those who desire for securing safe water. Our goal is to establish a new water monitoring system to reduce the number of infectious gastroenteritis patients which amounts to 5,600,000 cases every year. We will develop rapid, highly precise and exhaustive detection methods for pathogens in the water environment. By frequent monitoring of urban wastewater with the new detection methods, warnings can be issued immediately after the transmission of infectious diseases. With this system, we expect the number of infectious gastroenteritis patients be significantly reduced, because it helps us to take immediate response in order to control the spread of infectious diseases before the diseases become prevalent.

Water-saving System for Advanced Precision Agriculture (WSSPA)

Sakae SHIBUSAWA
Professor, Tokyo University of Agriculture and Technology

A technological system for site-specific irrigation management aims to meet the need of plant growth by using a precise control technique for water resources in the rooting zone, followed by high efficiency uses of agricultural water. The system involves various technologies including precise monitoring of water content in the rooting zone, on-line real-time precision irrigation, using differences in soil water resources, re-using and recycling of water resources, and identification of soil water parameters to describe the crop needs for water, towards the development of an energy-efficient and water-saving plant factory system. The proposed system will be also applicable to water-saving agriculture in arid lands.

A tracer Simulator of Fallout Radionuclides for Safe and Sustainable Water Use

Taikan OKI
Professor, The University of Tokyo

For sustainable water use, a technology to diagnose and predict properly whether the water is suitable for human usage is indispensable. This study will develop a simulator which is capable to estimate how fallout radioclides, such as iodine 131 and cecium 137, are transported in the atmosphere, fall along with rainfall, and flow down through streams with sediments. The simulator will also enable us to estimate the timing when these fallout radioclides arrive at the intake of water purification plants and their concentrations. The simulator will support securing the safety of drinking water through temporary shutoff of intakes and/or proactive water treatments, and is expected to contribute for realizing secure and untroubled water use.

Sustainable Groundwater Management System based on Regional Hydrologocal Cycle

Jun SHIMADA
Professor, Kumamoto University

Dependance on groundwater as water resources has been rapidly increased in many areas over the world because of the recent global warming and abrupt growth of world population. For the stable supply of water resources, it is urgently required to establish the sustainable groundwater management system based on the regional hydrological cycle. This project aims to establish the groundwater management system based on the regional groundwater flow system for its quantitative aspects and also to develop the on-site reduction method of the nitrate concentration in the groundwater and to develop the advanced nitrate monitoring system based on the freshwater fish for its qualitative aspect. The project will start to develop the methodologies at Kumamoto area, where is the most advanced groundwater utilization area in Japan, and then will apply the developed system to the remote coral islands, where stand on the edge of a precipice of groundwater quantity and quality.

Development of Innovative Technologies to Exploit Groundwater Resources in Mountainous Regions in order to Achieve a Sustainable Supply of Unpolluted High-quality Water

Ken'ichirou KOSUGI
Associate Professor, Kyoto University

In order to mitigate water problems that will intensify with climate change, and to achieve a sustainable supply of unpolluted high-quality water, it is essential to exploit natural water resources that are safe from contamination and disasters. By effectively combining hydrological observations, remote sensing, and geophysical surveys, this study develops innovative technologies to discover and exploit groundwater resources in mountainous headwater regions efficiently. These technologies enable the utilization of mountains, which cover 73 % of the national landmass, as natural reservoirs. As a result, it is expected that diverse water resources will be ensured, which will contribute to the achievement of a sustainable supply of unpolluted high-quality water, and the occurrence of floods and sediment disasters will be mitigated.

Research Area

Fundamental Technologies for Medicine Concerning the Generation and Regulation of Induced Pluripotent Stem (iPS) Cells

Research Supervisor:
Toshio SUDA
Professor, Keio University

FY2008

Mechanism of Reprogramming by Germ Cell Histones

Shunsuke ISHII
Chief Scientist, RIKEN

Modification of histones play an important role for regulation of gene expression during development. We have found that the histone variants expressed in oocyte and testis also present in the early embryo. We also found that these histone variants have the capacity to reprogram somatic cells. In this research, we are attempting to study the mechanism of reprogramming by these histone variants, and to contribute to establish the basic technology for reprogramming of somatic cells.

Isolation of Molecular Markers that Represent Pluripotency and Tumorigenicity of Human iPS Cells

Haruhiko KOSEKI
Group Director, RIKEN

Towards clinical application of human iPS cells, one of essential prerequisites is to gauge levels of the efficacy and security during its therapeutic use. To this end, we first establish therapeutic models by using haematopietic lineage cells derived from human iPS cells in totally immuno-compromised mice. We then reveal gene expression and epigenetic profiles of various human iPS cells genome-widely. By combining these data, we try to squeeze molecular markers that represent pluripotency and tumorigenicity of human iPS cells.

Manipulation of Epigenetic Status of Hematopoietic Stem Cells for Regenerative Medicine

Atsushi IWAMA
Professor, Chiba University

Generation of self-renewing human hematopoietic stem cells (HSCs) from ES cells or iPS cells is a challenging project. Our proposal aims to solve this problem. To this end, we first understand the epigenetic status, particularly the histone modification profiles of adult HSCs. We also characterize the role of polycomb genes, important regulators of histone modifications, in the maintenance of HSCs and reprogramming of hematopoietic cells to pluripotency. These approaches should provide critical epigenetic regulatory machinery that determines adult HSCs. Finally, we identify the epigenetic programs essential for generation of adult HSCs from iPS-derived embryonic hematopoietic progenitors. By applying all these results to HSC induction from iPS cells, we hope to provide a road map for iPS cell-based regenerative medicine in the lympho-hematopoietic field.

Analysis of Abnormal Regulation of Cell Differentiation and Drug Development Research by using Induced Cancer Stem Cells

Hideyuki SAYA
Professor, Keio University

We have succeeded to generate cancer stem cells which possess the capacity to self-renew and to cause the heterogeneous lineages of cancer cells from normal somatic cells by introducing particular genetic alterations. In our proposed project, we intend to develop cell-based assay systems using the induced cancer stem cells (iCSCs), which can be applied to screening of chemical compounds and antibodies that suppress the tumorigenic activity by controlling cell differentiation and niche function. In addition, we would like to generate human iCSCs from differentiated human somatic cells for drug targets.

Invention of Devices for Elevating Security Level of iPS Cells Through Understanding the Molecular Mechanisms of iPS Cell Generation

Akihiko OKUDA
Professor, Saitama Medical University

iPS cells have many advantageous characteristics compared to ES cells such as avoidance of ethic issue and immune-rejection problem. However, iPS cells have apparently one major drawback about the safety issue compared to ES cells for the potential source of regenerating medicine. In our laboratory, we will perform experiments to lower the risk of iPS cells including trial for generating iPS cells with integration-defective lentivirus. We will also try to elucidate the molecular bases of iPS cell generation in order to obtain clues to elevate safety level of the cells.

Analysis of Reprogramming Mechanism of Germline Stem Cells

Takashi SHINOHARA
Professor, Kyoto University

Germline stem cells from the postnatal testis can convert into ES-like, multipotent germline stem cells without any genetic treatment. We will examine 1) the differences between SSCs and ES cells, 2) analyze the reprogramming machinery, and 3) derive mGS cells from a variety of animal species.

Towards Ideal iPS Cells for Gene Therapy and Regenerative Medicine using a Human Artificial Chromosome (HAC)

Mitsuo OSHIMURA
Professor, Tottori University

This study aims 1) Induction of safe iPS cells using human artificial chromosome (HAC) which has several characteristics i.e., stable episomal maintenance that avoids insertional mutations and the ability to carry large and multiple gene inserts including their regulatory elements, and 2) Basic study on gene and cell therapy for Duchenne's muscular dystrophy and diabetes, using the HAC containing defective gene and several genes for induction and monitoring of differentiation.

Research on iPS Cell-Derived Dendritic Cells and Macrophages Aiming at Clinical Application

Satoru SENJU
Associate Professor, Kumamoto University

In this project, based on our study using mouse and human ES cells, we will establish methods to induce differentiation of human iPS cells into dendritic cells and macrophages. Our project also includes basic research for clinical application of such iPS cell-derived immune cells.

Since FY2008

Analysis of the Transcription Factor Network Governing Establishment of Pluripotency in Somatic Cells

Hitoshi NIWA
Project Leader, RIKEN

It is a mystery why the combination of few transcription factors is sufficient to establish pluripotency in somatic cells. In this research project, we will try to disclose this mystery by analysing the structure of the transcription factor network encoded by the genome.

A Comprehensive Analysis of the Mechanism Underlying the Genome-wide Epigenetic Reprogramming in the Germ Cell Lineage and Its Application

Mitinori SAITOU
Professor, Kyoto University

Germ cell development involves genome-wide epigenetic reprogramming, which occurs in a highly ordered fashion. Unveiling the mechanisms involved in this process would be important for understanding the molecular logic for epigenetic reprogramming in general, which will shed a new insight into the mechanisms underlying iPS cell induction. In this project, we aim to reveal the nature of genome-wide epigenetic reprogramming associated with early germ cell development at a high resolution, to clarify the molecular mechanisms inducing this event, and to reconstitute this event in vitro. These studies will serve as an important basis for the development of regenerative medicine.

Molecular Mechanisms of Transcriptional Regulation in Cell Reprogramming and Differentiation

Eisuke NISHIDA
Professor, Kyoto University

This study aims at (I) elucidation of molecular mechanisms of changes in transcriptional programs during cell reprogramming, (II) understanding of transcriptional programs in cell differentiation processes, (III) establishment and molecular analyses of automated programs for transdifferentiation, and (IV) analyses on the action mechanisms of transcription factors and the molecular mechanisms of epigenetic regulation. Thus, this study will provide molecular bases for generation of various tissues and organs from iPS cells.

A Novel and Efficient Method of Cellular Reprogramming using Human Artificial Chromosomes (HACs).

Yoshihiro YONEDA
Professor, Osaka University

Generating iPS cells from patient's somatic cell will become one of the most important techniques for future regenerative medicine. To overcome several issues of a current method of iPS generation, which utilizes viral vectors for transgene delivery, we will attempt to develop a new method using next-generation human artificial chromosomes (HACs). Further, we will extend our research based on novel insights into the interplay between reprogramming factors and their nuclear import/export receptors. By regulating the environment of nucleo-cytoplasmic molecular transport, we will try to further increase the efficiency of cellular reprogramming.

Analysis of Molecular Mechanisms Involved in Physiological Cell Reprogramming

Nobuyuki TAKAKURA
Professor, Osaka University

It has emerged that somatic cell reprogramming occurs in vivo physiologically and endogenously. We have recently found the possibility that the hematopoietic stem cell (HSC) population induces reprogramming of somatic cells into the stem cell lineage through delivery of stemness factors. This reprogramming method may be utilized for regenerating damaged tissue under physiological conditions. We will attempt to define this physiological pathway of cell reprogramming at the molecular level and believe that this will contribute to the development of new technology for tissue regeneration.

FY2010

Direct Reprogramming of Fibroblasts into Cardiomyocytes by Defined Factors and Its Application to Potential Regenerative Therapies

Masaki IEDA
Project Assistant Professor, Keio University

Heart disease is a leading cause of mortality. Because cardiomyocytes have little or no regenerative capacity, cardiac regeneration is a very exciting therapeutic approach. Pluripotent stem cells possess cardiogenic potential, but efficiency of cardiac differentiation, risk of tumor formation, and survival of transplanted cells must be overcome. We recently found that a combination of three developmental transcription factors reprogrammed cardiac fibroblasts directly into cardiomyocytes in mouse. We will investigate the mechanism of cardiac reprogramming and advance this new technology for potential regenerative therapies.

FY2009

Development of Personalized Preventive Medicine Toward Neurodegenerative Diseases Based On Pathomechanistic Insight Explored by iPS Cell Technology

Haruhisa INOUE
Associate Professor, Kyoto University

Recapitulation of disease-niche, by using neural cells from disease-specific iPS cells of Alzhemimer's disease or Amyotrophic lateral sclerosis, will make it possible to monitor misfolded protein, and to evaluate the responsible molecule(s) for neurodegeneration by genetic analysis or by animal experiments. The research will develop the concept, "early diagnosis and treatment", which is critical for conquering neurodegenerative diseases, into personalized preventive medicine.

In vivo Directed Reprogramming of Neural Crest Cells

Yoshiko TAKAHASHI
Professor, Nara Institute of Science and Technology

The iPS technology has opened a way to reprogram differentiated cells into other cell types. Progress of iPS research has mostly been made in vitro system, which requires a long-term cell culture and subsequent cell transplantation into host animals. We aim to establish an in vivo directed reprogramming technology with neural crest cells as a model. Neural crest cells are a population of stem cells that give rise to peripheral nervous system and pigment cells. The principle of technology developed for neural crest cells can also be applied to other cells/tissues, and it will therefore serve as a general basis for advanced regenerative medicine.

Search for Pathogenesis and Novel Therapeutics of Hematological Malignancies Based on Generation of iPS Cells From Primary Tumor Cells

Mineo KUROKAWA
Professor, The University of Tokyo

Primary tumor cells from patients with hematological malignancies are ideal sources for the research of pathogenesis and therapeutics, but it is often difficult to obtain them sufficiently. In this study, we reprogram patient-derived tumor cells into iPSCs and expand them through re-differentiation into hematopoietic cells. Using these cells, we perform extensive studies which require a large number of living cells such as epigenomics, proteomics, functional genomics, and drug screening. Through these analyses, we aim to elucidate disease mechanisms and establish novel targeted therapies for hematological malignancies.

Analysis of Molecular Basis of Stem Cell Generation using Guided Differentiation of iPS Cell into Tissue Stem Cells

Takumi ERA
Professor, Kumamoto University

The tissue stem cells such as mesenchymal and hematopoietic stem cells and renal progenitors are invaluable to the medical therapies for intractable diseases. This study aims 1) Establishment of induction method from iPS cell into tissue stem cell through identifying the intermediates during iPS cell differentiation, and 2) Elucidation of molecular mechanism of stem cell development using iPS cells. Our results are expected to contribute to the generation of the new basis that can not only help promote the conventional treatment with tissue stem cells but also facilitate the development of novel therapies using tissue and induced-pluripotent stem cells.

Directed Induction of Chondrogenic Stem / Progenitor Cells from Dermal fibroblast Culture by Defined Factors

Noriyuki TSUMAKI
Professor, Kyoto University

The generation of iPS cells has enabled full reprogramming of somatic cells into pluripotent stem cells, followed by differentiation to other cell types of diseased organs. Alternatively, we aim to induce chondrogenic stem / progenitor cells directly from mouse dermal fibroblast culture by employing methods of directed reprogramming. Induced cells could produce homogenous cartilage tissue in vivo, providing materials with joint diseases in regenerative medicine. This approach induces cells without reversion to a pluripotent stem cell state, possibly reducing a risk of tumorigenesity and producing homogenous tissues of diseased organs.

The Generation of High-Quality Human iPS Cells and Their Characterization

Yutaka HANAZONO
Professor, Jichi Medical University

There are considerable differences between human and mouse iPS cells in the developmental state. Mouse iPS cells are closer to the ground state than human iPS cells. iPS cells derived from other animals (e.g. monkeys and pigs) are similar to human iPS cells in terms of the developmental state. The purpose of this study is to bring human, monkey, and pig iPS cells into the ground state to generate high-quality ones. We will also show what we can do using the high-quality iPS cells (dissociated culture, homologous recombination, animal developmental engineering, etc.).

Construction of Functional Liver Tissues using iPS Cells

Atsushi MIYAJIMA
Professor, The University of Tokyo

Functional hepatocytes are necessary for regenerative medicine, drug discovery and bioartificial liver.This project is aiming at reconstruction of three dimensional liver tissues in vitro using hepatocytes in combination with hepatic non-parenchymal cells. The ultimate goal is to make fully functional liver tissues in vitro using human iPS cells, which can be used for drug development.

Establishment of the Mouse Model with Human Liver Derived from iPS Cells and Its Use for Experimental Therapy

Ken-ichi YAMAMURA
Professor, Kumamoto University

To test the safety and usefulness of human iPS derived liver cells in vivo, we develop 1) optimum mouse for transplantation of human liver cells, 2) mouse with human liver, 3) mouse with human liver derived from iPS cells of patients with human genetic diseases, 4) ideal mouse model for patho-physiological analysis and experimental therapy.

Chemical Regulation of Nuclear Epigenome and Mitochondrial Genome

Minoru YOSHIDA
Team Leader, RIKEN

Epigenetics in the nuclear genome, which is mainly controlled by histone modifications, plays an important role in reprogramming and cellular differentiation. Compared to the nuclear genome, mutations accumulate more frequently in the genome of mitochondria, which is involved in aging and age-related diseases. Reprogramming of not only the nuclear but also the mitochondria genome is desired for ideal regeneration therapy using induced pluripotent stem (iPS) cells. This project aims at developing new technologies to enhance reprogramming and differentiation by identification of bioactive compounds that regulate epigenetics and mitochondrial DNA metabolism.

Research Area

Enhancing Applications of Innovative Optical Science and Technologies by making Ultimate Use of Advanced Light Sources

Research Supervisor:
Tadashi ITOH
Professor / Vice Director, Institute for Nano Science and Design, Osaka University

FY2008

Elucidation of Elementary Dynamics of Photo-Induced Phase Transition by using Advanced Ultrashort Light Pulses

Shinichiro IWAI
Professor, Tohoku University

Photo-induced phase transition is the most dramatic and complicated phenomenon related to interaction between light and solid-phase materials. In this study, we attempt to elucidate the primary dynamics of photo-induced phase transition using ultrashort pulses with a time scale of several periods of the carrier oscillation of electric field of visible light (<10 fs), infrared (ca.10 fs), and terahertz (ca.1 ps) regions. Elementary dynamics of charge, spin, and lattice that are driven by the light are clarified. Ultrafast control of the electronic properties of the highly correlated system, which can be achieved using ultrashort light pulses, will indicate the directions of the development of new light sources.

Development of Novel Quantum Manipulation and Measurement Methods using Ultranarrow-Linewidth Lasers

Yoshiro TAKAHASHI
Professor, Kyoto University

We develop ultrastable lasers with the linewidths of a few Hertz and even sub-Hertz. Through the application of such lasers to laser-cooled two-electron atoms in an optical lattice, we establish novel quantum manipulation and measurement technique for a single atom in an optical lattice by exploiting an optical magnetic resonance imaging method as well as a novel quantum measurement scheme utilizing a spin-squeezing technique. With these innovations we will realize a proto-type of optical lattice quantum computer and an optical lattice clock with increased precision.

Optical Science of Vector Beams and Nano-Imaging

Shunichi SATO
Professor, Tohoku University

Vector beams, which can be generated only by simultaneous and precise control of polarization, phase and intensity distributions, are one of the state-of the-art laser beams. Our goal is to exploit a new field of optical science by systematic investigation of behavior of light around a focal region, where innovative and functional features of the vector beams dominantly manifest. In addition, the development of unprecedented super-resolution optical microscopy, which enables nano-imaging in the far field, is propelled by performing interdisciplinary research with material and life sciences.

Transportation of Viral RNP in Nucleus and Manipulation of Chromosome using Optical tweezers: Challenge to Remove Viral Genome from Host Cell Nucleus

Ayae HONDA
Professor, Hosei University

After influenza virus infection, the viral genome RNA-viral RNA polymerase-NP complex (vRNP) is transported into nucleus, where transcription and replication of the viral genome takes place. Using the fluorescein-labelled virus, vRNP and the optical tweezers, we will perform: i) virus infection on to a single cell for monitoring single virus growth; ii) transportation of vRNP in nucleus; and iii) measurement of the power for vRNP transportation. Our research will be extended for development of a novel optical tweezers system to be used for manipulation of the chromosome and for removal of the viral genome from infected cell nuclei.

Development of Coherent Soft X-Ray Laser with High Repetition Rate and its New Application to Photoemission Science

Shik SHIN
Professor, The University of Tokyo

The advent of fiber laser will make new solid state science in soft X-ray region that can not be studied by the conventional laser. We will develop new materials science by laser photoemission with ultra-high energy resolution, ultra-fast time resolution, and ultra-high space resolution.

FY2009

In vivo optical Imaging and Optical Manipulation by using a Novel Multiphoton Microscopy with Advanced Ultrashort Light Pulses and their Application for Cancer Research and Medicine

Takeshi IMAMURA
Professor, Ehime University

In order to establish an innovative "*in vivo*" optical imaging, we will develop a novel non-linear optical microscopy by combining with adaptive optics and advanced light sources including an optical parametric oscillator, a supercontinuum light source and a small size femtosecond mode-locked laser source. The multiphoton microscopy will enable real-time image of multiple events in cancer cells and their microenvironment, and our research will facilitate development of novel light sources.

Ultrafast Photoelectron Spectroscopy using VUV and Deep UV Filamentation Light Sources

Toshinori SUZUKI
Professor, Kyoto University

Ultrafast electron dynamics in chemical reaction is investigated by time-resolved photoelectron imaging spectroscopy using a novel VUV and deep UV filamentation light source, Experimental results are compared with ab initio molecular dynamics simulations to elucidate reaction mechanism of complex molecular systems.

Optical Nano-imaging using Nano-optical source Excited by Focused Electron Beam

Yoshimasa KAWATA
Professor, Shizuoka University

The objective of this research is to develop ultra-high resolution optical microscope which has ten nanometer spatial resolution laterally and can be observed dynamic behaviors of specimens under various circumstances. The microscope integrates the advantages of optical and electron microscopes, and contributes to science innovation.

Development of the Frontier of Nonequilibrium Materials Leaded by Optical Science

Shin-ya KOSHIHARA
Professor, Tokyo Institute of Technology

Development of techniques for probing the lattice-electronic combined structural dynamics in nano-scale is essential to open new frontier of materials science. These technologies will realize new class of materials which shows highly sensitive photo-induced phase switching. Especially, dynamical X-ray structural science combined with domain observation by time-resolved PEEM will be powerful tool for promoting this new research field. We develop new light source for these probing technologies and an appearance of new field of materials science which can be named as 'nonequilibrium material science under critical condition', beyond the hitherto structural science.

FY2010

Coherent Control in the Condesed Phase with Attosecond Precision

Kenji OHMORI
Professor and Chairman, National Institutes of Natural Sciences

Coherent control is a technique that controls matter waves with light. We will develop a novel quantum simulator where our spatiotemporal coherent control with picometer and attosecond precision is combined with an ensemble of ultracold atoms or molecules trapped in an optical lattice. Methodology for observing and controlling many-body quantum systems obtained with this simulator will be applied to bulk solids to realize coherent control in the condensed phase.

Toward the Realization of Monocycle Entangled Photons for Novel Nonlinear Quantum Optics

Shigeki TAKEUCHI
Professor, Hokkaido University

Photons entangled on timescales of one period of the light field oscillation represent the ultimate limit of quantum correlations in time and frequency. In this project, we aim to generate such monocycle entangled photons by developing sophisticated quasi-phase-matched nonlinear optical devices. This optimization of the spectral and temporal features of light enables us to explore new aspects of optical nonlinearities at the quantum level, e.g. enhanced two photon absorption and related non-linear two photon interactions, or ultra-sensitive measurements in quantum metrology.

Material Control by Topological Light-waves with Total Angular Momentum

Takashige OMATSU
Professor, Chiba University

Topological light-waves, showing a total angular momentum defined as the vector sum of the orbital and spin angular momenta, provide a new quantum-mechanical scope for optics, and they can also lead to important new applications including the nano-scale processing of materials such as micro-needle fabrication. We are aiming to open novel photonic science fields and create new optical technologies by utilizing the topological light-waves produced by ultra-high-power laser technology and extreme nonlinear optics.

Since FY2008

Advanced Terahertz Spectroscopy with High-power Terahertz Light Source and its Application to Materials Science

Koichiro TANAKA
Professor, Kyoto University

We will develop a tunable high-power terahertz light source whose peak electric field is comparable to that inside the active semiconductor device and try to establish a novel non-linear terahertz spectroscopy for solid, liquid, and biological materials. We will visualize terahertz coherent transients in mesoscopic structures with real-time near-field terahertz microscope and semiconductor quantum structures using high-power terahertz light source. These advanced terahertz technologies will open new aspects in solid state physics such as nonperturbative nonlinear optical processes.

Study of the Imaging and Photo-activation of Cellular Systems, and Mechanism of Photo-damage and Uncaging of Caged Molecules

Takayoshi KOBAYASHI
Professor, The University of Electro-Communications

Two laser systems are to be developed. ① Multi-color lasers with high stability, high spatial and frequency and temporal coherence with minimum satellite. ② Three different deep ultraviolet-near ultraviolet pulse lasers with most suited properties to the ultrafast spectroscopy. Using laser systems ① interactions among many proteins and signal molecules are spatially and temporally resolved. Furthermore physiological processes are triggered by stimulation with the multicolor pulses with simultaneous observation of the process. Using laser systems ② the mechanisms of photo-damaging processes of biomolecules and biopolymers and uncaging processes of caged molecules are to be established. By these methods new methodologies of understanding the mechanisms of cancer, memory, immune, and photo-damage are to be established.

Development of Ultrafast Atomic-scale Imaging Device using Laser-plasma-driven Single Electron Bunch

Tomonao HOSOKAI
Associate Professor, Osaka university

We are going to develop a single-shot electron imaging device with the femtosecond temporal and the atomic-scale spatial resolutions, which enables us to observe ultra-fast transient phenomena in condensed matter.
In order to establish a high-performance ultra-short-pulse electron source for the imaging device, we shall elaborate a laser-plasma-driven electron injector, called the Laser Virtual Cathode (LVC) and based on the laser plasma electron acceleration, as well as the photo-controlled RF cavity techniques. In addition, we will expand the pulsed-power-driven electro-magnetic optics as the key component of the imaging system, which must be synchronized with the laser-driven electron pulses from the LVC.

Development and Applications of Scanning/ Transmission X-ray Microscopy with Coherent X-rays

Kazuto YAMAUCHI
Professor, Osaka University

We develop an adaptive optical focusing system that allows synchrotron radiation X-rays to be utilized without loss of coherence and flux, and applied it to the construction of a microscope system. In this system, the size of an X-ray beam can be varied from microscale to nanoscale by controlling its wavefront. We incorporate this focusing method into a scanning/transmission X-ray microscope system that enables the simultaneous visualization of electron density, elements and chemical bonding states.

Research Area

Creation of Nanosystems with Novel Functions through Process Integration

Research Supervisor:

Jun'ichi SONE

Vice President, National Institute for Materials Science

FY2008

Highly Functional Nano System Fabricated by Bio Frontier Process

Yukiharu URAOKA
Professor, Nara Institute of Science and Technology

Bio supramolecule has fascinating features such as size uniformity or self-assembling ability. Various kinds of self-assembled supramolecules designed based on the DNA information are fabricated on semiconductor substrates one to three dimensionally to develop new functionality. New functional devices such as switch, memory, bio sensor and MEMS sensors will be proposed based on the new concept as well as complete understanding of self-assembling process of new materials.

Development of Electronics on Self-Organized Graphite Sheets

Hiroshi FUJIOKA
Professor, The University of Tokyo

We will develop electronics using the state of the art top-down nano-technology on bottom-up self-organized low-cost graphite sheets with atomically flat surfaces that posses various advantages such as high thermal conductivity, high electrical conductivity, and flexibility. We will fabricate new functional semiconductor device system by the combination of high intensity LEDs, high speed electron devices, and high efficiency solar cells with this technique.

Biomedical Nano-system using Ion-Imaging Sensors Technology

Kazuaki SAWADA
Professor, Toyohashi University of Technology

Frontier research on biological cell/electronics integrated devices, in which biological elements (cells and neurons) and electronic circuits (VLSI) are integrated, is proposed by using Ion image sensors technology. By combining neurons and Ion image sensors, we can realize devices that have a learning capability (flexible functions) and electronic devices with integrated parts having biological functions.

Biotransistors with Bio-Functional Nano-Structured Gates

Yuji MIYAHARA
Professor, Tokyo Medical and Dental University

Electrostatic interaction between electrons and biomolecules is investigated using biotransistors with biofunctional gate structure. By controlling interfaces among biomaterials, organic molecules and semiconductor devices, biomolecular recognition and cell function are detected without labeling materials and non-invasively. Interdisciplinary field between biotechnology and electronics will be explored and developed through investigation on principles of biotransistors.

Electrochemistry-Based Biohybrid Devices

Matsuhiko NISHIZAWA
Professor, Tohoku University

The interface between biomolecules and device materials is one of the most important subject for both in-vitro and in-vivo biodevices. We are planning to study the potential use of microelectrode techniques as powerful tool for controlling bionic interfaces: special control of cell adhesion / growth; immobilization of proteins within a microfluidic device just prior to analysis; in-situ microcircuit formation with conducting polymers during cell cultivation. These electrochemical techniques will be applied to develop novel biohybrid devices including enzymatic biofuel cells.

FY2009

Development of Optoneuroelectronics Device and its Function and Applications

Tsuneo URISU
Professor, Nagoya University

We have succeeded in the development of incubation type ionchannel biosensor, which can measure precisely the ionchannel currents passing through the post synaptic membrane. In this research, we are going to form the neural network in the ionchannel biosensor and measure the memory and learning function of the network by inducing the action potential using laser irradiations. Furthermore, we are going to make the device multichannel type by using the top level nanofabrication technique, and develop the high through put screening device, which is useful for the analysis and drag discovery with the neurodegenerative diseases and also for unveiling of the higher order function of brain.

Functional Integrated CNT Flexible Nano MEMS Devices Fabricated by Self-Assembling Processes

Kenji HATA
Team Leader, Advanced Industrial Science and Technology

We would develop the fundamental fabrication process of nanotube devices and integration techniques with different materials to realize a CNT-MEMS industy in the future.We would combine the bottom-up and top-down techniques to self-assemble the nanotubes to realize CNT-MEMS devices with controlled shape and position, and designed functions.

Creation of Novel Functional Devices Explotting Peculiarity of Extended-Nano Space

Takehiko KITAMORI
Professor, The University of Tokyo

The extended nano, 10^{1}-10^{3} nm space is a unique space composed of only interfacial field. Our research group has found that unique properties appear on fluid characteristics and chemistry there, and demonstrated that those properties could open new horizon of micro/nano science and technology. This research aims to create novel device engineering exploiting the unique properties of the extended nano space, and realize new functional nano devices contributing to chemical, biological and energy fields.

Control of Quantum Effect in 3D Nano Structure to Develop New Functions Using Bio-template and Ultimate Top-down Etching

Seiji SAMUKAWA
Professor, Tohoku University

By combination of damage-free neutral beam etching and dense spherical bio-molecule template, we will develop super-high efficiency quantum-dot laser and quantum-dot solar cell. Additionally, through studying the carrier transport in the 2-dimensional array of silicon and compound semiconductor, we will prove the quantum dot size effect, miniband formation, and multiple exiton generation and then establish the method to control the quantum structure.

FY2010

Generation of Nanointegration of Heat, Electricity and Motion by Spin Current

Eiji SAITOH
Professor, Tohoku University

By fusing spintronics and nanomachining technique, we establish a new system of technology realizing quantum-mechanical conversion in between electricity, heat and motion. It has been made clear that in nanoscale various interactions between electron and nuclear exist via "spin current", flow of rotation of electron. By fusing these interactions in nanoscale, electric generation, driving of motion and heat energy conversion based on the principle of quantum mechanics is realized.

Large-Area Nano-Systems for Applications to Interfaces

Takao SOMEYA
Professor, The University of Tokyo

By improving substantially the controllability of molecular self-assembly and printing, I and my research team will establish a new scheme, which we refer to as "nanoprinting", to introduce nanofunctions in meter-scale large-area systems. And thus by integrating various nanofunctions on a plastic film, we will realize a novel sheet-type nano-system. This is a research challenge to show its feasibility as a machine interface that assists people by covering the surfaces of objects—ideally.

Digital Counting Systems for Biological Assay

Hiroyuki NOJI
Professor, The Univeristy of Tokyo

This project aims to develop novel microsystems for counting biomolecules and virus at single-molecule or single-particle level, based on our original techniques; femtoliter chamber array systems and ultra high-speed imaging of Brownian particles. The Microsystems are directly coupled with CMOS imaging sensor chips to develop portable and cheap clinical assay systems. It would allow us, for example, the detection of disease marker molecule in very early stage and the prevention of pandemic virus.

Development of Novel Nanosystems by Hierarchically Assembling Concentrated Polymer Brushes

Yoshinobu TSUJII
Professor, Kyoto University

We succeeded in preparing a new type of polymer assemblies, a concentrated polymer brush, with novel structure and properties. This project aims at fabricating new/novel nanosystems by hierarchically assembling such brush structure and then at developing new devices such as a all-solid lithium-ion microbattery and a non-invasive/ wearable sensor monitoring tear glucose.

Electrochromic Color-E-Paper

Masayoshi HIGUCHI
Group Leader, National Institute for Materials Science（NIMS）

To achieve the next generation display that contributes to energy conservation and the saving resource, we create reformative, electrochromic materials in which RGB and colorlessness are expressible and develop color electronic paper with them. We also reveal electronic and optical properties of organic-metallic hybrid polymers, a new series of electrochromic materials. Our research continuously proceeds from studies on the untrodden science area to the device fabrication based on "process integration".

Cell and Tissue Showcasing by Micro-Nano Integrated Devices

Teruo FUJII
Professor, The University of Tokyo

A system to showcase the behaviors of cells and tissues is realized by introducing artificial bio-surfaces into a microfluidic device. The microenvironment surrounding the cells and tissues, which is defined by the conditions of solutions and contacting surfaces, is controlled in an integrative way in the system. The system will be applied to the studies on the effect of microenvironments on the processes of differentiation of ES and iPS cells, leading to the realization of micro-nano integrated devices relevant to such scientific and diagnostic or therapeutic purposes.

Development of Metallo-processes for Novel Nanometals

Kimihisa YAMAMOTO
Professor, Tokyo Institute of Technology

Our project aims at the development of metallo-processes for novel nano-metals that the number and the composition of metal atoms freely and precisely were controlled, by using our original method of the finely controlled metal-assembly.

Since FY2008

Research Area

Development of High-Performance Nanostructures for Process Integration

Research Supervisor:
Masahiro IRIE
Professor, Rikkyo University

FY2008

Development of Biomolecular Nanosystem for Integration of the Information, Structure, and Functionality

Hiroshi SUGIYAMA
Professor, Kyoto University

Various DNA nanoscale structures can be designed and arranged by programming of the DNA sequences. Using this unique property, we will place a wide variety of molecules and materials into the individual position called "address", precisely arrange them onto the DNA structures, and explore the novel functionalities expressed in the nano-scale space on the versatile nanostructures. We will develop the advanced and integrated biomolecular devices by utilizing these fundamental techniques, and combine them to the top-down nanotechnology.

Design of Highly Functionalized Nano-Materials by Hierarchical Three-Dimensional Control of Structures and Morphologies

Noritaka MIZUNO
Professor, The University of Tokyo

In this work, highly functionalized nano-materials with controlled pore sizes and volumes are synthesized by the self-organization of polyoxometalate-based compounds designed at atomic/molecular levels. In addition, the self-organization processes are kinetically controlled to consider not only the crystal structures but also the external morphologies of the materials. The application of the materials such as catalysts, adsorbents, hydrogen storage, electrodes, and infrared blockers will also be attempted.

(Research term: 1 Oct.2008-31 Mar.2011)

Design of High Performance Nanosystems using Soluble Carbon Nanotubes

Naotoshi NAKASHIMA
Professor, Kyushu University

Carbon nanotubes (CNTs) have been in the forefront of nanoscience and nanotechnology because of their remarkable properties and specific functions. We have presented a novel concept to obtain soluble CNTs. In this project, we design and create novel CNT nanohybrids using soluble nanotubes as materials based on the regulation of CNT nanostructures as well as the combination of bottom-up and top-down processes. We will also shed light on unknown basic CNT electronic properties.

FY2009

Dynamic Interfacial Nanotechnology for Integration between Nano and Macroscopic Worlds

Katsuhiko ARIGA
Principal Investigator, National Institute for Materials Science

This project will develop a novel technology, so-called dynamic interfacial nanotechnology or hand-operating nanotechnology, in which functional nano and molecular systems can be operated by macroscopic stimuli. With this dream technology, we can catch, align, recognize, and release target molecules and/or nanomaterials by our hands, leading to innovative technologies such as size-integrated sensing, drug delivery, and material separation.

Construction of Dynamic Nano-Aggregates and their Bio-Relevant Functions

Itaru HAMACHI
Professor, Kyoto University

We challenge to construct novel dynamic nano-aggregates that can detect a target in the interior of live cells or can regulate and monitor the cell functions from the exterior, by supramolecular chemistry, organic synthesis and MEMS technology. These nano-aggregates and materials are expected to be applicable to bio-imaging, diagnosis, and new 3D-intelligent cell matrices, that should be fundamental to advanced medical chemistry and engineering.

Highly Functional Catalysts Based on Acid-base Combined Supramolecular and Dynamic Complexation

Kazuaki ISHIHARA
Professor, Nagoya University

It is one of the most important subjects on synthetic organic chemistry to develop practical chemozymes bearing enzymatic functions such as remote asymmetric induction, stereocontrol of cascade reactions, a high level of molecular recognition, etc. which are hard to be controlled by unimolecule catalysts. We develop highly functional chemoenzymes which are superior to natural enzymes and establish to their efficient preparation methods towards an environmentally benign and precision organic synthetic technology. The key to introduce a versatile functionality into chemoenzymes is to design supramolecular dynamic salt catalysts based on acid-base combination chemistry.

Dynamics and Functionalization of Self-Organized Supramolecular Polymers

Akira HARADA
Professor, Osaka University

We are going to construct various supramolecular polymers by self-organization using host-guest interactions. We are going to use cyclodextrins, photo-responsive proteins, and antibodies (immunoglobulins) as host molecules, and photo-responsive molecules, redox-responsive compounds as guest molecules. We are planning to devise a system in which a molecular part slides each other to cause contraction and extension. Furthermore, we are going to make supramolecular catalytic systems, energy-conversion systems, supramolecular sensor and transport systems.

Exploration of Higher-Order Functionality Based on the Dynamic Self-Assembly of Boronic Esters

Nobuharu IWASAWA
Professor, Tokyo Institute of Technology

In this research, we will aim to achieve 1) establishment of the guest induced dynamic self-assembly of boronic esters and of the bottom-up synthesis of boronic ester conjugates utilizing their characteristic properties, 2) realization of various dynamic function on the molecular level, in particular, molecular catalysis, separation and storage of molecules, etc, and 3) development of these molecular function into useful materials.

Nanoscale Chiral Molecular Rods for Hierarchical Integration and Assembly of Functions

Michinori SUGINOME
Professor, Kyoto University

Exploration of new functional materials are pursued on the basis of fine integration and assembly of functional groups on the chiral helical macromolecules, which can be regarded as nanoscale chiral molecular rods. The molecular rods, to which a variety of functional groups that manage catalysis, chiral induction, light emission, cross-linking, hydrogen-bonding, coordination, etc. are introduced, are further assembled by virtue of their simple rod shape, leading to new functions on the basis of hierarchical integration of the functional groups. New chiral polymer catalysts and chiral separation membrane are included in our initial targets to realize.

Electronic Functions of Radical-Nano Interfaces

Kunio AWAGA
Professor, Nagoya University

The present project elucidates radical-nano interfaces between open-shell compounds and electrodes. Using effective charge separation at these interfaces, we develop highly-efficient, ultrafast optoelectronic conversion. We also apply the radical-nano interfaces to solid-state electrochemistry, aiming at high energy-density, molecule-based rechargeable batteries.

Creating Nano-scale Multimetallic Cluster Catalysts for Novel Chemical Transformation

Kazushi MASHIMA
Professor, Osaka University

Aiming at environmentally benign reactions by catalysis of high efficiency and unique selectivity, this project is focused to create new nano-scale metal cluster catalysts comprised of more than two metal centers of non-expensive transition metals such as early transition metals and the first row transition metals. Such cluster catalysts are expected to assist new reactions with different chemical transformation from ordinal mononuclear catalysts of mainly noble metals, changing chemoselectivity, enhancing reaction rate, and so on.

Bottom-up Synthesis of Innovative Functional Nanomaterials based on Magnetochemistry

Shin-ichi OHKOSHI
Professor, The University of Tokyo

To realize new functional magnetic materials and to develop innovative magnetic devices, this project, which is based on magnetochemistry, investigates the bottom-up synthesis of functional nanomaterials. Specifically, we will demonstrate next-generation high-density memories and electromagnetic wave absorbers using metal oxide-based nanomagnets. Moreover, to discover new phenomena due to the coupling effect between magnetism and ion conductivity (and/or photon), we will prepare a novel type of metal complex-based magnet by controlling the crystal structure and its dimensionalities. Through such investigations, we will elucidate the relationship between magnetic properties and molecular structure (or nanostructure).

New Nano-hybrid Materials Fabricated from Nanosheets

Yasumichi MATSUMOTO
Professor, Kumamoto University

Single crystal inorganic nanosheets with about 1nm thickness are promising and prospective materials, because they have quantum size effect, special interface, high charge separation effect of electron and hole as well as the unique chemical and physical properties themselves. In this project, various new nano-hybrid materials such as hybrid layered materials, will be fabricated by combining various nanosheets and functional chemical species, DNA, etc., and their chemical and physical properties will be studied. They will be also researched from the viewpoint of application.

Creation and Development of High-performance Soft π Materials

Shigehiro YAMAGUCHI
Professor, Nagoya University

We aim at creating a new class of functional π materials as key components for future electronics with high efficiency in the energy conversion and low energy consumption. Our approach is based on the development of sophisticated 2D-expanded π -conjugated skeletons and their clustering. We will tackle this subject by rational molecular designs based on quantum chemical calculations and competent synthesis including the development of our original reactions. Through the construction of flexible nanostructures with unusual photo- and electronic properties, dynamic functions, high-performance amorphous phase, or fluid condensed phase, we will establish the design principle for this class of soft materials.

FY2010

Development of High-performance Fast Photochromic Materials

Jiro ABE
Professor, Aoyama Gakuin University

Considerable interest has been focused on organic photochromic materials that change their color upon irradiation with light; the photogenerated species can be reversed to the initial species either by thermally or by subsequent irradiation with a specific wavelength of light. In particular, thermally reversible photochromic molecules offer the opportunity to change and reset the molecular properties by simply turning a light source on and off. In this project, we design and create high-performance fast photochromic materials which could eventually evolve into solid-state photonic materials with unique photoresponsive characters.

Creation of Hoop-shaped π -conjugated Molecules through the Supramolecular Chemical Approach and Elucidation of Their Properties

Shigeru YAMAGO
Professor, Kyoto University

Synthesis of hoop-shaped π -conjugated molecules as exemplified in cycloparaphenylenes, which possess simplest structural unit of arm-chair carbon nanotube, will be investigated through the supramolecular chemical approach. Applications of these molecules to organoelectronic device materials and elucidation of their functions by forming higher-order structures will be also studied. We will develop the science and technology of hoop-shaped π -conjugated molecules through this study.

Since FY2008

Research Area

Creation of Innovative Technologies to Control Carbon Dioxide Emissions

Research Supervisor:

Itaru YASUI

President, National Institute of Technology and Evaluation /Vice Rector Emeritus,United Nations University

FY2008

Innovation of s-Block Metal Batteries towards Low-Carbon Societies

Yoshiharu UCHIMOTO
Professor, Kyoto University

The innovation of a new battery with long operating life and high energy density beyond the present lithium-ion batteries is the key to the stable supply of electrical energy generated from natural sources such as wind power, solar power, and so on. In this project, s-block metals are used as the anode of the new battery. The hetero-interface for the reaction between "ion" and "electron" is the key part of the new battery. In order to control the hetero-interface at the nanometer level, nano-sized electrode materials are investigated. We will establish a hetero-junction between an electrode and an electrolyte for fast s-block metal ion transfer.

Investigation of Highly Efficient Organic Thin Film Solar Cell

Susumu YOSHIKAWA
Specially Appointed Professor, Kyoto University

To reduce carbon dioxide emission, plastic solar cell with 10 % efficiency will be prepared, by developing fullerene derivatives, conductive polymers, dye super-molecules, and tandem structured cells with wide spectral range of absorption. Science of organic photovoltaics will be developed regarding the molecular and film structure.

Development of Highly Efficient Thermoelectric Materials and Systems

Kunihito KOUMOTO
Professor, Nagoya University

In order to contribute to suppressing CO2 emission by reducing the usage of fossil fuels through improvement in the efficiency of energy utilization, highly efficient thermoelectric materials composed of non-toxic and resource-abundant cheap elements will be developed and assembled into Thermoelectric devices and systems to harvest electric power from heat coming out of industries, vehicles, etc. and also from natural heat such as solar heat, geoheat, etc.

Sophisticated Utilization of Alkaliphilic Strains of Oil-producing Green Alga, Botryococcus

Makoto M. WATANABE
Professor, University of Tsukuba

The green alga, Botryococcus braunii absorbs carbon dioxide by photosynthesis and produces oil with the purity of more than 90% . The objective of this research project is to increase the efficiency of oil production of the alkaliphilic Botryococcus strains to one digit higher than the present level. To achieve the goal, the three research groups of biology, chemistry and engineering construct the culture and information centers as the research fundamentals of this project and perform the studies on optimum conditions for oil production, genetic improvement of the strains, efficient extraction and cascaded utilization of oil and the other bioactive compounds, and mass cultivation in outdoor test- and demonstration-plants. Based on the results obtained, the design of the large-scale plant with market value will be drafted, opening up a new vista of future large-scale commercial plant.

Sustainable Production of Woody Biomass in Tropical Peatlands

Katsumi KOJIMA
Professor, The University of Tokyo

Field experiments of reflooding and reforestation will be carried out to verify the possibility of bringing the drained tropical peatlands that emit huge amount of carbon dioxide back to a sink of carbon dioxide. Suitability of the woody biomass for biofuel and other biomaterials will be examined as well. The goal is to establish, through the evaluation of potential emission reduction and the examination of feasibility, a system for sustainable land management considering peat conservation, plantation and product utilization.

FY2009

Innovation and Development of New CO_2-Fixation-Promoting Technology for Increasing Bio-Material Production

Ken'ichi OGAWA
Director, Research Institute for Biological Sciences, Okayama (RIBS Okayama)

We aim at developing an epoch-making technology for increasing the production of "carbon-neutral" bio-materials and thereby to achieve a new technology suppressing fossil-derived CO2, by means of innovatively improving CO2 assimilation and carbon transportation in plants (which are mainly soybean and Eucalyptus plants). The present level of our technology is estimated to enable 5% suppression of the total amount of annual CO2 release from Japan (if it is applied to main countries for soybean and Eucalyptus production), and 10 % suppression is a target level.

Catalyst Development for Conversion of Wood Biomass to Liquid Fuels Via Gasification

Keiichi TOMISHIGE
Professor, Tohoku University

Biomass conversion to clean liquid fuels is one of value-added methods for the utilization of renewable resources with promising energy efficiency. Our team has developed the catalysts for the energy-efficient conversion of biomass to synthesis gas, the single-step conversion of the synthesis gas to gasoline, and one-pass conversion of the synthesis gas to methanol. These will be connected to the construction of energy-efficient biomass conversion process and the reactor downsizing.

(Research term: 1 Oct. 2008 - 31 Mar. 2011)

Development of Bioethanol Production Process from Marine Algae

Akihiko KONDO
Professor, Kobe University

Biofuel production from renewable marine-biomass would be able to overcome the limitation of land and water resource. In this project, we aim to increase starch production by more than two times in Spirulina microalgae that can grow in salt water not only by establishing the mass cultivation system but also by improving photosynthesis efficiency and metabolic capacity of the microalgae. We will develop efficient bioethanol production process from algae starch by using our core technology, cell surface engineering.

Biodiesel Production by Marine Microalgae Using Multistoried Cultivation System

Tsuyoshi TANAKA
Associate Professor, Tokyo University of Agriculture & Technology

We propose a novel multistoried cultivation system, aimed towards the production of biodiesel using marine microalgae as a biomass resource. The introduction of our system can reduce carbon dioxide emission and will not require the use of food resources. As a candidate, a marine diatom has been selected from marine culture collection. The multistoried cultivation system will enable us to maintain a stable supply of biodiesel, which will not be affected by regional energy conditions, biomass circulation and the cost of raw materials.

Development of Carbon-Neutral Energy Cycle by Highly Selective Catalysis

Miho YAMAUCHI
Associate Professor, Kyushu University

We propose carbon-neutral (CN) energy cycle as the most practical energy circulation system. The CN cycle employs a Pt-free alkaline type fuel cell for selective oxidation of alcohols to acids. Aiming at materialization of this cycle, highly-selective base-metal catalysts will be developed. Fuels are regenerated by reduction of the waste acids in the system with photocatalytically-generated hydrogen or hydrogen produced in the waste heat utilization system, so that the CN cycle will be an environmental benign circulation system.

Next-generation Power Inverter based on Interface-controlled GaN High-electron-mobility Transistors

Tamotsu HASHIZUME
Professor, Hokkaido University

We intend to establish fundamental and elemental technologies for a high-performance GaN power inverter that will act as a core device in energy saving technologies. The research includes characterization of defect-origin electronic levels in GaN-based materials and their correlation with operation instabilities of devices, development of a novel high-electron-mobility transistor (HEMT) based on a multi-mesa-channel structure with hetero-interface control, and design and simulation of power inverters utilizing the GaN HEMT. This will open up a key technology for a next-generation power inverter system.

Development of High Performance OH Ion Conducting Membrane and Fuel Cell Technology Platform for the Advancement of Novel All Solid-state Alkaline Fuel Cells

Takeo YAMAGUCHI
Professor, Tokyo Institute of Technology

In this study, we will try to establish a basement for the development of "all solid-state alkaline fuel cells". These fuel cells can use any metal catalysts; however there are virtually no membranes available at present limiting their practical use. In this study, we will reconsider the traditional ion conduction mechanism, and expect to develop new high OH-ion conductive membranes for these fuel cells. Our goal is to build a global technology platform to accelerate the development of these innovative "all solid-state alkaline fuel cells". High efficiency, low cost due to the possibility of using metals other than platinum as catalyst as well as the prospect of using a variety of fuels will be the key advantages of this new technology.

Investigation of Protonic Electrochemical Capacitors

Masaru MIYAYAMA
Professor, The University of Tokyo

The development of secure, low-cost energy storage devices with energy densities comparable to that of lithium-ion battery is very important to expand green technological options for suppressing CO2 emission. We investigate protonic electrochemical capacitors employing monoatomic layered electrodes to achieve markedly large capacities in aqueous electrochemical cell systems. A new mechanism of huge energy storage in these high-surface-area, monoatomic layered electrodes will be elucidated to develop science and technologies for advanced energy storage devices.

Research for Ultra-Low Loss Power Devices

Satoshi YAMASAKI
Principal Research Scientist, National Institute of Advanced Industrial Science and Technology (AIST)

Research for development of ultra-low loss power devices with novel concept is performed, giving an innovative effect on the reduction of carbon dioxide emission. Diamond semiconductor is taken up as the candidate because of its unique physical properties. Complementary research is performed, including understanding of its unique properties, establishment of device physics using its unique physical properties, and development of the material process and the device fabrication process. The novel ultra-low loss power device will be proposed and fabricated, from which the issues for wide utilization in society is clarified.

FY2010

Fabrication of All-Solid-State Rechargeable Batteries with Controlled Solid Interfaces

Masahiro TATSUMISAGO
Professor, Osaka Prefecture University

The development of innovative rechargeable batteries with high performance and low cost is necessary for the coming low carbon society. In order to realize all-solid-state batteries as an ultimate goal of energy storage systems, in this project, all-solid-state lithium secondary batteries with high power and high energy density will be developed by employing sulfide glass-based superionic materials as one of the most promising solid electrolytes. The structure and reaction of the solid/solid interface between electrolytes and electrodes will be studied and the processes to fabricate the most efficient interface in the batteries will be investigated.

Since FY2008

Research Area

Etiological Basics of and Techniques for Treatment of Allergic and Autoimmune Diseases

Research Supervisor:
Kazuo SUGAMURA
Chief Direcfor, Miyagi Prefectural Hospital Agency

FY2008

Elucidation of the Pathogenic Mechanisms of Allergic and Autoimmune Diseases and Development of new Therapeutics Targeted on IL-17 Family Molecules and C-Type Lectin Recepors.

Yoichiro IWAKURA
Director and Professor, The University of Tokyo

Upon infection, immune cells are activated and produce cytokines through recognition of these pathogens by pathogen-associated molecular pattern recognition molecules such as TLR or C-type lectins, resulting in the eradication of these pathogens. However, excess activation of this system may also cause allergy and autoimmunity. In this project, we will analyze the functional roles of cytokines including IL-17A/IL-17F and C-type lectins including Dectin-1/2 and Dcir in the development of diseases such as rheumatoid arthritis, allergy, and infectious diseases, and try to develop novel therapeutics against these diseases.

Mechanis of Organ Specific Inflammatory/ autoimmune Diseases and the Development of Its Control Approach

Toshio HIRANO
President, Osaka University

We recently showed dysregulation of an IL-17–triggered positive feedback loop of IL-6 signaling, which involves the activation of NF-kB and STAT3 in fibroblasts, plays a role for arthritis development in mutant mice. Because this mechanism appears to enhance experimental autoimmune encephalomyelitis in wild-type mice, it might be a general etiologic process underlying other Th17 cell-mediated autoimmune diseases as well as chronic inflammatory diseases. In this project, our research is focused on analyzing in vivo homeostasis of the IL-6 loop on the molecular level to identify several molecular targets to efficiently control the enhancing level of the loop in vivo.

Conquest of Mucosal Immune Disorders on the Basis of Dendritic Cell Regulation

Toshiaki OHTEKI
Professor, Tokyo Medical and Dental University

Mucosa is a major entry site for antigens and its associated lymphoid tissues comprise a unique system of dendritic cells (DC) that maintains immune tolerance. In this research project, we will elucidate the induction mechanisms of DC-mediated mucosal immune tolerance and disorders. Based on the results, we will further aim at the development of DC-based technology for prevention and treatment of mucosal immune disorders.

A Novel Strategy for Treatment of Immune-Related Disorders by using Cytoskeleton Regulating Signals as Targets

Yoshinori FUKUI
Professor, Kyushu University

Remodeling of the actin cytoskeleton regulates many cellular functions in the immune system. The CDM family of proteins, evolutionarily conserved guanine nucleotide exchange factors, induce cytoskeletal reorganization by functioning downstream of various receptors. In this study, we will analyze comprehensively the structure, function and signal transduction of the CDM family proteins to identify chemical or natural compounds that inhibit effectively immune responses. This accomplishment will lead to the development of new therapeutics for intractable diseases such as autoimmune diseases and graft rejection.

Novel Immunotherapies Exploiting Inhibitory Mechanisms of Immunoreceptors

Toshiyuki TAKAI
Professor, Tohoku University

We will establish novel therapeutic strategies against allergic and autoimmune diseases by enhancing immunoregulatory potential of cell-surface receptors, such as FcgRIIB and LILRB, critical inhibitory receptors for IgG and MHC class I molecules, respectively. We plan polishing-up of intravenous g-globulin therapies and enhancement of self-tolerance by developing agonistic ligands to the critical immunoregulatory receptors. Moreover, we will examine these basic and pre-clinic ideas in NOG mice with the humanized immune system, and will maturate our original concept into the development of versatile immunoregulatory tools for the immune system in humans.

Reprograming of Immune System by Modulation of Intracellular Signal Transduction

Akihiko YOSHIMURA
Professor, Keio University

Helper T cell is known as a commander of immunity. After activation by antigenic stimulation, naïve helper T cells differentiate into either effector T cells responsible for positive immune reactions or regulatory T cells necessary for the negative regulation of immunity. Dysregulation of the balance between effector and regulatory T cells causes immunological disorders such as allergy and autoimmune diseases. We have discovered SOCS family proteins, which play pivotal roles in keeping such balance. In this project, we will further elucidate molecular mechanisms for the maintenance and regulation of helper T cell differentiation. Furthermore, we will develop new methods for reprogramming helper as well as memory T cells: conversion of effector and memory T cells into regulatory T cells, which will be a novel strategy for the regulation of immunological diseases.

Engulfment and Degradation of Apoptotic Cells, and Its Failure

Shigekazu NAGATA
Professor, Kyoto University

Everyday several billions of cells undergo apoptosis in our bodies. They are swiftly engulfed by macrophages for degradation. More than 10 billions of red blood cells are produced everyday. During erythropoiesis, nuclei are expelled from erythroid precursor cells and engulfed by macrophages. The failure of this process, the engulfment and degradation of apoptotic cells and nuclei, causes systemic lupus erythematosus (SLE)-type autoimmune disease and strong inflammation accompanied by anemia and polyarthritis. In this project, we will study the molecular mechanism how the inefficient engulfment and degradation of dead cells and nuclei cause the autoimmune disease and inflammation.

FY2009

Regulation of Immune Response and Infection by Targeting Paired Receptors

Hisashi ARASE
Professor, Osaka University

Paired receptors that consist of activating and inhibitory receptors play an important role in the regulation of autoimmunity. Paired receptors are also involved in host defense against various infectious diseases. In the present study, we investigate recognition mechanism of a series of paired receptors as well as their functions in immune diseases and infectious diseases. Furthermore, we will develop a novel method to regulate autoimmunity and allergy as well as immunity to pathogens and tumors by modulating the function of paired receptors.

Identification of New Therapeutic Targets by Genetic Dissection and Reconstitution of Autoimmune Diseases in Mice.

Taku OKAZAKI
Professor, The University of Tokushima

Most of the autoimmune diseases are regulated by multiple genes. However, little is known of the hierarchical genetic regulation of autoimmunity. Recently, we found that the introduction of PD-1 deficiency resulted in the reduction of the number of genetic factors involved in the development of type I diabetes in NOD mice, a mouse model of type I diabetes. In this project, we try to identify all genetic factors required for the development of type I diabetes to unravel the whole regulatory mechanism of type I diabetes. We will also analyze other autoimmune diseases including myocarditis and vasculitis. Based on these genetic studies, we will identify new therapeutic targets of autoimmune diseases.

Analysis of the Regulatory Mechanisms that Underlie Nucleic Acid-mediated Immune Responses and Its Development into Therapeutic Strategies against Immune Disorders

Tadatsugu TANIGUCHI
Professor, The University of Tokyo

During microbial infection or tissue damage, DNA and RNA potently activate the innate and adaptive immune responses. As a consequence, the nucleic acid-mediated activation of the immune system can result in the development and/or exacerbation of immunological disorders such as autoimmunity. We previously identified DAI as a cytosolic DNA receptor, while more recently demonstrated that a single mechanism integrates all nucleic acid-sensing systems with the discovery that high-mobility group box (HMGB) proteins function as universal sentinels for the detection of nucleic acids. In this project, we seek to further elucidate the mechanism-of-action of these sensors by gene targeting and other approaches. These findings will lay the foundation to establish assay systems with which to identify novel compounds for the suppression of nucleic acid-mediated activation of immune responses with the aim of developing novel drugs for autoimmunity, allergy and allograft rejection.

Novel Mechanisms of Allergy and Its Regulation

Hajime KARASUYAMA
Professor, Tokyo Medical and Dental University

Allergic disorders have increased in prevalence these days in industrialized countries including Japan, and become an object of public concern. We have recently discovered novel players in the pathogenesis of allergy through studies on basophils and hyper-IgE syndrome. Based on these new findings, in this project we will clarify novel mechanisms of allergy and its regulation at the molecular, cellular and in vivo levels, and explore key strategies toward the development of new therapies for allergic disorders.

FY2010

Control of Allergic Diseases by Regulation of Human Mast cell Activation

Akira SHIBUYA
Professor, University of Tsukuba

Allergy is induced by the release of chemical mediators from mast cells. We identified novel immunoreceptors, Allergin-1 and MAIR-I, which inhibit the release of chemical mediators from mast cells. In this project, we will search novel inhibitory immunoreceptors expressed on human mast cells and clarify their role in the regulatory mechanism of allergic diseases. Furthermore, we will develop novel therapeutic approach targetting the inhibitory immunoreceptors on mast cells for allergic diseases.

Since FY2008

Disregulated of Immune-cell Trafficking Signaling and Development of Autoimmunity

Tatsuo KINASHI
Professor, Kansai Medical University

Dynamic trafficking of immune cells throughout the body plays important roles in immunosurveillance. We discovered the small GTpase Rap1 in controlling immune cell trafficking, and have clarified the regulatory mechanism. Unexpectedly, impairment of the Rap1 signaling to control trafficking have led to autoimmunity of multiple organs in mice. This project aims to clarify the mechanism and function of trafficking regulatory signaling in self tolerance, and further investigate the involvement in intractable autoimmune disease in human.

Development of a New Strategy Targeting Innate Immunity for Treatment of Intestinal Immune Disorders

Kiyoshi TAKEDA
Professor, Osaka University

Disregulated activity of innate immunity causes several immune disorders such as inflammatory bowel diseases. Mucosal immunity is an unique system, and there exist peculiar subsets of innate immune cells, which regulate intestinal homeostasis. In this project, we will reveal the regulatory mechanism for mucosal immune responses by innate immunity, and will develop a new strategy to treat intestinal immune disorders.

Development of a Novel Way to Treat Autoimmune Disease by Regulating Humoral Immune Systems

Tomohiro KUROSAKI
Specially Appointed Professor, Osaka University

It has been thought that self-antibodies produced by plasma cells are one of the critical determinants for initiation and amplification of antoimmune diseases such as rheumatoid arthritis (RA). Focusing on self-reactive plasma cells and their precursor memory B cells, this study aims at identifying activation, inhibition, and survival factors of these cells, thereby developing a novel way to treat autoimmune diseases.

Research Area

Alliance for Breakthrough between Mathematics and Sciences (ABMS)

Research Supervisor:
Yasumasa NISHIURA
Professor, Hokkaido University

FY2008

A Mathematical Challenge to a New Phase of Material Science

Motoko KOTANI
Professor, Tohoku University

The development of high-performance materials serves the well-being of human-society. Now that we observe and design nano-scale systems for the material development, demands for a new mathematical theory to describe nano-scale phenomena are increasing.
By a mutually beneficial partnership between mathematics and material science, our research project aims to meet these demands and to develop mathematical models. The key, we believe, lies in the fundamental understanding of micro-meso-macroscopic structural relations and in the identification of mechanisms in terms of mathematics. In the future, this research team is expected to evolve into the research core of "mathematical materials sciences" with high integration of mathematical science, information science, physical chemistry and chemical physics, and materials science.

Rigorous Topological Computation of Global Dynamical Structures for Rhythmic Behaviors in Coupled Systems and Applications

Hiroshi KOKUBU
Professor, Kyoto University

The purpose of this research is to develop various mathematical methods, especially rigorous topological computation, for studying global dynamical structures in coupled systems, and to give better understandings of the mechanism of rhythmic behaviors in neural network models and models in the system bio-mechanics. Based on the theoretical analysis for rhythm adjustment mechanism of brain-body interaction, combined with experimental studies of model robots, we intend to lead our results to new technologies and applications for controlling various rhythmic behaviors of humans and animals.

Innovations in Controlling Hyper Redundant and Flexible Systems Inspired by Biological Locomotion

Ryo KOBAYASHI
Professor, Hiroshima University

Our goal is to develop truly biomimetic robots that exhibit life-like agile and supple locomotion under real world constraints, endowing robots with (very) large degrees of freedom. In order to achieve this goal, we revisit and rethink the concept of autonomous decentralized control, and consider the way of control that allows robots to orchestrate and maneuver large degrees of freedom without impairing the adaptivity. One of the significant features of our project is that we intend to capture the control principle by greatly relying on mathematical modeling of various types of locomotion, ranging from amoeboid locomotion to legged locomotion.

Mathematical Structure of Complex Financial Products and Infinite Dimensional Analysis

Arturo KOHATSU-HIGA
Professor, Ritsumeikan University

Structure products are complex financial derivatives whose liquidity has increased in recent years. They have been blamed as part of the current financial crisis. The goal of this project is to provide a sound mathematical framework for these products using infinite dimensional methods. Furthermore we aim to use projection/dimension reduction approaches in order to provide effective valuation and hedging methods as well as risk control methods for these products.

Harmony of Gröbner Bases and the Modern Industrial Society

Takayuki HIBI
Professor, Osaka University

It brings positive contribution of mathematics for solutions of social difficult problems to investigate harmony of the theory of pure mathematics that developed highly and the forefront of technology in the modern industrial society. Our research group consists of algebraists, computer scientists and statisticians who engage in the research of Gröbner bases, a trendy topic of modern mathematics. Our goal is to make the progress of the theory together with the development of the algorithm in order to answer the request of realistic questions as well as to apply the latest theory of Gröbner bases to the forefront of technology.

A Challenge to Unsolved Problems in Fluid Engineering with Modern Mathematical Analysis

Yoshihiro SHIBATA
Professor, Waseda University

In this study, mathematicians whose specialty is modern mathematical analysis and experts on fluid mechanics collaborate toward developing rigorous formulation and analytical methods for unsolved problems in fluid engineering. The results will be applied to important issues facing society in recent years, verified through carefully controlled experiments and demonstrated their usefulness. We expect that this study gives the start of reconnection between mathematical analysis and fluid mechanics which had been closely related in the nineteenth century and collaborative exploration for seeds which will grow to permanent culture of human being.

FY2009

Establishment of Foundations of Verified Numerical Computations for Nonlinear Systems and Error-free Algorithms in Computational Engineering

Shin'ichi OISHI
Professor, Waseda University

The purpose of this research is to establish methodologies of designing error-free algorithms for solving various problems in computational engineering. Focus is on the development of efficient algorithms. For this purpose, techniques of verified numerical computations and error-free numerical algorithms will be combined with algorithms in computational engineering. Concretely, foundations of efficient methods of verified numerical computations will be established for finite dimensional nonlinear systems, which appear as fundamental problems of computational engineering. This breakthrough enables us to design efficient error-free algorithms in computational engineering. As a result, it has significant ramifications for various arias of science, engineering and industry.

Mathematical Medicine Develops Tumor Growth Explications and Medical Technology Innovations

Takashi SUZUKI
Professor, Osaka University

We clarify the mechanism of cancer morbid growth through mathematical models, and, simultaneously, develop several methods of cancer diagnosis linked with the theory of inverse problems. We study, especially, the process of sub-cell deformation derived from the bio-chemical reactions inside cells in the early stage of invasion via the automatic, computer-assisted modeling based on the mathematical formulas and medical experiments. As applications, prediction of the morbid state, selection of the optimal treatment, creation of new medicines, and automatic cell diagnosis provided with new schemes become practical.

FY2010

Mathematics for Expressive Image Synthesis

Ken ANJYO
Visual Effects / R&D Supervisor, OLM Digital, Inc.

Computer graphics (CG) is increasingly transforming every aspect of image creation and processing. This project pursues a new mathematical framework to greatly enhance the expressive ability of digital image creation. It seeks a methodology for making animations directable in a quicker and more intuitive way than ever before, even while focusing on challenging image categories such as humans and fluids.

Clarification of Dermatological Disease Mechanisms through Collaboration of Physiology and Mathematical Science

Masaharu NAGAYAMA
Professor, Kanazawa University

Stratum corneum plays an important role as a barrier function, and it is known that its failure relates to various dermatological diseases. We will establish a mathematical model for the dynamics seen in keratinocytes and confirm the validity of the model through physiological experiments. Using the model, we will understand how to realize the barrier function of a skin from the viewpoints of both physiology and mathematical science. Through these approaches, we aim to clarify the cause and treatment of diseases related to the failure of the barrier function.

Toward a Paradigm Shift Created by Mathematics of Vortex-Boundary Interactions

Takashi SAKAJO
Professor, Hokkaido University

Vortices generated by turbulent fluctuations in the proximity of streamlined wings of an airplane are detrimental to the flight. On the other hand, the creation of vortices allows insects to fly efficiently by flapping their thin wings. This suggests a new flight strategy that makes use of vortices. Our project attempts to develop a mathematical theory and high resolution computational fluid dynamics for vortex generation and their interactions with boundaries of the solid bodies. With "vortex-boundary interactions" as a key concept, we actively find our way into research collaborations with other disciplines in life-and environmental sciences. We will then propose an efficient new design for locomotion with vortices, which will replace streamlined shapes.

Realization of High-Performance Clinical Analysis Based on Collaboration between Radiology and Mathematical Sciences

Hiroshi SUITO
Professor, Okayama University

This research project will contribute to high-performance clinical diagnoses through construction of decision-making tools including mathematical modeling, simulation technology, statistical analysis, and inverse analysis. Mathematical science will evolve greatly through this research project, not only from its application to medical science, but also from its own evolution derived from that application. This research project is ultimately aimed at evolution of both mathematical science and clinical medicine, leading to improvement of the medical services available to our society.

Computational Illusion — Mathematical Modeling of Optical Illusion and its Applications

Kokichi SUGIHARA
Professor, Meiji University

Through mathematical modeling of human optical illusion, we understand mechanisms of optical illusion, extract quantitative measures for evaluating illusion effects, and establish methods for controlling the illusion effects. We apply them in two directions. Minimizing the illusion effects, we develop environment that can be recognized easily and thus raise safety, and maximizing the illusion effects, we offer new visual representation methods and thus contribute to cultural maturity. On the basis of these activities, we develop flexible and robust methods for mathematical modeling together with the associated computation techniques for analyzing human perceptual and cognitive behavior.

Since FY2007

Research Area

Creation of a Novel Technology towards Diagnosis and Treatment based on Understanding of Molecular Pathogenesis of Psychiatric and Neurological Disorders

Research Supervisor:
Teruhiko HIGUCHI
President, National Center of Neurology and Psychiatry

FY2007

Development of PTSD Remedy based on the Molecular Mechanisms underlying Fear Memory Formation

Kaoru INOKUCHI
Professor, University of Toyama

Post-traumatic stress disorder (PTSD) is triggered by a traumatic experience that is based on strong fear memory. This project aims to understand the molecular mechanisms underlying fear memory formation in animal models. Specifically, we will focus our attention on the molecular and cellular basis of reconsolidation and extinction of fear memory. Based on these results we also attempt to develop a theoretically novel PTSD remedy.

Identification of Endophenotype in Psychiatric Disorders using Genetically Engineered Mice

Tsuyoshi MIYAKAWA
Professor, Fujita Health University

Elucidating the factors underlying psychiatric illness is hampered by current methods of clinical diagnosis. The identification of biological endophenotypes is essential, but represents a considerable challenge in human subjects. In this project, we first try to identify endophenotypes in genetically-engineered mice showing behaivoral abnormalities related to pscyhiatirc disorders. And then we investigate human subjects, utilizing the knowledge obtained in mice. Our project will reveal molecular and neural mechanisms underlying psychiatric disoreders.

Comprehensive Study for the Development of Disease-modifying Therapies for Alzheimer's Disease

Takeshi IWATSUBO
Professor, The University of Tokyo

The present research project aims at elucidating the pathophysiology of Alzheimer's disease (AD) focusing on the production, aggregation and clearance of amyloid beta peptide (Abeta), the latter being the pathogenic protein in AD, thereby developing novel therapeutic strategies for AD. Gamma-secretase responsible for Abeta production, synaptic and dendritic failures as consequences of Abeta toxicity, and enhancement of Abeta export from brain, are the major targets to be tested. Furthermore, we will identify biomarkers that represent early AD changes by careful comparison of model animals and humans, thereby facilitating the clinical application of novel therapies.

FY2008

Novel Approach to Reconstruct Neuronal Circuits after Spinal Cord Injury and Brain Diseases

Hiroshi ONODERA
Assisatant Director, National Hospital Organization Nishitaga Hospital

Although innovations in neuronal stem cell science are amazing, neuronal cell transplantation techniques are still unsatisfactory. This is partly because of insufficient neurite outgrowth of grafted neurons in the host tissues. We develop a method to encourage neurite extension in damaged neuronal tissues by utilizing cell adhesion molecules-bound magnetic substances, which can be arranged in the putative neuronal circuites in the host tissues suffering from spinal cord injury or brain diseases.

Elucidation of Molecular Pathogenesis of Schizophrenia by Analyzing Susceptibility Genes

Kozo KAIBUCHI
Professor, Nagoya University

Schizophrenia is a complex genetic disorder with fairly high heritability. Although it has been reported that schizophrenia has high inheritance, the molecular pathogenesis of schizophrenia remains currently unknown. To understand the molecular pathogenesis, we will identify the proteins interacting with susceptibility gene products, and analyze their patho-physiological functions. Moreover, we will generate knockout and transgenic mice of the susceptibility genes. Our aim is to establish a new approach of prophylaxis and treatment of schizophrenia.

Identification of Molecular Mechanism and Development of Novel and Curative Pharmacological Treatment for Dysfunction of Social Reciprocity in Autism

Nobumasa KATO
Professor, Showa University

Our research project aims at identifying molecular mechanisms and developing pharmacological intervention for dysfunction of social reciprocity, the most fundamental feature of autism spectrum disorders. To this end, we will focus on oxytocin as a key molecular target. By collaborations of genetics, animal models, neuroimaging, and clinical trials, we will establish early detection and treatment strategy for oxytocin-related social dysfunction in autism.

Elucidation of Parkinson's Disease (PD) Gene Networks and Establishment of Strategies for Treating PD

Ryosuke TAKAHASHI
Professor, Kyoto University

Parkinson's disease (PD), which is characterized by progressive and selective degeneration of dopaminergic neurons, is the second most common neurodegenerative disorder affecting more than 100,000 patients in Japan. Development of rational and radical remedies for PD based on correct understanding of its pathogenesis is an urgent issue in aging societies. In this project, we establish genetic models of PD in tissue culture cells, Medaka fish and mice, each harboring a single or multiple mutations in genes responsible for or associated with familial PD. With these complementary model systems, we clarify the complex pathophysiology of PD that involves the endoplasmic reticulum stress response, protein degradation mechinery, mitochondria and dopamine metabolism. The goals of our project are to generate research resources, to define molecular targets, and to discover small-molecule lead compounds, for the treatment of PD and related neurodegenerative disorders.

Development of Diagnosis and Treatment Techniques for Patients with Sever Intractable Depression and Insensitivity to Antidepressant Treatment Based on Molecular and Cellular Researches on BDNF and Depression

Masami KOJIMA
Leader, National Institute of Advanced Industrial Science and Technology (AIST)

The finding that chronic antidepressant (AD)-treatment increases the level of brain-derived neurotrophic factor (BDNF) in brain raised a possibility that BDNF is a key molecule implicated in pathology of depression and biological response to AD treatment. Nevertheless, molecular and cellular mechanisms that link BDNF action with severe and antidepressant-resistant depression remain ill-defined. In this project, we have assumed that deficits in secretion and processing of BDNF are crucial causes of intractable depression and resistance to AD exposure. Based on this hypothesis, we will attempt the development of new diagnosis and treatment techniques for patients with sever intractable depression and insensitivity to AD treatment by clarifying molecular pathogenesis of depression, searching for blood biomarkers, and by using diagnostic functional and structural imaging of brain.

Development of Molecular Targeted Therapy for Sporadic ALS Based on Creation of Animal Models

Gen SOBUE
Professor, Nagoya University

Amyotrophic lateral sclerosis (ALS) is sporadic in over 90% cases. Its pathogenesis remains largely elusive and the basic remedy for this disease is not established so far. In this CREST project we will develop animal models mimicking molecular events observed in the pathological tissues of sporadic ALS patients and clarify molecular pathogenesis and target molecules leading to motor neuron degeneration. Moreover we will develop molecular targeted therapy and aim for its clinical application.

Development of Comprehensive Therapies for Polyglutamine Diseases

Nobuyuki NUKINA
Lab Head, RIKEN

Polyglutamine diseases are hereditary disorders including Huntington disease, SBMA and some of hereditary cerebellar ataxias, in which CAG repeat in their responsible genes is expanded. So far, no effective therapy has been developed. In this CREST project, we will develop the comprehensive therapies targeting molecules, which modulate pathological processes including protein degradation, aggregation and gene transcription. We will also employ the methods of chemical genetics, determine the molecular targets and develop new drug and gene therapies.

FY2009

Development of Anti-amyloid and Anti-tau Therapeutics based on the Molecular Mechanism of Alzheimer's Disease

Yasuo IHARA
Professor, Doshisha University

The present work is undertaken to enhance our understanding of the pathogenesis of Alzheimer's disease. Regarding anti-amyloid therapy, we seek to develop "substrate-specific drug", in which cleavage of APP (β CTF) alone would be suppressed, whereas the cleavage of other substrates is not interfered with thus bringing few adverse effects. We also seek to clarify the role of A β oligomer by characterizing the new APP mutation found in Japan, which is ready to form A β oligomer but not fibrils. Finally, we test our hypothesis that unbalanced expression of tubulin and tau leads to tauopathy, and aim at exploring anti-tau therapeutics.

Development of Diagnosis and Treatment based on the Molecular Pathomechanism of Purkinje Cell Degeneration

Hidehiro MIZUSAWA
Professor, Tokyo Medical and Dental University

Cerebellar Purkinje cell (PC) impairment cause spinocerebellar ataxiass (SCAs) but there has been few treatments. In this research, we plan to elucidate pathologic pathways from RNA expression to individual disease onset as well as to establish a treatment strategy through development of animal models imitating genetic SCAs with PC degenaration, and omics and chemical biology techniques. We would finally like to create treatment methods and diagnostic markers which could be applicable to PC impairment and cerebellar ataxia in general.

Integrative Research on Neuropsychiatric Behavioral Diseases

Toru TAKUMI
Professor, Hiroshima University

Abnormal behaviors are often seen in neuropsychiatric diseases. We have developed a new humanoid mouse model for autism by using a chromosome-engineering technique. In this project we study molecular pathophysiology of animal models such as autism and mood disorder and basics for new diagonistic and therapeutic tools.

Elucidation of Molecular and Cellular Basis of Synapse-Glia System Dysfunction in Schizophrenia toward Creation of Novel Strategies for its Diagnosis and Treatment

Toru NISHIKAWA
Professor , Tokyo Medical and Dental University

Despite a body of evidence indicating that disturbed glutamate (Glu) neurotransmission may be involved in schizophrenia that is an intractable brain disease with a high prevalence, the exact mechanisms of the disturbance remains unclear. In the present research project, we aim at elucidating not only neuronal but also glial components of the Glu synapse dysregulation in schizophrenia by focusing our special attention on the molecular and cellular basis of the neuron-glia communication by a crucial Glu synapse modulator D-serine. Based upon these new approaches together with the clinical trials of a D-serine signal modifier, D-cycloserine, to treatment-resistant schizophrenic patients, we will attempt to create innovate diagnostic and therapeutic strategies targeting the Glu synapse-glia system for schizophrenia.

Since FY2007

Research Area

Fundamental Technologies for Dependable VLSI System

Research Supervisor:
Shojiro ASAI
Executive Vice President, Rigaku Corporation

FY2007

Dependable VLSI Platform Using Robust Fabrics

Hidetoshi ONODERA
Professor, Kyoto University

Extreme scaling imposes enormous challenges on LSI design such as manufacturability degradation, variability increase, performance aging, and soft-error vulnerability. In order to overcome these difficulties, we investigate a reconfigurable VLSI platform that can realize dependable circuits with required reliability. The platform consists of variation-tolerant robust fabrics with self-repairing capability of deteriorated circuits. We will demonstrate that the platform can be applicable to various embedded systems ranging from satellite applications to consumer products with a wide variety of dependability.

FY2008

Circuit and System Mechanisms for High Field Reliability

Seiji KAJIHARA
Professor, The Kyushu Institute of Technology

With the progress of VLSI technology, it becomes a crucial issue to deal with faults that occur in operational mode as well as the production test. In our work, we propose new mechanisms of circuits and systems that allow adaptive power-on testing to detect problems caused by aging and faults of VLSIs operating on the field, and to warn or recover before an error appears. The work tries to contribute not only to extension of MTTF (Mean Time To Failure) but also to supply of safe and secure systems for users.

Ultra Dependable VLSI by Collaboration of Formal Verifications and Architectural Technologies

Shuichi SAKAI
Professor, The University of Tokyo

For precise and errorless design of VLSI which is one of the most primary elements in today's information-centric society, this project will comprehensively develop dependability technologies from circuit design to system architectures. It includes new formal verification techniques, introductions of field programmable circuits for the test-phase corrections, the circuit which prevents timing errors and architectural technologies to prevent permanent failures. These techniques will be tightly integrated and will substantially increase VLSI dependability. The research results will include the new design tools, new digital circuits and architectures which will be fed back to industry and will construct the basis to reinforce the industrial competitiveness in the area of semiconductors, home electronics, automobiles and aerospace technologies.

Dipendable SRAM Techniques for Highly Reliable VLSI System

Masahiko YOSHIMOTO
Professor, Kobe University

The goal of the project is to develop design techniques for scaled SRAM to enhance a dipendability of VLSI system in deep sub-deci micron era and beyond. To overcome several error factors including process variation, operating condition fluctuation, performance degradation by aging and soft error phenomena, we will develop fundamental techniques to predict failure situations, to sustain normal state of operation and to avoid fatal errors. Then by unifying the above techniques, an autonomous dipendable memory platform will be established. Finally effectiveness of proposed methods will be verified for car-electronics application using virtualization techniques.

Development of Dependable Wireless System and Device

Kazuo TSUBOUCHI
Professor Emeritus, Tohoku University

For implementing wide-area and high-data-rate wireless access, we are developing a dependable wireless next-generation network (NGN) large-scale integrated circuit (LSI) with optimum control of communication area, data rate, power consumption and quality of service (QoS). This broadband all-silicon mixed signal complementary metal-oxide-silicon (CMOS) chip set achieves low bit error rate (BER) using frequency domain equalization (FDE). The research will contribute to realize high-mobility and ultra high-data-rate mobile terminal.

Development of Dependable Network-on-Chip Platform

Tomohiro YONEDA
Professor, The National Institute of Informatics

In order to obtain large and complex VLSI systems using advanced semiconductor process technologies, problems of how to increase utilization of collected many cores and how to tolerate delay variation due to process variation, delay faults caused during operation, changes of environmental parameters, and so on should be solved. This project will develop several core technologies to overcome those problems and propose a design methodology to construct highly dependable, adaptable, and efficient network-on-chip platform. It is also planned to demonstrate the proposed methodology by implementing some concrete automotive applications on a prototype NoC platform.

Modeling, Detection, Correction and Recovery Techniques for Unified Dependable Design

Hiroto YASUURA
Trustee and Vice President, Kyushu University

The goal of the project is to establish a design flow in system and RT levels for dependable digital VLSI. We will define models errors and indexes of dependability, and develop techniques to evaluate the indexes and to improve them. We will implement the techniques as design and analysis tools, and combine the tools into an existing design flow to make a prototype of design flow in which designers can consider tradeoffs among cost, performance, power consumption and dependability.

FY2009

Three-Dimensional VLSI System with Self-Restoration Function

Mitsumasa KOYANAGI
Professor, Tohoku University

We aim to develop a new dependable VLSI by employing a three-dimensional (3D) LSI and highly parallel processing which can provide functions of self-restoration, self-organization, self-repair, reconfiguration and self-test. This new VLSI has function generators with look-up tables which generate redundancy and self-test circuits. A part of these redundancy and self-test circuits are dynamically converted to functional logic circuits to enhance the flexibility and efficiency of LSI.

Dependable Wireless Solid-State Drive (SSD)

Ken TAKEUCHI
Associate Professor, University of Tokyo

This project will develop wireless Solid-State Drives (SSD) containing tera-byte capacity NAND flash memories and their host system with 1mm distance 10Gbps ultra high-speed wireless communication and power transmission capabilities. The proposed wireless SSDs are dependable against various error factors such as the data retention and the endurance failure of the flash memory cells, 2) human errors such as the water contact and the unexpected power outage, 3) the contact wear-out failure of the interface and 4) the ESD failure.

The Design and Evaluation Methodology of Dependable VLSI for Tamper Resistance

Takeshi FUJINO
Professor, Ritsumeikan University

The smart cards, which keep money and personal information in their LSIs, are widespread in the social system. The dependability and security assurance of these LSI are critical issues. The attacker reveal secret information by analyzing the side-channel information such as power consumption and electro-magnetic field. Furthermore, the attacker could clone security LSIs by analyzing physical information. The purpose of this research is the design and evaluation methodology of dependable VLSI against these tamper attacks.

Fundamental Technology on Dependable SoC and SiP for Embedded Real-Time Systems

Nobuyuki YAMASAKI
Associate Professor, Keio University

We make researches on the fundamental technology on the dependable SoC (System-on-Chip) and SiP (System-in-Package) for embedded real-time systems to realize practical VLSI systems. To realize practical embedded real-time systems, we study on the co-design of applications (robots and spacecrafts), software (OS), and hardware (architecture), the co-design of SoC and SiP, and the design, implementation, and evaluation schemes for them.

Research Area

Research of Innovative Material and Process for Creation of Next-generation Electronics Devices

Research Supervisor:
Hisatsune WATANABE
President, EUVL Infrastructure Development Center, Inc.

FY2007

Research of Functional-oxides and Development of Interface-Phase-Change Switching Devices

Hiro AKINAGA
Director, National Institute of Advanced Industrial Science and Technology (AIST)

Electronic states and the strongly correlated phase transition of metal / insulating-oxide interfaces will be studied to construct a physical and technological framework toward functional oxide electronics. As the concrete representative, we aim at the development of non-volatile switching devices by using these interfaces.

Study on Resist Materials for Nanofabrication and Development of Process Simulator

Seiichi TAGAWA
Specially Appointed Professor, Osaka University

Ionizing radiation (EUV, EB etc) is a key technology for future nanofabrication because it can deposit their energy on nanoscale region without any difficulty. Our purpose is the establishment of scientific foundation for the application of ionizing radiation to nanofabrication on industrial scale. We clarify reaction mechanisms induced in resist materials for nanofabrication by ionizing radiation. The knowledge on reaction mechanisms are applied to resist and process designs. We develop a process simulator based on reaction mechanisms.

Development of Graphene-on-Silicon Material/ Device Technologies

Taiichi OTSUJI
Professor, Tohoku University

We develop our original "graphene-on-silicon" (GOS) materials/process technology. Based on it, furthermore, advanced complementary switching devices (CGOS) and the plasmon-resonant terahertz devices (PRGOS) will be developed. This research will lead to the realization of innovative carrier-transit-time-free, ultrafast, large-scale-integrated device technology.

Three-dimensional Carbon Active Interconnects for LSI

Mizuhisa NIHEI
Fujitsu Limited

This research project focused on the development of graphene interconnect technologies to solve reliability and performance issues of LSI interconnects. We succeeded in growing multi-layer graphene, by using our original photoemission-assisted plasma-enhanced CVD method, on dielectrics without metal catalyst films.

(Research term: 1 Oct. 2007 - 31 Mar. 2010)

Development of Nonlinear Optical Crystal for Vacuum UV Laser

Takatomo SASAKI
Specially Appointed Professor, Osaka University

The purpose of this project is to develop nonlinear optical crystal for generating VUV light at the wavelength below 180 nm in order to realize high-resolution mask and wafer inspection system. We will try to reveal the mechanism of UV laser-induced damage in nonlinear optical crystal, and to establish the shorter-wavelength and longer-lifetime VUV sources.

FY2008

Research and Development of Vertical Body Channel MOSFET and Its Integration Process

Tetsuo ENDOH
Professor, Tohoku University

The device technology of a vertical body channel MOSFET with a new concept that assumes the entire body area of the device to be its current drive area is developed. The circuit technology and material/process technology for the vertical body channel MOSFET are developed.
It aims to offer a new universal technological platform for semiconductor LSI to improve the driving current characteristic, the leak current characteristic, and the integration density in comparison with conventional planar type MOSFET.

Spin-Based Functional MOSFET Devices Using Half-Metallic Ferromagnet

Satoshi SUGAHARA
Associate Professor, Tokyo Institue of Technology

In order to establish a new class of silicon integrated electronics employing spin degrees of freedom, we develop MOSFET-based functional spin-transistors using a half-metallic ferromagnet (HMF) for the source/drain (referred to as spin-MOSFETs), and hybrid devices using a MOSFET and magnetic tunnel junction with HMF electrodes (referred to as pseudo-spin-MOSFETs). Novel CMOS logic architectures based on these functional devices, such as nonvolatile logic and reconfigurable logic, are also explored.

Development of Ultra-Fine Structure Metrology System using Coherent EUV Source

Hiroo KINOSHITA
Professor, University of Hyogo

A new metrology system has been developed that is based on X-ray diffraction microscopy in the EUV region and is capable of measuring CD value and inspecting pattern defects with a high accuracy. The integration of a coherent EUV source employing a high-harmonic laser system and EUV scatterometric microscopy has enabled the construction of a practical system for CD measurement and the inspection pattern defects with subnanometer accuracy.

Understanding and Control of Solid-State Interfaces for Ge-CMOS with High-K Gate Dielectric Film

Akira TORIUMI
Professor, The University of Tokyo

Ge-based devices with high electron and hole mobilities are expected for the next generation CMOS which will enable us to achieve high driving performance with a low voltage operation. It is, however, well known that Ge interfaces with dielectric films or metals are thermally or electrically unstable, so it is strongly demanded to control them based on the understanding of inherent origins behind them. This research program is to elaborately study those interfaces and to develop revolutionary methods for designing high-quality interfaces.

Design and Study of Graphite Devices based on Computational Science

Susumu OKADA
Associate Professor, University of Tsukuba

Ever increasing effort has been put into developing graphite-based devices. There remains, however, much to be elucidated about fundamental properties of graphite and about controlling of device properties. In this project, we unravel fundamental properties of graphene, graphite, and other nanostructures of graphene derivatives, and address practical principles for designing the novel graphite-devices based on the computational material science on the quantum physics.

Development of Integrated Simulators from Atomistic Theory to Compact Model

Nobuya MORI
Associate Professor, Osaka University

We develop integrated simulators for next-generation MOS transistors. The transport model is based on the newly developed R-matrix quantum-transport theory, which greatly saves the computational time. The simulators allow us to find the optimal solution from an enormous number of options in choosing materials, device structures, and circuit design.

Development of Novel Materials and Functions Based on Numerical Simulations

Sadamichi MAEKAWA
Director, Japan Atomic Energy Agency

In the next-generation nano-electronics, not only electric charge current but spin and heat currents are expected to be utilized. Our aim of research is to develope the general equations of charge, spin and heat currents in nano-devices, to perform numerical simulations of the whole nano-devices based on the microscopic equations, and to clarify the interaction and conversion processes among the currents. Based on these studies, we develope novel materials and functions in the next-generation nano-electronics.

Development of Local Evaluation method for the mechanical strength of high density multi-layer wiring and three dimensional stacking structures

Shoji KAMIYA
Professor, Nagoya Institute of Technology

Reliability of integrated semiconductor devices has been an issue of serious importance, since their mechanical characteristics are not clear enough while further densification is going with multi-layer wiring and three dimensional stacking structures. Guidelines for long-term reliability design will be worked out in this study by developing submicron-scale local evaluation mehotds for the mechanical strength of high density wiring and three dimensional LSI.

Development of Metal/oxide Hybrid Devices by Novel Deposition Processes

Shinji YUASA
Director, National Institute of Advanced Industrial Science and Technology (AIST)

We develop novel deposition processes by optimizing basic materials and deposition techniques in order to realize metal/oxide hybrid devices having non-volatile switching functionality.

Research and Development on Process Science and CD Control in High-Throughput Nanoimprint

Shinji MATSUI
Professor, University of Hyogo

There are serious issues in the high-throughput, mold release and CD control to apply nanoimprint to the manufacturing of integrated circuit. To solve the above problems, we develop the new processes and materials through the scientific elucidation to achieve the practical nanoimprint lithography.

Development of ultra-high Speed Nano Spin Devices using a Three-dimensional Injection Technique of Charge-less Spin Currents

Takashi KIMURA
Professor, Kyushu University

We develop a three-dimensional injection technique of charge-less spin currents, a high-speed modulation technique of spin-current directions, and an efficient generation technique of spin currents using high quality Heusler alloy. Finally, we realize ultra-high-speed nano spin devices with very low power consumption and excellent thermal disturbance tolerance.

FY2009

Development of Guiding Principles for Controlling Fluctuations in Nanoelectronic Devices through the Picosecond-scope Physical Analyses

Kenji OHMORI
Associate Professor, University of Tsukuba

In nanoelectronic devices, time and space are reduced to the point where fundamental events such as carrier scattering become statistical in nature. This research project is focused on understanding fluctuations in carrier transport in nanoelectronic devices, and thus developing guiding principles for reducing fluctuations in time and space under non-stationary and non-equilibrium conditions.

Development of the Three-terminal Nonvolatile device 'Atom Transistor'

Tsuyoshi HASEGAWA
Principal Investigator, National Institute for Materials Science (NIMS)

Three-terminal nonvolatile device 'Atom Transistor', where the source and drain electrodes are electrically connected by metal atoms (ions) supplied from the gate electrode to achieve high ON/OFF ratio, will be developed. New functional devices based on Atom Transistor will be also developed.

Since FY2007

Research Area

The Dynamic Mechanism of and Fundamental Technology for Biological System

Research Supervisor:
Shigetada NAKANISHI
Director, Osaka Bioscience Institute

FY2006

Unraveling How Cells Connect Global Tissue Asymmetry to Individual Cell Polarity

Tadashi UEMURA
Professor, Kyoto University

Our body and organs take asymmetrical shape along various axes and this global asymmetry is coupled to polarity of individual cells in epithelial planes (planar cell polarity). We are exploring logic of this connection. Our approaches include tracking key molecules and subcellular structures in live animals and mathematical analysis of those behaviors. Planar cell polarity underlies critical epithelial functions and our long-term goal is to contribute to understanding basis of diseases that are caused by defective cell polarization.

System Dynamics of Neural Circuit Governing Behavior

Ikue MORI
Professor, Nagoya University

Understanding how brain functions during cognition, learning and memory is a fundamental question in neuroscience. We challenge this issue by focusing on a simple neural circuit that regulates thermotaxis behavior in C. elegans. We will conduct systematic optical imaging of neurons in the thermotaxis circuit to apply computational biology, and ultimately propose a new concept for dynamics of neural circuit governing behavior.

Mechanism of Ultradian Rhythms of Gene Expression

Ryoichiro KAGEYAMA
Professor, Kyoto University

During cell proliferation and differentiation, many genes function in proper timings, but biological clocks that regulate these timings remain to be analyzed. We have been elucidating that the transcription factors Hes1 and Hes7 function as ultradian clocks and that there are other ultradian oscillators, but their whole picture is not known. In this research project, we will make and evaluate mathematical models and elucidate the mechanism of ultradian oscillators and their roles in cellular events.

FY2007

Fluctuation Analysis of Stochastic Biomolecular Computation System in Living Cells

Masahiro UEDA
Professor, Osaka University

Recent progress in the area of single-molecule detection techniques has realized the stochastic nature of biomolecules in living cells. This leads to a fundamental question about intracellular signaling processes in general. How do living cells manage successfully to acquire noise-robust characteristics and flexibility in their information processing under the strong influence of thermal and stochastic fluctuations? In this research project, we are going to clarify the significance and roles of the fluctuations in the dynamical behaviors of biomolecular computation systems.

Information Coding Systems of Signal Transduction

Shinya KURODA
Professor, The University of Tokyo

Cells code various extracellular information into the temporal and spatial patterns of signaling networks and elicit various cellular functions. Such coding systems may involve the temporal patterns-coding (frequency-response) and the expression-patterns-coding. We will try to extract such coding-principles of signaling network.

Circadian System of Cyanobacteria

Takao KONDO
Professor, Nagoya University

Circadian clock is a basic mechanism of living organism to coordinate its metabolism with daily environmental alteration of the earth. We reconstituted circadian oscillation by mixing three Kai proteins and ATP in a test tube. We will elucidate a sub-molecular mechanism of Kai protein to tick time precisely. We also address how this protein oscillator is integrated with cellular system and functions inside cyanobacteria cells as accurate clock.

Mechanism Generating Biological Polarities

Hiroshi HAMADA
Professor, Osaka University

Generating polarities is an essential event during the early phase of embryogenesis. In this study, we will focus on anterio-posterior and left-right poralities, and wish to reveal how these polaries are generated in the mouse. Signaling molecules (Nodal and Lefty) that determine these polarities will be visualized in the mouse embryo. By combining experimental data with theoretical modeling, we wish to reveal the principle that controls embryonic patterning.

Regulation of Gene Expression Mediated by RNA Silencing

Mikiko C. SIOMI
Associate Professor, Keio University

Small RNAs trigger various forms of sequence-specific gene silencing, which is now collectively referred to as RNA silencing. It is becoming clear that RNA silencing is involved in multiple pathways in eukaryotes, including developmental transition, organogenesis, metabolism, and genome surveillance. Thus, it enables the integration and networking of complex suites of gene activity, thereby elaborating multicellular complexity. Our goal is to elucidate how RNA silencing pathways function in Drosophila and reach a deeper understanding of complexity of biological systems involving RNA silencing mechanisms.

Establishment of the Analytical Basis toward Comprehensive Understanding of the Ubiquitin System

Keiichi NAKAYAMA
Professor, Kyushu University

The ubiquitin system controls a number of important biological phenomena, and more than a thousand of enzymes are involved in the system. However, the relationship between the enzymes and their corresponding substrates has not yet been well established, and the development of technology that comprehensively analyzes the ubiquitin system is necessary. In this project, we intend to develop a new methodology by the combination of genetics and proteomics to understand the ubiquitylation as a system, by which molecular mechanisms underlying a number of biological phenomena will be elucidated.

Since FY2006

Research Area

Dependable Operating Systems for Embedded Systems Aiming at Practical Applications

Research Supervisor:
Mario TOKORO
Chairman, Sony Computer Science Laboratories, Inc.

Deputy Research Supervisor:
Yoichi MURAOKA
Professor, Waseda University

FY2006

Dependable Single System Image Operating System for Parallel/Distributed Embedded Systems

Yutaka ISHIKAWA
Professor, The University of Tokyo

In this research, a dependable and high performance distributed operating system on embedded computers connected by networks is designed and developed. Applications such as database server, search engine, and high performance computing run in such an embedded system. The distributed operating system enables dynamic configuration so that multi-core computers with/without local hard disks are dynamically connected or disconnected in response to the application's requirement or hardware failures. The distributed operating system is based on the Linux kernel and it provides a single system image to users.

Dependable System Software Development Technology

Toshiyuki MAEDA
Research Associate, The University of Tokyo

We realize technologies that enable us to ensure and verify safety and reliability of system software based on static program analysis theories, especially by type theory and model checking theory. In addition, we develop and release practical verification tools that can be widely used by system software developers.

Low-power and Highly Dependable Parallel Computer Platform for Embedded Systems

Mitsuhisa SATO
Professor, University of Tsukuba

We investigate dependable technologies for a high-performance parallel embedded computer platform with multi-core/multiprocessor systems. We develop a reliable software distributed memory system with redundant remote page management to provide fault-tolerance for embedded parallel programs. A communication facility using multiple network links is also developed to provide fault-tolerance and power management in the communication layer of embedded parallel systems. We also develop a power management run-time system to optimize performance and power consumption under real-time constraints.

FY2008

Research on Realtime Parallel Dependable Operating System with Realtime Networking Function

Satoshi KAGAMI
Deputy Director, National Institute of Advanced Industrial Science and Technology (AIST)

This research aims to develop an dependable operating system that has realtime, reliability, safety, and maintenance availability functions for robotics application. The system will be designed and implemented by following P-Bus architecture that is proposed and under developing in CREST Dependable OS project. For this purpose, ART-Linux that we have been developed in last 10 years will be rewritten. An asymmetric multi-processing and realtime ethernet communication functions will be developed. We will open this OS and investigate by applying our robots including humanoid robot project, RT-middleware project, and several company projects.

A Dependable Operating System for Micro Ubiquitous Nodes

Hideyuki TOKUDA
Professor, Keio University

We build an operating system for micro ubiquitous nodes, such as wireless sensor nodes and tiny mobile nodes. We consider high availability, security, reliability and real-time functionality are essential needs in the operating systems layer to achieve adequate dependability in practical applications. We provide an operating system infrastructure by extending the Linux OS, which ensure reuse of existing applications and ease of application development on it.

Study on User Oriented Dependability

Yoshiki KINOSHITA
Principal Research Scientist, National Institute of Advanced Industrial Science and Technology (AIST)

The goals of this project are to clarify the notion of dependability for information processing systems and to set up a standard based upon it. Systems' social responsibility is taken into account. The project also aims at presenting two guidelines accompanying the standard; one for the conformity assessment and the other on how to manage system life cycle (design, development, operation and maintenance, disposal) according to the standard. As a result, users will have objective criteria for the dependability of the system they work with. Moreover, developers will be able to provide the dependability of their products as an objective added value backed up by the standard.

A Dependable Operating System for Highly Functional Information Appliances

Tatsuo NAKAJIMA
Professor, Waseda University

The goal of our research is to develop a virtualized execution environment that integrates control processing and information processing, and increases reliability and extensibility. Our system will reuse various existing software on Linux, but we provide a common framework for failure management, I/O management, and resource management to realize the goal.

A Study on Runtime Dependability with Security Weaver and P-Script

Kimio KURAMITSU
Associate Professor, Yokohama National University

This research addresses two kinds of new technologies: one is a security weaver that ensures runtime dependability under unexpected threats, and another is a P-Script that provides us with the capability of describing dependability policy. The final outcomes shall be open source software to be widely evaluated by the industry.

Producing Highly Attack-Resistant Secure Operating Systems

Kenji KONO
Associate Professor, Keio University

This project aims to produce a highly secure operating system that bridges the gap between traditional security mechanisms and those required by modern information systems. In this project, we extensively utilize promising hardware technologies such as virtualization and security chips. In principle, we provide an extensible Linux that can incorporate and cooperate various security mechanisms, and guarantee the validity of the kernel itself from the virtualization and security hardware layers.

Since FY2006

Research Area

Development of the Foundation for Nano-Interface Technology

Research Supervisor:

Seiji SHINKAI

Professor Emeritus, Kyushu University
/ Professor, Sojo University

FY2006

Creation of Functional Organosilica Hybrid Materials with Highly Ordered Nano-structure

Shinji INAGAKI
Senior Fellow, Toyota Central R&D labs., Inc.

The object of this research is the creation of new function of organosilica hybrid materials through the control of the molecular arrangement structure and nano-porous structure. The drawbacks of organic materials, the low stability and the difficulty of nano-structure control, will be overcome by hybridization with inorganic materials in molecular level. We have already succeeded in the synthesis of highly ordered and stable mesoporous organosilica materials and aim to apply them to the photo-conversion system and high efficient molecular recognition system.

Catalyst Design of Gold Clusters through Junction Effect with Metal Oxides, Carbons, and Polymers

Masatake HARUTA
Professor, Tokyo Metropolitan University

Although gold is chemically inert, its reactivity dramatically changes when it becomes smaller than 2 nm in diameter being composed of less than 300 atoms. These gold clusters are deposited on a variety of support materials including base metal oxides, carbons having different nano-structures, and polymers as soft materials in order to tune the catalytic performance in a much wider scope. New catalytic processes are exploited in an attempt to expand the frontiers of green sustainable chemistry.

Ultra-high Brilliant Synchrotron Radiation Analisys and Control Station for Functional Interfaces

Masaharu OSHIMA
Professor, The University of Tokyo

In order to develop nano devices utilizing novel nano interface structures, we aim at developing a ultra-high brilliant synchrotron radiation analysis and control station at a long undulator. We will systematically perform the following four research programs: 1) 3-dimensional profile analysis, 2) nano-spectroscopy, 3) sub-micron soft X-ray emission spectroscopy, and 4) dynamic observation of interfaces by soft X-ray holography.

FY2007

Spin-polarized Electric Current Induced by Giant Rashba Effect

Tetsuya ARUGA
Professor, Kyoto University

The researchers have recently found a giant Rashba effect, which surpassed the previous record by nearly an order of magnitude. The effect will enable us to control the motion of interface electrons according to their spin states without external magnetic field or magnets. In this research program, we develop novel means to generate electric current with a specified spin state and to distinguish spin states of electrons.

Interfacial Device Physics for Oxide- and Organic-Electronics

Masashi KAWASAKI
Professor, The University of Tokyo

Two dimensional interfaces created by adjoining oxide semiconductors, correlated electron oxides and organic molecular compounds will be studied to elucidate the ways of efficient injection and/or accumulation of charge carriers. The electronic, magnetic and photonic properties played by thus engineered carriers will be promoted to functional devices.

Integration of Self-Assembly Strategies for the Construction of Smart Nanointerfaces

Nobuo KIMIZUKA
Professor, Kyushu University

This project aims to develop new molecular self-assembly and self-organization techniques to engineer new functional exploitable materials with varied nano-interface architectures. Fabrication of nano-interface architectures by interdisciplinary molecular self-assembly is a key feature of the project, and their components are widely selected from organic, inorganic, metal complexes to biomolecules. It will provide a new platform for designing molecular-system memories, nano-dielectrics, surface sensors and bio-nanodevices.

Creation of the Metal-Organic Hybrid Protonics and Functional Nano-Layer Integrated System

Hiroshi KITAGAWA
Professer, Kyoto University

Dynamics of molecules and ions in metal-organic hybrid nano-layer integrated system are acted by characteristic nano-fields such as intermolecular interaction, coulomb interaction, catalytic action, etc. This project is to establish the metal-organic hybrid protonics, and to create functional nano-layer integrated system, where the energy conversions can be easily operated. In particular, we aim at the construction of functional nano-layer system using coordination polymers which is able to control a series of energy operations such as generation, separation, storage, material conversion of an energy gas, H_2, or electron / ion transport.

Novel Physics and Device Applications of Nanogap Electrode/Quantum Nanostructure Junctions

Kazuhiko HIRAKAWA
Professor, The University of Tokyo

Electrical manipulation and read-out of quantum mechanical states in single quantum nanostructures by nanogap metallic electrodes is expected to bring about great innovations in ICT devices. In this project, we will establish technologies of accessing to single molecules, quantum dots, and graphene sheets by nanogap metallic electrodes and explore device applications of novel physics manifested in such nanogap junctions.

Self-assembled Discrete Nanointerfaces

Makoto FUJITA
Professor, The University of Tokyo

The present research utilizes self-assembled M_nL_{2n} spherical complexes, which are prepared by our own methodology. On the interior and exterior surfaces of the spherical complexes, we will develop the chemistry of discrete nano-exo- and endo-surfaces, and discrete nano-spaces to create new molecular- based materials possessing useful functions.

Foundation of the Nano-Interface Technology by the Surface Forces Measurement

Kazue KURIHARA
Professor, Tohoku University

The aim of this project is to create the novel nano-interface science and technology for designing functional nano-materials and devices for the next generation technology. The main tools are our original "twin-path surface forces apparatus" and "resonance shear measurement", which will be further developed by combining them with other spectroscopic methods. We consider even liquids at the interface as functional molecules. Subjects studied will include; (1) characterization of functional interfaces such as metals, (2) confined liquids and photoreactions in a confined space, (3) self-assembled formation and regulation of hierarchical structures at the interface.

Design of Multidimensionally Biological Interfaces through Manipulating Molecular Mobility

Nobuhiko YUI
Professor, Tokyo Medical and Dental University

In order to achieve the design of ideal interfaces between implantable medical devices and living bodies, we will examine to manipulate the molecular mobility of materials via intermolecular forces at nano-meter scales and then design multidimensionally biological interfaces. Finally, our approach enables to design biological interfaces, at which biomedical functions can be performed permanently in the living bodies.

Manipulation of Nano Interface of Drug-Delivery System and Its Application to Vaccine for Bird Flu

Kazuo SAKURAI
Professor, Kitakyushu University

The function of nanoparticles employed to drug delivery system is mainly governed by interactions through hydrophobic/hydrophilic interface. Throughout this project, we are planning to explore nanostructure of the particles and how the drugs are trapped in the interface of the particles by use of synchrotron X-ray scattering. One of the major applications is to provide novel methodology for molecular design of vaccine for pandemic flu and gene delivery

FY2008

Macroscopic Properties of Liquids in Interfacial Nanopores

Izumi ICHINOSE
Managing Director, National Institute for Materials Science

It has been known that liquids in nanopores are in different thermodynamic states. Boiling and freezing points of the liquids can be treated with parameters such as temperature and pressure. However, scientific treatment of the macroscopic properties like density, viscosity and diffusion coefficient has not been systematically studied. We will examine the fluid-dynamic properties of the liquids in interfacial nanopores by means of molecular simulation and the latest structural analysis technologies, aiming at developing innovative membrane separation systems.

Quantum Nano Devices by Control of Quantum Nano Interface

Kazuhiko MATSUMOTO
Professor, Osaka University

The present research will realize the quantum nano devices by utilizing the real feature of the nanowire. The fundamental quantum device will control the wave nature and the particle nature of the carrier at our will by modulating the quantum interface between the carbon nanotube and the metal. The quantum nanowire memory will be developed as a real device, which consists of the coaxial structure of the nanowire and two layers of insulators, and 1/10 of writing bias compared to the present memory will be realized due to the electric field concentration.

Energy Conversion via the Interface with Hydrogen Activation Aqua Catalysts

Seiji OGO
Professor, Kyushu University

Energy conversion under ambient conditions is developed by using the interface with hydrogen activation aqua catalysts, which are models for the active site in hydrogenase enzyme, i.e., (1) development of the fuel cell with the hydrogen activation aqua catalysts, (2) development of the energy conversion from hydrogen to light, and (3) development of the energy conversion from hydrogen to the chemical reactions under ambient conditions in water.

Research Area

Establishment of Innovative Manufacturing Technology Based on Nanoscience

Research Supervisor:
Yasuhiro HORIIKE
Fellow Emeritus, National Institute for Materials Science（NIMS）

FY2006

Development of Manufacturing Processes of Supramolecular Nanodevices for Practical Gene Therapy

Kazunori KATAOKA
Professor, The University of Tokyo

To realize safe and effective gene therapy, we are going to develop supramolecular nanodevices with multiple smart functions integrated into a nanometric-scale through the self-assembly of nanomaterials elaborated by advanced polymer synthesis. Intensive study will be done to confirm the functions and safety of nanodevices justified for their practical clinical applications. Also, we will establish efficient manufacturing processes for such smart nanodevices. The goal of this project is to establish new basis for the practical use of nanodevices in the treatment of three major diseases of cancer, cardiovascular diseases, and movement disorders in aged society.

Research and Development of Self-organizing Molecular Semiconductors for Device Applications

Jun-ichi HANNA
Professor, Tokyo Institute of Technology

The fast electronic conduction takes place in nano-scaled molecular aggregates of liquid crystalline molecules such as smectics and discotics. This discovery lead to the recognition that liquid crystals are a new type of organic semiconductors that self-organize into closely packed and oriented molecular aggregates. In this study, we aim to establish the scientific and technological basis of liquid crystals for device applications such as organic TFTs and organic LEDs.

Development of Bio/Nano Hybrid Platform Technology towards Regenerative Medicine

Hidetoshi KOTERA
Professor, Kyoto University

In this project, a novel platform technology for the scientific research of regenerative medicine in cellular and organ levels are developed, based on MEMS/NEMS technology such as bio-manipulation in micro/nano fabricated structures. By merging the two fields of bio and MEMS, creation of new manufacturing methodology for the next generation biotech, as well as a new application area of MEMS, is expected.

Precise Synthesis of Nano-particulate Materials in Micro-space

Hideaki MAEDA
Team Leader, National Institute of Advanced Industrial Science and Technology（AIST）

Nanoparticle technology holds great promise as a bottom-up nanotechnology in the 21st-century. In this research, various nano-particulate materials including metal, inorganic and organic nanoparticles are formed via liquid phase synthesis by using a micro-reaction technique. The goal of this study is to establish the most appropriate route for nanoparticles with desirable characteristics, and to develop the process that can satisfy the various outside demands for nanoparticle applications.

Autonomous Reaction Control in Solution Plasma for Application to Nanosynthesis and Nanoprocessing

Osamu TAKAI
Director and Professor, Nagoya University

"Solution plasma" stands for discharge in liquid. The features of the plasma are quite different from discharge in gas phase. Recently, "solution plasma" is expected to be a novel reaction field. In this study, we develop new generation methods of "solution plasma" in nanobubbles in order to explore the possibility of the application to material processing. We also aim to establish the fundamentals of "solution plasma" by developing qualitative-quantitative analysis method for excited states and chemically active species in the solution. Finally, we design and create a new reactor for "solution plasma" with an autonomous reaction control device.

FY2007

Manufacturing of Polymeric Nanoparticle Vaccines with Control Capability of Immune Responses

Mitsuru AKASHI
Professor, Osaka University

This project is aimed at the development of biodegradable polymer-based nanoparticles with control capability of immune responses, and the establishment of manufacturing technology and pharmaceutical process for practical applications of polymeric nanoparticle vaccines. We design and prepare a safe and universal nanoparticle-based vaccine using nanoparticles capable of controlling intracellular kinetic of antigens and having adjuvant activity. This strategy will provide a novel immune therapy for infectious diseases, cancers, and autoimmune diseases.

Development of High-perfomance Organic Transistor

Kazuhito TSUKAGOSHI
Principal Investigator, National Institute for Materials Science（NIMS）

Performance of organic transistor strongly depends on the interface properties in the transistor. Especially in current short channel transistors, the contact interface dominates the transistor properties. The interfaces must be fully understood to control the organic transistor operation. This allows us to realize short channel organic transistor with stable operation, and eventually increase operation performance. We will unveil and develop basic transport properties of the organic transistor for a future plastic electronics.

Development of an Automated Synthesis Apparatus and a Large Production for a Highly Functional Molecule "Super Catalytic Antibody"

Taizo UDA
Professor, Oita University

"Super catalytic antibody" is a nano-molecule and possesses sophisticated functions recognizing the targeted antigen with high specificity and can enzymatically cleave it. From the viewpoint of tailor-made therapy, in this study, we will develop essential and/or elemental technologies in order to complete the epochal tool（automated synthesis apparatus）, with which a medical doctor can make the human "Super catalytic antibody" suitable for each patient. In addition, we will genetically make some human "Super catalytic antibodies", develop the large production method, and investigate their behavior in vivo. Through these studies, we will realize human "Super catalytic antibody" as the new medicine against infectious viruses and cancers as a front runner in the world.

Development of Irreplaceable Devices by Creation of the Second Generation Carbon Nanotube

Hiromichi KATAURA
Group Leader, National Institute of Advanced Industrial Science and Technology (AIST)

Carbon nanotubes (CNTs) are classified into two types, metals and semiconductors. The mixed production of them obstructed the practical use. In this project, we first develop a new technology to separate CNTs almost perfectly into semiconductors and metals. Further we insert other molecules into CNTs to control the electronic properties and finally create highly functional the second generation CNTs. By using them, we develop high-performance thin film transistors and non-linear optical devices exploiting the original potential of CNT.

FY2008

Development of the High-Speed Molecular Evolution System for Enzymes using Nanobiochip Technologies

Takanori ICHIKI
Associate Professor, The University of Tokyo

This research aims to develop the innovative biomimmetic manufacturing system of molecular machines by fusion of high-speed molecular evolution, nanobiochip, and single-molecule imaging technologies. This research is expected to realize a practical and versatile system for the evolution of enzyme molecules that are useful in various application fields such as medicines, clinical test, detergents, food processing, bioenergy, bioremediation, biosensors, and so forth.

Development of Innovative Synthesis Methods of Nano-materials Using Ionic Liquid and Vacuum Techniques

Susumu KUWABATA
Professor, Osaka University

Ionic liquid having negligible vapor pressure is not vaporized even in vacuum condition. Our experiments based on this unique feature led us to discovery of surprising phenomena; 1) Gold sputtering to ionic liquid results in synthesis of Au nanoparticles in the liquid; 2) Ionic liquid in a vacuum chamber can be observed by an electron microscope without any charging of the liquid. These must be the base technologies for developing novel nano-material synthesis and in situ measurements of chemical phenomena with several vacuum analytical instrument including electron microscopes. Realization of such the innovative ideas is the purpose of this research project.

Novel Engineering of Hierarchically Structured Biomimetic Surfaces

Masatsugu SHIMOMURA
Professor, Tohoku University

In order to establish "Biomimetic Engineering", that is a novel bottom-up typed manufacturing technology inspired by the hierarchical structuring and unique function characterized by self-assembly and self-organization of biological systems, hierarchically structured novel surfaces of various materials from nanometer to micrometer scale are newly prepared by using combination of physical self-organization processes, e.g. regular pattern formation from disorder by using dissipative structures, and chemical plating processes.

Establishment of Process Navigation by Creation of Plasma Nano Science and Soft Material Processing

Masaru HORI
Professor, Nagoya University

In order to realize the future nano device manufacturing, we will make the paradigm shift from plasma process by a trial and error method to that on the basis of plasma science. The desktop combinatorial plasma analysis equipment with the monitoring technique for radical density, ion density and energy is developed and using the equipment, plasma nano science is created. Moreover, we will establish the guiding principle "process navigation" by the process data map based on plasma nano science. Herewith, innovative nano process manufacturing technology for organic soft materials is established.

Creation of New Nanostructured Materials and Manufacturing Processes for Next-Generation Electronics using Inorganic Nanosheets

Takayoshi SASAKI
Fellow, National Institute for Materials Science (NIMS)

We will develop a solution-based nanofabrication technique, which involves layer-by-layer deposition of inorganic nanosheets as a two-dimensional functional building block into nanostructured or superlattice assemblies. Based on this new process, we will create nanofilms with innovative electronic and magnetic properties, and also develop a new method for epitaxial growth of functional crystal films, which will contribute to the progress of electronics and information technologies.

3 Dimensional Molecular Imaging for Soft Materials

Jiro MATSUO
Associate Professor, Kyoto University

A novel molecular imaging (secondary ion mass imaging) for soft materials used in bio-technology and molecular electronics is being developed with swift-heavy ions. In order to realize molecular depth profiling of soft materials, cluster ions will be utilized to remove soft materials without destroying molecular structure. Objective of this project is to offer a novel technique for nano-technology and bio-technology.

Development of Single Electron Devices by Highly Precise Bottom-up Processes

Yutaka MAJIMA
Professor, Tokyo Institute of Technology

We develop the novel single electron devices by using highly precise three bottom-up processes. First, nanogap electrodes with 5 nm or less in gap separation are fabricated by electroless plating with a self termination process. Second, metal clusters and molecular wires using metal complexes are synthesized for a use as Coulomb islands. Third, the synthesized Coulomb islands are selectively integrated into the nanogaps. By using these highly precise bottom-up processes, we demonstrate a single electron device operation at room temperature and establish fabrication processes toward a logic circuit.

Research Area

Advanced Integrated Sensing Technologies

Research Supervisor:

Kiyoshi ITAO

Professor, Tokyo University of Science

FY2005 (Completed Research)

Development of Integrated Ubiquitous Microsensor Devices for Peace and Security of Human Life

Makoto ISHIDA
Professor, Toyohashi University of Technology

In this project, we developed highly integrated microchip sensor-node (micronode) for ubiquitous sensor network which is promising to realize peace and security of human life. The 'micronode' is a complete wireless sensor node integrating plural microsensors and processing circuits with radio-communication unit and wireless power receiver. By this project, an innovative sensor micronodes were realized, which are released from power supply wires and battery life problem. The developed micronodes can be applied to healthcare monitoring of artifacts and human beings.

Basic Technology Research on Sensing and Computational Theory of Everyday Life Behavior for Injury Prevention

Yoshifumi NISHIDA
Team Leader, National Institute of Advanced Industrial Science and Technology (AIST)

This research developed a human behavior observing and modeling technology by integrating a ubiquitous and IT-based sensing technology for human behavior, a processing technology of large scale human behavior data, and a technology for developing a human behavior model from the large scale data. This research established injury prevention engineering by applying the developed human behavior observing and modeling technology to the field of injury prevention for children in an applicative work-frame, and also proposed a new social system of "a safety knowledge circulating system." Through the above basic and applied research, this research presented a concrete methodology for sustainably developing "a System of Everyday Life Knowledge."

Space Gazer System for Safety and Convenience in Living Environment

Koichi KURUMATANI
Group Leader National Institute of Advanced Industrial Science and Technology (AIST)

The target of this research project is to realize space gazer system that watches living environment in order to achieve safety and convenience simultaneously on a single software platform. Noticing the position of human user, we have realized an autonomous indoor navigation system that consists of 1) autonomous positioning system that estimates user's position in a robust way against noise and signals loss in 2.4GHz ISM band, 2) navigation system that provides convenience route guidance and that provides route information to emergency exits in ordinary and emergency situation respectively. Noticing motion of human user in addition to position, we have also realized remote human-motion monitoring system that measure and estimate human motion by a small -size and light-weight mobile motion sensor. The estimated human motion information is transferred to remote users such as user's family by using wireless cell phone IP networks.

Mobile-type Ful-automatic Multi-BWA (Biological Warfare Agents) Detection System

Jiro YASUDA
Chief, National Research Institute of Police Science

The crime and terrorism using Biological Warfare Agents (BWA) have become a big threat for our safety and security. When incidences using BWA occur, quick detection, identification and transmission of the information are the most important to minimize individual and social damages. Our research is driving for the development of advanced unification sensing systems for BWA. The systems are the forerunner of the world and possible to rapidly detect and identify many kinds of BWA at once only by injection of the suspicious materials into the portable equipment.

(Research term: 1 Oct.2005-30 Sep.2008)

Moving Object Sensing Technology for Security and Safety

Tomomasa SATO
Professor, The University of Tokyo

The project realized integrated sensing technology not only to measure and accumulate behavior information of human and machine but also to extract typical behavior pattern from acculated data. The project established noble service technology to realize personalized and situation adapted support in such a field as daily life, physical distribution and transportation as well as car driving.

FY2006

Development of Animal Watch Sensor System for Human Health and Food Safety

Toshihiro ITOH
Deputy Director, National Institute of Advanced Industrial Science and Technology (AIST)

We develop wireless sensor nodes and networks for animal healthcare that contribute to human health and food safety. The "Animal Watch Sensors" which are miniaturized, light, flexible as well as self-sufficient sensor nodes are realized by developing ultra low power MEMS sensors and film-based microsystem integration and packaging technologies. As one of the important applications, we utilize the sensor nodes and networks for a global avian influenza surveillance system, which is necessary to defend human beings from an influenza pandemic.

Development of Odor Sensor System for Security

Kiyoshi TOKO
Professor, Kyushu University

In the present study, we aimed at the development of an ultra supersensitive odor sensor system for ppt (parts per trillion) level detection of explosives by combining a surface plasmon resonance (SPR) sensor technology with antigen-antibody reaction and an electrode polarization controlling sensor which utilizes a molecular imprinting method. The sensor network system can be adapted to security of airport and railroad, detection of explosives on police work, quality control of foods and water. The sensor system contributes to realize safety and security of society.

(Research term: 1 Oct. 2005 - 31 Mar. 2010)

The Creation of Safety Monitoring Network Systems by Mechanoluminescence Sensors

Chao-Nan XU
Team Leader, National Institute of Advanced Industrial Science and Technology (AIST)

This project is to develop for stress sensor devices to monitor wide area by detection capability that minute abnormality can be found by mechanoluminescence particles. The mechanoluminescence particles are the particles that each microparticle can activate as a sensor element, transferring mechanical energy to photon energy. Based on this novel sensor, real time system for monitoring stress dangers (abnormality) and memory system for stress hysteresis will be developed, and then these systems will be tied up by network system to realize the safety monitoring system comprehensively in order to detect dangers sign of structural objects such as tunnels and pipelines.

*The reported research affiliations are those at the time of the projects completed.

OSOITE: Software Infrastructure of Network Sensing for Real-World Search

Yoshito TOBE
Professor, Tokyo Denki University

In Overlay-network Search Oriented for Information about Town Events (OSOITE), we aim at providing users of personal devices with information about secure and safe actions in a usual urban life as well as in an emergency by utilizing the real-world overlay sensor networks. Specifically, we provide the users with alarms in a background and safe navigation based on the extracted high level information obtained with search in different types of database including real-time sensed data.

Wearable Integrated Sensing System of Fundamental Brain Function to Create Information Environment Safe for the Brain

Manabu HONDA
Research Director, National Center of Neurology and Psychiatry

The latest brain science has revealed that specific stress caused by inconformity between information environment and the brain induces abnormal function of the fundamental brain region, which regulates various life activities. Abnormal fundamental brain function can induce various modern diseases through abnormal functions of emotional, autonomic, hormonal or immune systems. In this research, we intend to develop the wearable system sensing the fundamental brain function by integrating various vital signals for creating safe and comfortable information environment.

Development of a Practical Monitoring System of Urban Infrastructure for Disasters and Accidents

Yozo FUJINO
Professor, The University of Tokyo

The research project aims at constructing a practical sensor network system to quantify the risk of individual infrastructure by monitoring its hazard as well as vulnerability. Toward this, the-state-of-the-practice sensors are fully utilized, and new optical sensing systems and a vunerability assessment technique using semi-active sensing of small and moderate hazards are also developed. The system is implemented in the buildings of the main campus of the University of Tokyo and viaducts of high speed railway are also selected as experimental sites.

Multi-sensory Communication, Sensing the Environment, and Behavioral Navigation with Networking of Parasitic Humanoids

Taro MAEDA
Professor, Osaka University

Parasitic Humanoid is a wearable robot in order to measure the senses and the motion of the wearer, and induce the behavior using illusions with multi-sensory display. Networking of Parasitic Humanoids can support security and safety of social human life. This technology will realize coordinated works assisted with multi-sensory communication, sensing the unexpected environmental information from the wearer's behavior, and personal and crowd behavioral navigation with supporting sensor network.

Portable High Performance Gas Sensor System for Hazardous Gasses

Kazushi YAMANAKA
Professor, Tohoku University

It is required for the safety of environment to rapidly and sensitively detect many hazardous gasses. In this research, we improve the ball SAW sensor which accurately measure the effect of absorbed gas by using the multiple roundtrips of SAW on the surface of a sphere. Then, we develope a portable sensor system for many gasses using ball SAW sensors with gas separation by chromatograph columns prepared by micro fabrications.

Development of a Physiological and Environmental Information Processing Platform and its Application to the Metabolic Syndrome Measures

Ichiro YAMADA
Professor, The University of Tokyo

The purpose of this research project is to develop a novel information processing platform to simultaneously record physiological and environmental data in one's daily life and objectively confirm one's lifestyle habits. Fundamental technologies in the areas of data collection using wearable sensors and data mining for screening of health risks will be developed. As an example of the expected project outputs, the relationship between various physiological and environmental data and the metabolic syndrome condition will be investigated and the results will be used to devise new strategies to improve patients' lifestyle habits. Particularly, new concepts of personal healthcare services that could prevent and treat the metabolic syndrome condition will be proposed and the effectiveness of the new concepts will be verified by demonstration experiments.

FY2007

Advanced Wireless Communication Technology for Efficient Rescue Operations

Teruo HIGASHINO
Professor, Osaka University

In this project, we consider situations where many persons are simultaneously injured in disaster such as earthquakes and train accidents, and propose an advanced electronic triage system for sensing physical condition of those injured persons and collecting their sensed data in ad-hoc wireless communication. The triage system presents dynamic change of injured persons' location and physical condition on monitors in real time. Our research aims to improve efficiency of rescue operations in disaster using the proposed advanced wireless communication technology.

Research Area

Technology Innovation and Integration for Information Systems with Ultra Low Power

Research Supervisor:
Takashi NANYA
Adviser, CANON INC.

FY2005 (Completed Research)

Generation of High-performance, Ultra-low-power, Short-range Wireless Mobile Information System

Tadahiro KURODA
Professor, Keio University

Power reduction of 1/1000 in short-range wireless data communications and energy feeding was achieved to develop mobile information system where robots, cars, and cellular phones are connected to wireless networks. Concrete achievements of our projects were: inter-chip communications of 10Tbps/100mW, inter-terminal communications of 10Gbps/80mW in extremely-close-ranges and 100Mbps/1mW in short-ranges, as well as a power-feeding sheet of 1/1600 less power dissipation that enabled battery recharge of moving terminals.

FY2006

Development of Ultra-low-power FPGA with Fine-Grained Field-Programmable Threshold Voltage Control

Hanpei KOIKE
Group Leader, National Institute of Advanced Industrial Science and Technology (AIST)

While FPGA (Field Programmable Gate Array) has been adopted as an important compornent in wide range of application fields from supercomputers to information appliances, increase of static power consumption caused by leakage current has become an important design issue in future FPGA. In this project, "Flex Power FPGA", an ultra-low-power FPGA with fine-grained field-programmable control of the threshold voltage of the transistors, is developed aiming at 1/100 reduction of the static power consumption.

Extremely Low Power System Display by Use of Fine Gate Structure

Hikaru KOBAYASHI
Professor, Osaka University

The purpose of the project is to achieve extremely low power thin film transistors (TFT) for operation of display devices by use of a low temperature Si oxidation method developed by us, i.e., "nitric acid oxidation method". The quality of silicon oxide layers formed by the nitric acid oxidation method is much superior to those for the conventional methods, which enables the use of much thinner oxide layers as gate oxide, and consequently the electricity consumption of TFT could be decreased to 1/225. Moreover, by the fabrication of TFT with fine gate structure and development of new circuit technology and architecture, the electricity consumption of system displays could be reduced to 1/9 ～ 1/50, leading to the decrease in the total electricity consumption to l1/2,000 ～ 1/10,000.

Research on Ultra Low Power SoC for Media Processing

Satoshi GOTO
Professor, Waseda University

The purpose of this project is to reduce the electric power consumption by 1/100 of the current product's one in the area of multimedia information processing such as video, image, audio and text. New innovative technologies will be developed to achieve this goal. (1) Optimum algorithm to assign Error Correcting Code and/or Encryption Code to the media content by taking account of the importance of the information itself, (2) Low power circuit design for video compression, error correction and encryption functions by introducing a new algorithm and architecture. (3) High level synthesis EDA tool integrated with Floor Plan design and a new configurable processor design.

Optical Routing Network Technologies that Enable Ultra-Low Power Consumption

Ken-ichi SATO
Professor, Nagoya University

In order to attain wide penetration of various bandwidth-hungry broadband services in the future, both further network performance advances and dramatic reductions in network power consumption must be attained. Photonic network technologies that utilize WDM and wavelength routing will provide the solution. This project succeeded in creating next-generation network technologies that can dramaticaly reduce power consumption exploiting photonic network technologies.

Low-power, High-performance, Reconfigurable Processor using Single Flux Quantum Circuits

Naofumi TAKAGI
Professor, Kyoto University

We research on a processor with a large-scale reconfigurable data path realized by using superconductor single flux quantum circuits. We develop basic technologies for a 10 TFLOPS desk-side computer which consumes about a hundredth of electric power compared to that realized by using today's technologies.

Hardware/Software Co-Optimization for Low-Energy Embedded Systems

Hiroaki TAKADA
Professor, Nagoya University

As a hardware/software co-optimization framework for minimizing energy consumption of embedded systems, we have proposed the concept of DEPS (Dynamic Energy Performance Scaling) and developped multi-performance processor, ULP software development environment, and ULP RTOS for its realization. We have also investigated on software development method for low energy consumption and proposed a basic theory on low energy consumption algorithms.

Innovative Power Control for Ultra Low-Power and High-Performance System LSIs

Hiroshi NAKAMURA
Professor, The University of Tokyo

Further performance improvement of system LSIs is limited by increasing power consumption. To solve this problem, we develop an innovative power control method based on tight collaboration and cooptimization of circuit implementation, architecture/compiler, and system software. The goal of this research is to reduce power consumption by two orders of magnitude.

*The reported research affiliations are those at the time of the projects completed.

FY2007

Strategic Integration of Ultra-Low Power Systems for Ambient Intelligence

Haruhisa ICHIKAWA
Professor, The University of Electro-Communications

Ultra-low power (ULP) information systems are expected to bring us industrial and social innovations. This project will construct and demonstrate a ULP ambient intelligence system that infers and searches for event occurring in the real world. This includes the development of ULP wireless sensor nodes, and the public demonstration of the ambient intelligence system integrated with technologies developed in the ULP research area and ubiquitous network technologies targeting at post-IP era. The demonstration shows how the ultra-low power technologies contribute to the industrial strategies and the rich and comfortable human life in the future.

Ultra-Low-Power Data-Driven Networking System

Hiroaki NISHIKAWA
Professor, University of Tsukuba

This research is aiming at developing a data-driven networking system by which the coming networking environment can be achieved with ultra-low-power consumption 1/100 to 1/1000 of the present. In order to achieve ultra low power consumption, the research will ultimately utilize passive data-driven principle in realizing both (1) data-driven chip-multi-processor platform based on self-timed elastic pipeline and (2) networking scheme based on ad hoc network technology.

Optimum Control of Electrical Power in IT Systems by ULP Networked Sensing Systems

Ryutaro MAEDA
Director, National Institute of Advanced Industrial Science and Technology (AIST)

Energy demands has been increased dramatically for IT systems, such as personal computers and IDC (Internet data center). Ultra Low Power (ULP) networked sensing systems are proposed to visualize the energy consumption of IT systems. Employing the visualized consumption maps, IDC control system is to be developed for minimizing energy consumption. Furthermore, social experiments are planned to establish the reduction method of all energy consumption for all IT systems including air conditioning facilities.

ULP-HPC: Ultra Low-Power, High-Performance Computing via Modeling and Optimization of Next Generation HPC Technologies

Satoshi MATSUOKA
Professor, Tokyo Institute of Technology

The importance of High-Performance Computing (HPC) is now widely recognized; however, the rapid increase in power consumption beyond tradeoff for performance is regarded as critical. We aim to improve the power/energy vs. performance efficiency of HPC by 1000-fold in the next 10 years; our proposal, ULP-HPC (Ultra Low-Power HPC) will (1) apply autonomous performance tuning of system parameters based on sound mathematical foundations for power-performance optimization onto (2) new reed of HPC platforms including many-cores, vector accelerators, next-generation memory systems, etc., and (3) construct testbeds for verifying our approach including the utilization of TSUBAME, the No.1 supercomputer in Japan at Tokyo Tech., and furthermore (4) aim at optimizing HPC applications and their algorithms themselves for low power. The result will allow "shrinking" of current-day massive TSUBAME onto a desktop size, greatly contributing towards advancement of science and technology.

Since FY2005

Research Area

High Performance Computing for Multi-Scale and Multi-Physics Phenomena

Research Supervisor:
Genki YAGAWA
Director / Professor, Toyo University

FY2005 (Completed Research)

Hybrid Simulations of Complex Liquid-solid Interfaces at Nano, Meso, and Micro Range-scales

Shuji OGATA
Professor, Nagoya Institute of Technology

A suite of concurrent-type, hybrid simulation codes have been developed for supercomputers by combining the elementary simulation methods for various levels of physics ranging from the electronic structures to the fluid dynamics including the coarse-graining. Some of the codes have been demonstrated to have the capability to run on a world-wide computation grid. The hybrid codes have been applied to various engineering processes at liquid/vapor-solid interfaces including the friction of NEMS, the diffusion of atoms in layered materials, the flow in porous microstructures, the flow-induced vibration of ultra-thin sheets, and the flow with polymers.

Advanced Model Development and Simulations for Disaster Countermeasures

Keiko TAKAHASHI
Program Director, Japan Agency for Marine-Earth Science and Technology

The multi-scale multi-physics simulation code (Multi-Scale Simulator for the Geoenvironment: MSSG) with ultra high-speed computation has developed to forecast disaster, such as a typhoon and local severe rain. In the MSSG, novel computational schemes, micro cloud physics model with turbulence and an interaction model between ocean and atmosphere, which was based on the results of experiments in laboratories, were developed. It becomes clear that those schemes affect strongly forecast accuracy.

Construction of Nano-Architecture Based on Computational Quantum Theoretical Science

Atsushi OSHIYAMA
Professor, The University of Tokyo

In this research project, we have newly developed a real-space scheme in the density functional theory to explore electronic structures of nano- and bio-materials in close collaboration between materials-science and computer-science groups. This allows us to perform first-principles calculations for large-scale systems containing 10000 - 20000 atoms. Physical properties and new functions of nano- and bio-materials, including Si nanodots, naowires, and carbon nanomaterials, have been clarified.

A Program System with Hierarchical Quantum Chemical Methods for Accurate Calculations of Biological Molecules

Seiichiro TEN-NO
Professor, Kobe University

Based on highly accurate ab initio theory, we have developed novel computational methods for biological molecules with quantum mechanical (QM/QM) and molecular mechanical (QM/MM) hierarchies. Reliable and robust simulation techniques granted by the studies of low scaling and novel wave function methods along with the cultivation of new molecular properties provide the bases of modern science and technology which enable us to study electronic states, dynamics, and properties transcending the limitation of a field.

Global Cloud Resolving Model Simulations toward Numerical Weather Forecasting in the Tropics

Masaki SATOH
Team Leader, Japan Agency for Marine-Earth Science and Technology

The global cloud resolving model which simulates the global atmospheric circulation with 3.5km-horizontal mesh is now available using the Earth Simulator. This model explicitly resolves cumulus convection whose horizontal scale is a few kilometers; the effects of cumulus convection is poorly representated in existing global circulation models. In this study, we succeeded in realistic simulations of multi-scale structure of tropical convection such as the Madden-Julian Oscillation, and tropical cyclones. The global cloud resolving model will play more important roles in numerical weather forecasting and climate study.

Simulations and Dynamics for Nanoscale and Biological Systems

Kimihiko HIRAO
Special Advisor, Advanced Science Institute,RIKEN

In this study, we have developed a next-generation molecular theories integrating new electronic structure and dynamics theories for simulating nano-bio systems and a high-speed molecular calculation software on Japan Next-Generation Supercomputer-K. These theories and softwares enable us to perform the quantitative calculations and simulations of nano-bio systems containing more than several thousand atoms, and make major advances to theoretical analyses of biological functions and theoretical material designs of nano systems.

Theoretical Studies of the Charge Transfer Mechanisms in Biological Systems with QM (MRSCI+DFT)/MM methods

Toshikazu TAKADA
Coordinator, RIKEN

To understand the mechanism of the electron transfer in the photosynthetic reactions center, a new QM/MM theory specially designed for excited electronic states has been formulated and the code was developed based on it. From the calculations including the 6 pigment molecules such as chlorophyll, it is shown that the electron transfer occurs by using small energy for each step. Further more, an idea for artificial photosynthetic devices which enable to store solar energy directly to chemical compound was obtained by comparing with photo catalysis.

(Research term: 1 Oct. 2005 - 31 Mar. 2009)

Integrated Predictive Simulation System for Earthquake and Tsunami Disaster

Mitsuhiro MATSU'URA
Project Professor, Institute of Statistical Mathematics

For contributing to the reduction of earthquake and tsunami disaster, we succeeded in developing an integrated computer simulation system to reproduce and predict the chain of earthquake-related processes, namely tectonic stress accumulation due to relative plate motion, earthquake generation, seismic wave and tsunami propagation, and the shake of buildings.

*The reported research affiliations are those at the time of the projects completed.

FY2006

Multi-scale Simulation of Condensed-phase Reacting Systems — Developing Coarse-Graining Theory and Reconstruction Method of Large-scale Atomic Data —

Masataka NAGAOKA
Professor, Nagoya University

Multi-scale simulation of condensed-phase reacting systems is realized to coarse-grain and reconstruct the atomic data obtained by ab initio molecular dynamics (MD) simulations for solutions, surfaces and biopolymers. We study (i) coarse-graining techniques and coarse-graining evolution equations, (ii) reconstruction methods of nonequilibrium states via the maximum entropy principle, and (iii) QM/MM interface connecting molecular orbital theory and MD method, and apply them to specific cases to establish the basis for practical uses of the multi-scale simulation of condensed-phase reacting systems.

Simulation of Complexes Molecular Systems Utilizing Hybrid Molecular Theories

Keiji MOROKUMA
Research Leader, Kyoto University

The goals of the present research are to develop further hybrid molecular theories such as ONIOM and RISM-SCF already invented by the principle and co-principle investigators, to demonstrate the feasibility of applying such hybrid methods to simulation of structure, reactions and dynamics of complex molecular systems such as nano, biomolecular and solution phase systems, and to actually solve by simulation some of the important existing problems in these fields.

High-accuracy Hierarchical and Many-body Schemes for Materials Simulations

Masatoshi IMADA
Professor, The University of Tokyo

Based on the density functional theory and theories for strongly correlated electrons, we innovate first-principles simulation methods by accurately estimating Coulomb interaction effects. Hierarchies in multi energy scale and diversity of material properties generated by competitions of kinetic and interaction energies will be elucidated. We will replace the "single-particle approximation", which has played a key role in semiconductor electronics, with many-body quantum simulation methods, by which enable us to clarify "quantum and macroscopically collective behavior" and "giant response" generated by strong electron correlations.

Scale interaction and large-scale variation of the ocean circulation

Hiroyasu HASUMI
Associate Professor, The University of Tokyo

We'll clarify the physical mechanisms controlling the oceanic mid-depth and deep circulation, by carrying out micro-to-global-scale simulations for formation, modification, and transportation processes of the oceanic intermediate and deep waters. Based on its understanding, we'll then establish effective and efficient modeling methods to evaluate influences of climate changes on large-scale ocean circulation and local-scale coastal environment.

Marine Environmental Simulation Study for Future Projection of Marine Ecosystems

Yasuhiro YAMANAKA
Professor, Hokkaido University

We will simulate marine environments to project impacts of global warming and ocean acidification on marine ecosystems and fishery resources. It is predicted that the carbon dioxide emissions associated with human activities will increase the atmospheric concentration of carbon dioxide, causing global warming. The ocean absorbs this carbon dioxide, which affects marine biota through ocean acidification. We will develop simulation techniques by integrating models developed in various fundamental fields of ocean science.

Multi-scale Plasma Particle Simulation for the Development of Interplanetary Flight System

Hideyuki USUI
Professor, Kobe University

Magneto Plasma Sail (MPS) is proposed as one of the innovative interplanetary flight systems. The propulsion of MPS is obtained as a result of multi-scale kinetic interactions between the solar wind plasma and the small-scale artificial magnetosphere created around the spacecraft. To examine the multi-scale plasma interactions in association with MPS, we will establish the foundation and the methodology for the multi-scale plasma particle simulations by combining Adaptive Mesh Refinement (AMR) and Particle-In-Cell (PIC) methods.

Framework Development for Multiscale and Multiphysics Simulations toward Novel Applications of Superconductivity

Masahiko MACHIDA
Principal Scientist, Japan Atomic Energy Agency

One of issues in this research project is to explore the puzzling mechanism of superconductivity (superfluidity), which is the most dramatic phenomena of condensed matters ever known to humankind, by performing superlarge scale simulations on massively parallel supercomputers. Intensive researches are also carried out toward novel applications of superconductivity to quantum devices, Tera-Hz laser, high-accurate irradiation detectors, etc. by developing originally multiphysics and multiscale simulation techniques. Our final goal is to make a breakthrough in superconducting science and engineering fields beyond the previous framework.

Multi-scale Simulations for Soft Matters

Ryoichi YAMAMOTO
Professor, Kyoto University

Softmatters, such as polymeric materials or particle dispersions, possess unique characters. It is however very difficult to predict their properties theoretically because of their complexity. The aim of this project is to establish new multi-scale simulation methods which enable us to interconnect among microscopic, mesoscopic, and macroscopic levels consistently. We aim also to develop a program code for material design.

Hierarchical Modeling of Interactions Among Biomolecules

Akio KITAO
Associate Professor, The University of Tokyo

We aim to construct the integrated simulation system for the prediction of biomolecular complexes and the analysis of their functional mechanisms. This novel simulation method gradually shifts from coarse-grained models to the finer-grained ones, selecting more possible candidates from a large number of model complex structures and then accessing a small number of candidates accurately. Thus we intend to realize effective and accurate modeling of protein-ligand and protein-protein interactions.

Research and Development of DDS Simulator

Masuhiro MIKAMI
Senior Research Scientist, National Institute of Advanced Industrial Science and Technology (AIST)

In this research project, we will develop a multi-scale simulation methodology for active targeting drug delivery system (DDS) consisting of a liposome and sugar chain. This simulation methodology based on the fragment molecular orbital method, molecular simulation and fluid dynamics enables us to do (1) design of DDS nanoparticle, (2) analysis of molecular interaction between lectin protein and sugar chain, and (3) flow analysis of DDS nanoparticles in a blood vessel, which are essential for the DDS development. Also, we will provide the basis for a general DDS design by developing DDS simulator which integrates these simulation methodologies.

FY2007

Highly Accurate Order (N) Computational Method for Gigantic Systems and Material Design for Nano-bio Systems

Yuriko AOKI
Professor, Kyushu University

We develop a highly accurate computational method for calculating electronic states with electron correlation effect included for gigantic systems. By this basics methodology, the physical properties for nano ~ micro size under various external fields can be obtained and material can be designed from micro-viewpoint. On the other hand, we aim at establishment of the molecular design integrated system for next generation functional materials, through maintaining the system requirements on a large-scale PC cluster and enabling to mount the next generation supercomputers.

Realizing Super-accurate Predictions and Giant-molecular Designs: Breakthrough of Frontiers of Quantum Chemistry with Innovative Methodologies in Computational Science

Hiroshi NAKATSUJI
Director, Quantum Chemistry Research Institute

Quantum principles like Schrödinger equation govern chemistry, biology and physics of matter, but have been believed to be insoluble for most actual systems for over 80 years since their birth. Recently, a general method of solving these basic equations has been discovered by us. In this project, this theory will further be advanced to realize truly predictive science and quantum chemistry with innovative methodologies in computational science. Our SAC/SAC-CI method will further be expanded to be seamlessly applicable even to giant molecular systems in the designs of photo electronic processes.

Since FY2005

Simulation for Predicting Quake-Proof Capability of Nuclear Power Plants

Shinobu YOSHIMURA
Professor, The University of Tokyo

Recently importance of nuclear energy has been recognized again due to serious concerns of global warming and energy security. It is one of the critical issues to verify safety capability of ageing nuclear power plants subjected to big earthquake. In this research, we will develop a multi-physics and multi-scale based simulator of quantitatively predicting actual function limit of ageing nuclear power plants under operation or just after scram event subjected to big earthquake.

Research Area

Basic Technologies for Controlling Cell Functions Based on Metabolic Regulation Mechanism Analysis

Research Supervisor:
Masahiro NISHIJIMA
Professor, Showa Pharmaceutical University

FY2005 (Completed Research)

Development of Quantitative Metabolomics and Intergration of Metabolome Data with Proteome Data

Yoshiya ODA
President, Biomarkers & Personalized Medicine Unit, Eisai Co., Ltd.

We have developed accurate & comprehensive quantitative metabolomics, and high sensitive metabolome analysis by nano-scale sample preparation, nano-scale stone bridge columns & selective enrichment techniques. We also constructed an universal software for mass spectrometry, and we are providing the software with no charge. We have collaborated Mass Bank (JST-BIRD) to develop metabolome database. We have submitted a patent for Alzheimer's disease diagnostics. One of our projects has been integrated with proteomics to understand mechnisam of the change of metabolomics.

Molecular Network that Supports Chromosome Segregation Metabolism

Mitsuhiro YANAGIDA
Investigator (Professor extraordinary), Kyoto University

How the number of chromosomes (46 for human, for example) is kept to be constant? This project elucidated cellular functions of molecular network that is essential for homeostasis of chromosome number. Metabolic regulatory pathways consisting of evolutionarily conserved proteins and metabolites exist and are required for inheriting chromosomes. We established the pathways using a variety of integrated technologies. Knowledge obtained and methodology developed will be applicable in principle to any organisms, so that their values are high and expected to be applicable in the areas of understanding the causes of 'chromosome diseases' and cancer.

Construction of the Fundamental System for Lipid Metabololics and Its Application

Ryo TAGUCHI
Professor, Chubu University

During this project, we could construct the fundmental thechniques for comprehensive analysis on the changes in lipid metabolites within living cells by mass spectrometry. With this method, we discovered unknown oxidized lipid metabolites and proved that lipid oxidation was titely concerning several lifestyle-related diseases. We could confirmed that lipid metabolomics is very important method for new drug discovery and neutral improvement of food adding to the elucidation in physiological function of lipids.

Global Analysis of Dynamics and Network of Protein Modifications

Minoru YOSHIDA
Chief Scientist, RIKEN

Cellular proteins are subject to a variety of post-translational modifications. The modifications may constitute dynamic networks to regulate the environmental responses and homeostasis. In particular, protein acetylation and methylation occur in concert with cellular metabolic activity. However, the overall connections between protein modifications and metabolism are still unclear. In this project, we systematically identified modifications that occur in the fission yeast gene products, and the functional significance of the modifications in the metabolism was elucidated. These studies revealed that the functions of many human homologues of the metabolism-related gene products were regulated by protein acetylation. Furthermore, we established the systems for developing inhibitors to control cellular metabolic activity.

Investigating the Mechanisms of Cellular Metabolism in Regulating Stem Cell Functions

Atsushi HIRAO
Professor, Kanazawa University

Stem cells are defined as cells that have the ability to perpetuate through self-renewal, and develop into mature cells of a particular tissue through differentiation. Appropriate controls of stem cell functions are critical for maintaining tissue homeostasis. It has been suggested that dysregulation of stem cell could lead to cell senescence or cancer. In this project, we attempt to reveal the potential mechanisms of cellular metabolism in regulating the functions of stem cells or cancer stem cells. This study made significant contributions to the development of therapies for the human disease.

FY2006

Elucidation of the Significance of Phospholipids Molecular Species in Biological Membranes

Hiroyuki ARAI
Professor, The University of Tokyo

It is well known that phospholipids present in biological membranes consist of various molecular species with different fatty acyl chains. However, the physiological significance of individual phospholipid and the molecular mechanisms of their formation are not fully elucidated. In this project, we utilize C. elegans genetics and mass spectrometry techniques to identify the enzymes for the formation of phospholipids molecular species and to isolate the membrane proteins requiring phospholipids with very long polyunsaturated fatty acids for their functions.

Molecular basis of Metabolic Regulation by Nutrient Signals in Plants

Shuichi YANAGISAWA
Associate Professor, The University of Tokyo

Plant nutrients are not only substrates for biosynthesis but also signaling molecules associated with regulation of gene expression and metabolism. Plant nutrients from the environment and their metabolites are deeply involved in the complex network for regulation of growth and substance production in plants. Comprehensive analysis of nutrient signaling systems and metabolic regulation by nutrient signals disclosed highly sophisticated mechanisms underlying substance production and paved the way to developing a new methodology to control production of useful materials in plants.

Development of Mass Spectrometry-based Analytical Platform of Small RNAs

Toshiaki ISOBE
Professor, Tokyo Metropolitan University

Recent genetic and biochemical evidence reveals important regulatory roles of diverse types of small RNA and protein complexes in various biological events. In this study, we will develop mass spectrometry-based technologies that offer sensitive and efficient solutions to analysis of the sequence, structure, modification and composition of small RNAs. Final goal of this study is to integrate these technologies with proteomics and allows comprehensive analysis of functional networks of ribonucleoproteome in a cell.

Since FY2005

*The reported research affiliations are those at the time of the projects completed.

The Study of Novel Mechanism Governning the Energy Metabolism of Animals

Yo-ichi NABESHIMA
President, Institute of Biomedical Research and Innovation, Foundation for Biomedical Research and Innovation

The energy metabolism in animals is regulated by the coordination of multistage events, i.e. intestinal uptake of nutrients, their metabolism in the body, and inter- and intra-cellular signaling generated by those metabolites. Beta-Klotho we identified is estimated to be an important regulator of energy metabolism. Our final goal is to clarify the molecular function of beta-Klotho and to expand our comprehensive understanding of the energy metabolism. As energy metabolism forms the background of obesity, aging and metabolic syndromes, our results may contribute to the clinical application of these diseases.

Mechanisms of Regulation of Cell Functions Maintaining Glucose Homeostasis

Susumu SEINO
Professor, Kobe University

Glucose metabolism is an essential bioreaction in the maintenance of life in living organisms. Islet of Langerhans in pancreas (pancreatic islet) is the most important sub-organ in the maintenance of glucose homeostasis. Loss of function of pancreatic islets causes severe disorders of glucose homeostasis such as diabetes mellitus. In this project, we aim to develop a basis for novel diagnoses and therapies for metabolic disorders that include diabetes, as well as clarify the pathogenesis of these diseases. We plan comprehensive metabolome analysis of islet cells to clarify the molecular mechanisms of regulation of pancreatic islet functions.

Metabolism-based Regulation of Organelle Homeostasis and Cell Function

Yukio FUJIKI
Professor, Kyusyu University

Peroxisome functions in numerous essential metabolic pathways such as the synthesis of ether-lipid plasmalogens and is involved in human neurological disorders and the production of many useful proteins in yeast systems. We delineate the mechanisms underlying the homeostasis, biogenesis and degradation, of peroxisome as a model organelle and metabolic disorders caused by its homeostasis dysregulation, by investigating the dynamism of molecular network regulated by the metabolism. We also establish the basic techniques applicable to developing the diagnostic as well as therapeutic agents for the neurological disease and producing recombinant proteins and food supply.

Elucidation of Amino Acid Metabolism in Plants based on Integrated Omics Analyses

Masami YOKOTA HIRAI
Team Leader, RIKEN

A comprehensive metabolome analysis is essential for complete elucidation of mechanisms regulating metabolism in living cells. However, data-mining methodology for systematic extraction of such biological information is yet to be established. In this project, we will develop such methodology and establish novel mathematical models using both metabolomic and other omics data as parameters. The models will also be verified by biological experiments.

Control of Plant Metabolic System by Engineering of Vacuolar Membrane Proteins

Tetsuro MIMURA
Professor, Kobe University

The vacuole is the largest organelle in plants cells and occupies most of the cell volume. Vacuoles are indispensable for maintaining the homeostasis of the cellular environment and metabolic activity. Communication between the vacuole and the rest of the cell occurs across the vacuolar membrane, in which is embedded a multitude of proteins, most of which are expected to be involved in transport of molecules into and from the vacuole. In the present study, we will transform vacuolar membrane proteins, and analyze the changes in metabolites both in the vacuole and in the cytoplasm. In this way we hope to identify the role of vacuolar membrane proteins in regulating cellular metabolism through transport-related changes in metabolite levels. The modification of the vacuolar membrane transporters may enable the new possibility for the production of useful materials.

Genetic and Biochemical Study of Stress Responses Mediated by Metabolites

Masayuki MIURA
Professor, The University of Tokyo

We have received various stresses that include infection, injury and starvation during development, growth and aging. Caspases are activated under various stress conditions and are thought to be critical stress sensing proteins. In this research, we will identify metabolites that activate caspases upon stress conditions and will study the stress responsible metabolites that are produced from caspase activated cells by biochemical and genetic approaches. Our research goal is to provide a novel insight of *in vivo* response of stress and maintenance of homeostasis under stress conditions.

FY2007

Analyses of Mechanism underlying Metabolism of Iron and its Prosthetic Groups and Iron-related Disorders

Kazuhiro IWAI
Professor, Osaka University

Iron is essential nutrient, but it is also toxic to human. Therefore, deregulation of iron metabolism is known to provoke various disorders. Iron is often incorporated into iron-prosthetic groups such as heme and utilized in cells. We have recently shown that cells sense changes in iron availability through iron-prosthetic groups. Moreover, new roles iron plays in the pathogenesis of many disorders have revealed. In this project, we will try to develop new methods for diagnosis as well as treatment for iron-related disorders.

Research Area

Photonics and Quantum Optics for the Creation of Innovative Functions

Research Supervisor:
Tatsuo IZAWA
Executive Vice President for Research, Tokyo Institute of Technology

FY2005 (Completed Research)

New Evolution of Nitride Semiconductor Lasers Based on Nanocolumn Crystals

Katsumi KISHINO
Professor, Sophia University

In this research project, we have developed fundamental technologies for realizing green light semiconductor lasers and three-primary-color LEDs, in which the crystal characteristics of GaN nanocolumns were utilized to overcome the challenging obstacles to lengthening the operation wavelengths of nitride-based lasers/LEDs. A method enabling the selective-area growth of GaN nanocolumns was developed for fabricating light-emitting elements based on nanocolumn arrays. As a result, green light (520-566nm in wavelength) optically pumped stimulated emissions were achieved for the InGaN-based nanocolumn arrays; a technique for controlling the emission color through the nanocolumn diameter and period was developed that enabled the wavelength to be adjusted over the visible emission range. Moreover the nanocrystal properties of single and band of self-organized nanocolumns were investigated and it was confirmed that the random disorder in the self-organized nanocolumn medium contributed to the light localization and random lasing phenomena.

Creation of New Quantum Optical Technology by Controlling Electric-field Waveform of Optical Pulses with an Extremely Short Duration

Mikio YAMASHITA
Specially Appointed Professor, Emeritus Professor, Hokkaido University

We achieved new photonic technologies by engineering the electric field with the over-octave-bandwidth from near-infrared (NIR) to ultraviolet (UV) :1) the generation of isolated monocycle (2.6 fs) pulses and that of the high energy super-continuum (860 μ J, 270-1000 nm) by induced phase modulation, 2) the ultrabroadband (330-720 nm) electric- field synthesis and the ultrashort pulse generation using the multiple coherent anti-Stokes Raman scattering, 3) amplification of over-octave-bandwidth (500-1350 nm) pulses by angularly-dispersed noncollinear optical parametric amplification, 4) development of the UV-to-NIR liquid-crystal spatial light modulator with the over-two-octave (300-1200 nm) bandwidth, and 5) development of the technology measuring the spectral phase of the electric field with the over-two-octave (330-1360 nm) bandwidth for sub-monocycle pulse characterization.

Creation of Superconducting Photonics and Its Applications

Ikuo SUEMUNE
Professor, Hokkaido University

Electron Cooper pair injection into a LED was confirmed by the observations of DC and AC Josephson effects and significant enhancement of LED light output and reduction of radiative recombination lifetimes were observed. A new theory dealing with radiative recombination of an electron Cooper pair and a hole pair was established and the observed new phenomena were explained as the radiative recombination of electron Cooper pairs that generates entangled photon pairs. This opened the new interdisciplinary research field between superconductivity and photonics, and the developed new photonic device will prove to be a key photon sources for the applications to quantum information processing.

FY2006

High Eneregy Density Plasma Photonics

Ryosuke KODAMA
Professor, Osaka University

We are exploring plasma photonics to develop advanced functional devices made of high energy density plasmas created by ultra-intense laser light. The plasma photonic devices are realized by coherently and transiently controlling the high energy density plasmas. The advantage of the plasma photonic devices is direct control of high energy density particles as well as intense light with high damage tolerance, which are extremely promising in view of innovative applications in scientific, technological and medical areas.

Development of Ultimate Light-Emission Technology Based on Photonic Crystals

Susumu NODA
Professor, Kyoto University

In this project, we aimed at developing ultimate light-emission technology based on photonic crystals, by which ultrahigh efficient light-emitting device and/or large-area coherent laser with a perfect single mode and various unique beam patterns has been developed. In addition, optical phenomena including weak and strong couplings between electron-photon systems has been investigated. These studies contribute to the future quantum optical computing and the realization of photonic chips.

Active Meso-optics based on Dynamical Spatio-temporal Control of Molphology

Makoto KUWATA-GONOKAMI
Professor, The University of Tokyo

We propose and demonstrate "active meso-optics", a novel method tocontrol light via the dynamical control of the morphology of materials. We examine mechanisms to enhance the unique optical effects caused by a non-local response and/or macroscopic coherence in a material, which aresensitive to a spatial modulation at a sub-wavelength scale. Novel methods to obtain an accurate control of the spatial and temporal profiles of light pulses are also investigated and utilized for a dynamical control of morphology. We also explore novel aspects of light-matter interaction in order to obtain schemes for the active control of light in the visible and THz spectral regions.

Creation and Simulation of Optoelectronics Function in Nanometer Space

Hirokazu HORI
Professor, University of Yamanashi

Nano-optoelectronics devices for innovative information processing and signal transfer systems have been created based on wiring-free electronic excitation transfer via optial near-field interactions in quantum nanostructures of diluted magnetic semiconductors, where carrier transport and optical near-field excitation transfer are controlled by external magnetic field. Based on fundamental studies of physical processes, simulation method and information theory have been established for design and analysis of novel optoelectronic systems of nanometer scale, and science and technology related to nano-optoelectronics functions have been extensively developed.

Photonic Nanostructure Active Functional Devices and Their Integration

Toshihiko BABA
Professor, Yokohama National University

Passive technologies for photonic nanostructures have greatly advanced in these years. In this study, we investigate active optical and photonic phenomena in these structures. Particularly we focus on slowlight generation, efficient optical amplifier, negative refraction, nonlinearity enhancement, and dynamic effects in photonic crystals, and their applications to functional devices. We integrate these devices with silicon photonics to provide a breakthrough technology for photonic integration and signal processing.

Since FY2005

*The reported research affiliations are those at the time of the projects completed.

Research on InN Semiconductor Laser Diodes with High Temperature-Stability for Optical Communication Systems

Takashi MATSUOKA
Professor, Tohoku University

To advance the information society, the development of high-capacity, cost-effective optical communications systems is desired. For this purpose, as a light source, a laser diode with temperature stability is needed. We have found that InN, a component of nitride semiconductors used in blue LEDs, emits infrared light whose wavelength is stable against temperature change. This laser has environmental advantages because it does not contain arsenic or phosphor. This project seeks to fabricate laser diodes with an InN emitting layer for optical communications systems.

Emission of Continuous THz Waves by Making Use of Superconductors and Its Applications

Kazuo KADOWAKI
Professor, University of Tsukuba

High temperature superconductors consist of thin CuO2 superconducting layers which stack in an atomic level, forming multi-Josephson junctions in a crystal. By exciting Josephson plasma in all Josephson junctions in a crystal synchronously we recently succeeded in generating intense, coherent and monochromatic continuous THz waves similar to LASER. We clarify the physical mechanism of this emission phenomenon and develop technology to generate more intense THz waves. We also employ spectroscopy of matter using this THz waves.

Bilateral Control of Electrons and Light through Electron Correlation

Kenjiro MIYANO
Professor, The University of Tokyo

Electrons in some transition metal oxides and complexes mutually interact strongly so that their independent motion is suppressed. This is called electron correlation. The correlation brings about spontaneous order among the electrons. The electron ordering is strongly affected by light and light, in turn, is strongly modulated by the electron order. In this way, light and the electron order are tightly bound and bilaterally controllable. In this project, we will optimize and maximize the light-electron interaction through artificial structures so that even electrons in a single lattice layer can produce profound effects.

Functional Control of the Primary Process of Photosynthesis in Nano Space

Hideki HASHIMOTO
Professor, Osaka City University

Photosynthetic pigment-protein complexes whose structures are modified are organized into lipid bilayer systems or onto electrodes in order to fabricate artificial photosynthetic membranes. These samples are subjected to the analyses using ultra-fast time-resolved coherent spectroscopy as well as time-resolved microscopic spectroscopy in order to make feasible the real time observation of excitation energy transfer. Determination of the phonon properties of these samples in broad spectral range is also performed. Based on all these investigations comprehensive understandings of the mechanisms of the excitation energy-transfer in the primary process of photosynthesis will be achieved. At the same time the way of utilization of photosynthetic systems as bio-nanodevices will be postulated. The expected outcomes are to establish guiding principles that lead the fundamental science and technology in the field of bio-nanotechnology of the 21st century.

Development of the Technique to Steer Electrons by the Ultrahigh Optical Field

Shuntaro WATANABE
Professor, Tokyo University of Science

Sub-100 attosecond, soft Xray pulses and optical field shapes on demand are achieved by combining the advanced high power laser technology with the precise optical synthesizing. "An attosecond oscilloscope" is developed by using a 100-attosecond pulses as a pump and trigger, and a saw tooth optical field as a sweep. With this system, the high-speed electron motion induced by Auger process and chemical reaction is recorded as continuous snap shots. In addition, the technique to steer electron motion in materials on an attosecond time scale is developed towards the verification of a new function.

Development of 230-350nm Band InAlGaN-based High-efficiency Deep-UV Emitting Devices

Hideki HIRAYAMA
Team Leader, RIKEN

High-brightness deep-ultraviolet (UV) light-emitting diodes (LEDs) or laser diodes (LDs) with emission wavelengths in the range of 230-350 nm have a wide range of potential applications, such as in water purification, sterilization, medicine and biochemistry, white light illumination, and light sources for high density optical recording. In this study, we will develop a crystal growth technique of nitride InAlGaN based semiconductors for obtaining deep-UV emitting devices, and achieve 230-250 nm band high-efficiency deep-UV LEDs and LDs.

FY2007

Development of Biomedical Photonic LSIs

Jun OHTA
Professor, Nara Institute of Science and Technology

Our project aims to exploit a novel biomedical photonic device to be applied for biotechnologies and medicine by merging photonic technologies and LSI (large scale integration) technologies. Collaborating with photonic device, biotechnology and brain-nerve researchers, we will explore the new paradigm of the photonic LIS devices for brain sciences the clinical applications to functional brain disease such as Parkinson and epilepsy.

Adaptive Power Photonics

Noriaki MIYANAGA
Professor, Osaka University

The optical technology that brings out the ultimate capabilities of ultra-short-pulse intense lasers enables us to precisely control a variety of laser-matter interactions. We are developing a few cycle laser system of ~ 30-TW peak power using the optical parametric amplification pumped by a laser diode-pumped solid state laser. We will release this laser to many applications adopting the spatiotemporal phase control and spatial polarization control. We aim to provide the technological base of "adaptive power photonics" for innovative applications of high-power lasers.

Research Area

Novel Measuring and Analytical Technology Contributions to the Elucidation and Application of Material

Research Supervisor:
Michiyoshi TANAKA
Professor Emeritus,
Tohoku University

FY2004 (Completed Research)

Development of an Detection Technique of Molecular-vibration and ESR Signal with an Atomic Scale Resolution for Low-dimensional Material and a Single Molecule

Tadahiro KOMEDA
Professor, Tohoku University

Exchange interaction between an isolated spin that is rotating with the Larmor precession frequency and tunneling electrons causes a high-frequency modulation in the tunneling current of STM. In this project, we successfully detected the high-frequency component, which is followed by a deduction of g value. Using a Si (111)-7x7 surface with minute amount of adsorbed oxygen, in which spins originated from dangling we succeeded to obtain the g-value with an atomic-scale space-resolution.

R005 Electron Microscopy for Light Elements Imaging and Analysis

Kunio TAKAYANAGI
Professor, Tokyo Institute of Technology

A new electron microscope (R005) with aberration correction lenses and a cold field emission gun has been developed. The world's highest 0.05 nm resolution (hydrogen atom radius) has been achieved, which enables us to observe quantitatively not only narrow-spaced atomic columns but also light elements such as lithium, boron, carbon, nitrogen, and oxygen directly. Structural and spectroscopic imagings of materials, molecules, and individual atoms, solve issues in physics, chemistry, and nano/green-technology.

Development of Femtosecond Timeresolved Scanning Probe Microscopy and Related Techniques

Hidemi SHIGEKAWA
Professor, University of Tsukuba

Ultrashort optical pulse technology has allowed us to observe transient phenomena in the femtosecond range, namely, the optical-monocycle region, which, however, has the drawback of a relatively low spatial resolution due to the electromagnetic wavelength used. On the other hand, scanning tunneling microscopy and its related techniques, although having a time resolution limited by the circuit bandwidth enables us to observe spatial dynamics at the atomic level in real space. We have succeeded, for the first time, in combining these two techniques to achieve a new technology which will advance the pursuit of future nanoscale scientific research in terms of the ultimate temporal and spatial resolutions.

Developments of a New Solid State Spectroscopy by Use of Extremely High Coherent Soft X-rays

Kazumichi NAMIKAWA
Professor, Tokyo Gakugei University

We have developed a new time correlation spectroscopy in which we can directly observe picoseconds order decay processes of a nanometer scale polarization excited in ferroelectric materials. A dynamic nature of polarization clusters in BaTiO3 which appears as a precursor phenomenon of the ferroelectric phase transition has been revealed. That is, a phenomenon of critical slowing down has been found to take place at 4.5K higher than Tc.

Development of Multi-quantum Coherent ESR and Elucidation of Macromolecular Structure

Yuhei SHIMOYAMA
Professor, Muroran Institute of Technology

To elucidate the macromolecular structure, we developed the double-quantum coherent (DQC) ESR system. We succeeded in detecting the DQC signal from the bilabeled proteins, and analyzed the distances of 2-6 nm. The further development of a distance distribution analysis system and new-type of resonators allowed elucidating the complex proteins, such as biomembranes proteins.

(Research term: 1 Oct. 2004 - 30 Sep. 2007)

FY2005 (Completed Research)

Studies on Nuclear Resonant Scattering Methods for Materials Science

Makoto SETO
Professor, Kyoto University

Nuclear excited states have great potentials for the examination of electronic states of materials, which have not been fully used. By applying the third generation synchrotron radiation source of SPring-8 which provides high-intense and high-brightness X-rays, we have developed synchrotron radiation based many-element Mössbauer absorption spectroscopy with the use of its energy tunability. Using the developed method, element-specified electronic states of advanced materials have been measured. Furthermore, we established measuring methods of the electronic states of nano-layered materials and of materials at multi-extreme conditions such as temperatures and pressures by using the high brightness of SPring-8.

Development of the Spatial- and Time-resolved Structural Study Technique for Nano-materials and Devices

Masaki TAKATA
Chief Scientist, RIKEN

Today, the spatial- and time-resolved structural study under photo-irradiation, electronic field, magnetic field and etc. is becoming more and more important in the research and development field of the nano-materials and devices. Our project has achieved development of the advanced X-ray measurement technique in nano-meter spatial scale and/or pico-second time scale by using the third generation synchrotron radiation at SPring-8. The developed system; "X-ray pinpoint structural measurement", has successfully applied to the time resolved atomic level investigation of fast optical recording process of DVD utilizing fast phase change phenomena of alloys. The system has also achieved the sub-micron single crystal diffractometery with demonstrating the effectiveness and impact of the X-ray pinpoint structural measurement.

Development of Bulk-sensitive Spin-resolved Ultrahigh-resolution Photoemission Spectrometer

Takashi TAKAHASHI
Professor, Tohoku University

Photoemission spectroscopy is a powerful experimental technique to directly observe the electronic states of materials, but it has some problems such as high surface-sensitivity and difficulty in spin-resolved measurement. To overcome these problems, we have developed a bulk-sensitive spin-resolved ultrahigh-resolution photoemission spectrometer, which now achieves the world-best energy resolution of 8 meV in the spin-resolved mode (0.9 meV in the non-spin-resolved mode). With this machine, we have succeeded in observing the superconducting gap of Fe-pnictide and graphite superconductors. In addition, by utilizing the merit of spin-resolution, we have experimentally established the spin-resolved electronic structure of several spintronics-related phenomena and materials such as surface Rashba effect and topological insulator.

*The reported research affiliations are those at the time of the projects completed.

Development of High Sensitive Multinuclear Solid-state NMR for Material Research

Kiyonori TAKEGOSHI
Professor, Kyoto University

Solid-state NMR is a useful tool for material research by exploiting local structures/dynamics at atomic level. So far, however, because of the low sensitivity and the popular nuclei in NMR being limited to 1H and 13C, application of NMR to materials has been limited. In this research project, we enhanced the capability of NMR by increasing its sensitivity. For that we developed a new cryogenic NMR-detection system and achieved the 1/16 reduction of experimental time. Further, a new microcoil detection system for a sample of ca. 0.1mg was developed and a new detection system for a thin-plate sample was also developed. In addition to these hardware, we exploited novel multi=pulse methods for high-resolution solid-state NMR of quadrupole nuclei.

Studies of Semiconductor Quantum Structures and Exploration of Terahertz Technology

Susumu KOMIYAMA
Professor, The University of Tokyo

A sensitive passive method of detecting extremely weak terahertz waves emitted from objects without external illumination is developped by ingeniously exploiting semiconductor quantum structures. Beyond characterization of matters, the method makes it possible to investigate phenomena and their dynamics in the object. The method will open up a widespread possiblity for clinic, security and environmental applications, as well as for basic studies of material properties and analysis of small number of molecules and biological cells.

Construction of Ultra High Resolution High Speed Imaging Mass Spectrometric Technology (MS Microscope)

Yasuhide NAITO
Associate Professor, The Graduate School for the Creation of New Photonics Industries

Imaging mass spectrometry (IMS) using matrix-assisted laser desorption/ionization (MALDI) and time-of-flight (TOF) mass spectrometer allows direct investigation of the spatial distributions of molecular contents on the sample surface. Conventional IMS is performed by scanning a focused laser on the sample. The spatial resolution of a scanning type imaging mass spectrometer is limited by the laser focus diameter to about 10 μ m. In order to achieve higher spatial resolution (< 1 μ m), we have developed a stigmatic MALDI imaging mass spectrometer, in which the spatial distribution of ions at the sample surface is magnified and projected onto a position-sensitive ion detector. Furthermore, in order to obtain a high mass resolving power, we have applied a perfect focusing property of the multi-turn TOF ion optics to a novel MALDI imaging mass spectrometer. The mass resolution more than 10,000 and the spatial resolution of about 1 μm have been achieved simultaneously.

Low-voltage TEM/STEM for Atomic Level Characterization of Soft Matters

Kazutomo SUENAGA
Team Leader, National Institute for Advanced Industrial Science and Technology (AIST)

Organic or biological molecules are very sensitive to the electron beam and have been considered quite difficult to observe by means of electron microscopes. This is because an intrinsic problem of the specimen damage due to the incident high-energy electron beam, which is definitely required for high spatial resolution imaging. In order to overcome this drawback, we will build a low-voltage TEM/STEM equipped with the aberration correctors. This machine will be capable to visualize the individual molecular structures of soft matters with higher resolution and less damage than ever.

Hydrogen Nanoscope

Katsuyuki FUKUTANI
Professor, The University of Tokyo

Ubiquitous impurities of absorbed hydrogen dramatically affect the electric and mechanical properties of solids as realized in microelectronic devices, hydrogen embrittlement, H-storage, and H-induced metal-insulator transition. We have developed a micro-beam nuclear reaction detection technique, which allows mapping out the hydrogen distribution in solids in all three dimensions even under atmospheric conditions. With this apparatus, we have succeeded in observing the hydrogen distribution at the fatigue-fractured surface of metals, in-situ measurements of hydrogen absorption by metals, and elucidating the degradation mechanism of semiconductor devices.

Development of Laser assisted wide Angle Three-dimensional Atom Probe and Its Applications for Device Analysis

Kazuhiro HONO
Fellow, National Institute for Materials Science (NIMS)

To broaden the applications of the three-dimensional atom probe (3DAP) technique for obtaining 3D atomic tomography of a wide variety of materials, the technical limitations of the conventional 3DAP that stem from the field evaporation process has been overcome by using pulsed-laser assisted field evaporation. A newly developed laser assisted wide angle 3DAP has been applied to nanostructure analyses of semiconductor and insulator materials and various devices that used to be impossible to analyze with the voltage pulsed 3DAP. At the same time, specimen preparation techniques that make it possible to analyze specific areas of various types of materials have been developed.

(Research term: 1 Oct. 2006 - 31 Mar. 2011)

FY2006

Plasmonic Scanning Analytical Microscope

Satoshi KAWATA
Professor, Osaka University

We propose to develop a new analytical nanoscope that uses surface plasmon polaritons (SPPs) as a nano-probe. SPPs are collective oscillation of electrons excited locally in metal nano structures. Our microscopy uses 1) locally enhanced electromagnetic field provided by SPPs and 2) perturbation of optical responses induced by the mechanical interactions between the probe and the sample with typical probe-applied force of the order of nano-Newton, which enables one to perform nano-analysis and imaging of nano-materials.

Development of a Multi-functional Optical Sum Frequency Microscope

Goro MIZUTANI
Professor, Japan Advanced Institute of Science and Technology

When a medium is irradiated with light beams of two different frequencies, it radiates another light field with the sum frequency. In an optical sum frequency (SF) microscope, this light field is focused on a two-dimensional detector and a sum frequency image is obtained. This project aimed to develop a SF microscope with functions of dynamical and two-dimensional vibrational imaging at surfaces and interfaces. Sum frequency microscopes operating in ultra high vacuum and in confocal configuration were developed. Phenomena observable only by this microscope were analyzed.

(Research term: 1 Oct. 2006 - 30 Sep. 2010)

Research Area

Novel Measuring and Analytical Technology Contributions to the Elucidation and Application of Life Phenomena

Research Supervisor:
Toshio YANAGIDA
Specially Appointed Professor,
Osaka University

FY2004 (Completed Research)

Development of High-speed Imaging Apparatus for Studying Nanometer Scale Dynamic Behavior of Protein

Toshio ANDO
Professor, Kanazawa University

We have developed an apparatus that makes it possible to capture high-resolution images of protein molecules in real time, without disturbing their physiological function. Using this cutting edge microscope we observed several types of proteins such as motor protein, myosin at work, and demonstrated its great value for biological sciences. The kinetic structural data obtained have provided the insight for the mechanism by which the proteins produce their functions.

FY2005 (Completed Research)

Investigation on the Enviornment Response of Biomolecule with Hybrid Localized SPR

Shigeru AOYAMA
General Manager, OMRON Corp.

In this research, we have developed a novel hybrid localized SPR sensing method which makes it possible to simultaneously detect the interaction between bio-molecules and environmental variations based on hybrid evanescent-localized electric field induced by nano-sphere array. We have developed hybrid localized SPR sensiors which allow to detect the kinetics of the interaction between bio-molecules. In addition, replication methods, which have attractive features such as low cost and mass productivity and nano-scale precision, have also been developed.

(Research term: 1 Oct. 2005- 31 Mar. 2010)

New Principle Measurement Tools using Optical-driven Nano Machine

Koji IKUTA
Professor, Nagoya University

The concept of the optical driven nanomachine fabricated original micro/nano stereolithography has been developed. New nano tools for handling and force measurement of cell has been proposed and developed by using optical driven nanomachine. In addition, these approaches have been extended to biological and medical areas to contribute to basic sciences and medical applications.

Development and Application of Chemical Probes for Dynamic Visualization of Biomolecules

Tetsuo NAGANO
Professor, The University of Tokyo

In this project, we have developed and applied fluorescent probes, and further made them fit to practical use. To detect dynamic changes in activity or concentration of biomolecules in living cells, in living organs or in vivo with fine temporal and spatial resolution is a powerful fundamental technique for analysis of unknown life phenomena. In this project, we have pioneered a novel world in measuring and analytical technology; we have elucidated two principles of fluorescence, developed many fluorescent probes based on those principles of fluorescence, and put three fluorescence probes on the market.

Noninvasive Detection of Biomolecules in Living Organisms by Magnetic Resonance

Masahiro SHIRAKAWA
Professor, Kyoto University

We have developed technologies for analyses of functions, localizations and tertiary structures of proteins in cells or organisms by using MR imaging, multi-dimensional NMR, and magnetic resonance force microscopy. We succeeded in determining atomic structures of proteins in live cells. The data have shed light on unknown properties of proteins in live cells.

Multi-target Development of RNA-based 'Nanosensors' and 'Modulators'

Yoshikazu NAKAMURA
Professor, The University of Tokyo

In recent years, research in RNA biology is improving dramatically, and a bright future for RNA-based technology is expected. In this work, we engineered RNA molecules with strong affinity against a variety of intracellular and extracellular target molecules using an in vitro evolution method. The systematic analysis revealed that these RNA molecules, named 'aptamers', are useful as novel elements for analyzing and/or regulating cellular activity. Importantly it is demonstrated that RNA possesses a tremendous conformational plasticity that fits a given target ('RNA plasticity'). Moreover, several aptamers provide promising therapeutic agents for human diseases. In fact, a few such aptamers are in pre-clinical stage of therapeutic development for autoimmune disorders.

Development of a New Observation Method for the Single Molecule Dynamics of Protein Folding

Satoshi TAKAHASHI
Professor, Tohoku University

To elucidate the dynamics of protein folding, we developed new experimental methods to observe the protein folding at the single molecule level, new analysis methods for the single molecule data, and new tools to analyze hydration of proteins. These methods were used to measure series of proteins. We have successfully developed the method to measure a single protein molecule in solution for long time, which contributes to single molecule techniques and understanding dynamics properties of proteins.

Creation of Perfect Protein Crystals

Yusuke MORI
Professor, Osaka University

Technologies for creating high-quality crystals of proteins are imperative for the structural analysis of protein molecules, which will become important in the post-genome era. In this study, we have clarified the mechanism of the crystallizing technology based on new principles of generation of crystalline nuclei using femtosecond laser irradiation and creating large, high-quality crystals by stirring the solution, and further improved the technique. We developed several new techniques, including the crystalline nuclei generation of protein by utilizing the combination of laser irradiation and agarose gel as well as the technique to grow very large crystals. These techniques enable us to obtain high-resolution structure of proteins by X-ray structural analysis and neutron diffraction methods.

Since FY2004

*The reported research affiliations are those at the time of the projects completed.

FY2006

The Development of the Noninvasive Quantitative Brain Functional Imaging Technique

Yoshichika YOSHIOKA
Specially Appointed Professor, Osaka University

We have develop the new quantitative brain functional imaging techniques. Our results show that the brain activity levels could be assessed by using the information of brain network revealed precisely by our MRI technique. The energy used by brain during light tasks could be estimated under some hypotheses by using the data of brain temperature. It is indicated that the excess energy, brain needs during general tasks, is a very little. Our results show also that the brain temperature can be used for the screening of the patients with brain disease. Our new techniques are expected to bring the new insight into the brain function and neuronal disease.

in vivo Nano-imaging of Movement of Molecules in Mice

Hideo HIGUCHI
Professor, The University of Tokyo

To understand the molecular mechanism of motility in mice, we develop the apparatus to observe the movement of molecules in vivo in mice. We develop the nano-particle formed by the multiple fluorescence quantum dots. The antibodies labeled with the dots are transformed into cells in mice using a newly developed injector. The movement of the antibodies is imaged with high temporal and special resolutions.

Observations of Biomolecular Structural Recognition Process from Highly Accurate Individual Single Molecular Movies

Yuji C. SASAKI
Professor, The University of Tokyo

Ultimate single molecular detection techniques can measure minute conformational changes of functional protein molecules with atomic size accuracy under the time resolution of micro-second in the place where biological functions appear in the cell. This program will achieve both high-speed Diffracted X-ray Tracking (DXT) and laboratory size Diffracted electron Tracking (DET), which are individual single molecular detection system using high-energy probes. Additionally, we will propose and develop scanning x-ray radiation pressure microscope (XPM). The above-mentioned three methodologies will observe a minute structural difference in molecular recognition under the immunity system and the bio-membrane system which are very important phenomena in the life science.

Biomolecular Tomography with Molecular Labels in the Cell

Atsuo MIYAZAWA
Professor, University of Hyogo

The aim of this study is the structural analysis of biomolecular complexes in the cell by electron tomography, using molecular labels which can be observed by electron microscopy. The biomolecular tomography requires the development of both the new method of genetical labeling with metal-binding proteins and the integration of the hardware and software for electron tomography applying to biological specimens. It leads to the general understanding of physiological functions of biomolecular complexes through the analysis of their three-dimensional structure and arrangement in the cell.

Measurement of Biological-single-molecule Dynamics by Carbon-nanotube Devices

Yoshikazu NAKAYAMA
Professor, Osaka University

Biological reactions proceed with various intermolecular interactions and energy transfer among molecules. This study is intended to develop devices to detect molecular mass shift (10-21 g), two-dimensional force (10-12 N), and heat flux (10-19 J) at the single-molecule level using the superior electromechanical properties of carbon nanotubes. This study establishes techniques to analyze the molecular kinetics of various enzymatic reactions at a time resolution of several milliseconds. These devices and techniques will be applied to develop highly sensitive sensors, nanomachines, and nanomedical devices.

Development of ns-nm Resolution Electron-Photon Hybrid Microscope

Kuniaki NAGAYAMA
Professor, National Institutes of Natural Sciences (NINS)

The combination of rapid freezing technique and phase contrast transmission electron microscopy (TEM) enabled us to observe biological samples without heavy metal staining, making the traditional lengthy specimen preparation obsolete. We have gone further by developing a method to observe live samples at normal temperature and normal atmosphere. A combination of three elements, the pulsed photo-electron gun, the environmental cell and phase contrast TEM, supported by a novel design for the electron lens have been established to construct high-resolution electron-photon hybrid microscope.

(Research term: 1 Oct. 2006- 31 Mar.2010)

Research Area

Foundation of Technology Supporting the Creation of Digital Media Contents

Research Supervisor:
Hiroshi HARASHIMA
Professor Emeritus, The University of Tokyo

FY2004 (Completed Research)

The Research of Ubiquitous Content Production Authoring System

Masahiko INAKAGE
Professor, Keio University

In this research, we have proposed a new ubiquitous content as a digital content domain for the 21st century and have developed a system to support the ubiquitous content production. Also, this research has aimed to establish the content design theory as a guideline to assist the creation of a high quality content. Futhermore, by using the ubiquitous content production authoring system and the design theory, high quality ubiquitous contents have been produced to demonstrate the effectiveness and validity of the research.

FY2005 (Completed Research)

Expressive Science and Technology for Device Art

Hiroo IWATA
Professor, University of Tsukuba

Device art is composed of interactive work that expresses essence of mechanical and digital technologies. This project achieved two goals; (1) systematizing technologies used in device art and (2) studying methodologies in creation and evaluation of device art. During the project, a new facility named "Gadgetrium" was established. It is a combination of research laboratory, exhibition space, and venture business. Device art has been recognized as new art form based on the achivement of this project.

Technology to Create Digital Public Art

Michitaka HIROSE
Professor, The University of Tokyo

Public art has three essential aspects, the spatiality of the environment, the tangibility of objects, and the sensation of participation. This project focuses on pursuing novel artistic expressions by extending these aspects by applying leading-edge media technology.
Not just researching and developing various fundamental technologies, we aimed to hold high quality exhibitions. Some examples are 'Tree and Digital' at Spiral, Aoyama, Tokyo and 'Air Harbor' at Tokyo International Airport (Haneda Airport), Tokyo, Japan. We had opportunities to present our works and interact with non-academic audiences and viewers, through these exhibitions at public spaces. We also focused on spread of our technologies and human resource cultivation through holding symposiums, taking interns and publishing a book.

Development of Design Reuse Technology for Nonverbal Time-Series Media

Haruhiro KATAYOSE
Professor, Kwansei Gakuin University

With the goal of providing novel music pleasantness, the CrestMuse project has developed interfaces to assist music design and active music listening, focusing on the human music experience and its source; that is, music examples. Positive social impacts on our inventions implemented into the real systems have proved the significance of the project. We hope to open the door to the future "Consumer Generated Media" cultural revolution, with our rich and inspiring outcomes.

Creating 21st Century Art form Based on Digital Media

Masaki FUJIHATA
Professor, Tokyo National University of Fine Arts and Music

A research project which is crossing borders between arts and sciences, and focused on "Drawing, Painting" as a kind of fundamental activity of human's expression for communication by using simulation technology with software applications and development of robots for understanding "Why humans draw pictures?"

Mixed Reality Pre-Visualization As Pre-Production Tool in Film-Making

Hideyuki TAMURA
Professor, Ritsumeikan University

We have developed new pre-visualization methods and tools for filmmaking by using mixed reality technology which merge real and virtual worlds. Those methods enable the realtime mixture of computer generated or pre-captured live action sequence and real background scene such as large set in sound stage, open set, and location site. The research results have been implemented into scalable hardware systems and interactive authoring tools. Finally, the effectiveness of MR-PreViz shooting are evaluated through filmmaking education and actual production of theater movie.

Fundamental Research for Contents Creation with Low Cost and High Efficiency

Shigeo MORISHIMA
Professor, Waseda University

The project aimed to renew a current Japanese animation production workflow by developing fundamental technologies necessary to realize automatic and efficient creation of various futuristic expressions. The fundamental technologies to be developed in the project are Directable-shader to manipulate creator's sense, Toon-simulator to create non-photo-realistic natural phenomenon effectively, Behave-sync to generate character motion synchronous with scenario or voice, and Reusable-corpus to recycle garbage contents. These technologies were implemented as a plug-in tool to be evaluated in a field and were proved to be very efficient in movie production as a result.

Development Support and Evaluation of On-line Games

Hitoshi MATSUBARA
Professor, Future University-Hakodate

This project proposes 'Universal Games for Life' aimed at improving the QOL (Quality of Life) in the coming networked society. In order to achieve this, we conducted research contributing towards the next generation of online games, with the goal of solving the online gaming problem of proper interaction between the game and the real world.

Since FY2004

*The reported research affiliations are those at the time of the projects completed.

FY2006

Technology which Creates the Advanced Space of New Traditional Arts using Super High Resolution Images and Interactive Biological Objects

Yoichiro KAWAGUCHI
Professor, The University of Tokyo

Our aim is development of the biological CG technology by natural modeling beauty, and the expression technology of a high resolution image (super Hi-Vision) and the mechanical modeling technology which reacts overly like a living thing. These technology and traditional performing arts of Japan are interlocked organically, and development of the creation technology of the space for tip-izing as "new traditional performing arts" is performed for "advanced translation into art of scientific beauty" which does not have a similar case in the world, either.

Technology to Display 3D Contents into Free Space

Hideo SAITO
Professor, Keio University

The purpose of this research is to develop a practical device technology for displaying real 3D images into free space where nothing exists except for the air, based on the plasma light emission induced in the air by laser radiation. We also aim to open up a new industrial market of 3D contents along with the development of the technology. To achieve those purposes, we will perform the research and development for the 3D display device with high quality and large display space, and for the basic technology to create 3D contents for the 3D display device. We will also investigate social demands for 3D media contents along with empirical experiments applying the 3D display device to practical advertisements.

Platform Design for Emerging "People's Art"

Takeshi SUNAGA
Professor, Tama Art University

"People's Art" are recently emerging as people generate, exhibit and exchange various and numerous narrative and visual expressions in the form of Blogs and Social Network Services. This project creates fundamental technologies which will be necessary to develop an open platform to assist such "People's Art" and to finally realize "Societies of Expressions".

Generation and Control Technology of Human-entrained Embodied Media

Tomio WATANABE
Professor, Okayama Prefectural University

With the aim of creating embodied media that unify performers and audiences for supporting the creation of digital media arts for entertainment and education, we will develop a generation and control technology of human-entrained embodied media by developing and integrating the following three technologies: (1) "embodied entrainment media technology" to set embodied media alight with virtual audiences' entrained responses; (2) "embodied space and image media technology" to integrate and display special media with embodied audiences; and (3) "embodied acoustic media technology" to produce music and embodied acoustics from body motions.

Introduction of Research Area

Completed Research Areas: 37 Research Areas, 533 Research Projects

First Year	Research Area	Research Supervisor
FY 2003	Creation of New Technology Aiming for the Realization of Quantum Information Processing Systems	Yoshihisa YAMAMOTO
	Elucidation of Mechanisms Underlying Brain Development and Learning	Tadaharu TSUMOTO
FY 2002	Clarification of the Biological Functions of Sugar Chains and the Use of this Knowledge in Applied Technologies	Naoyuki TANIGUCHI
	Basic Technology to Establishing Tailor-Made Medicine by Utilizing Genome Information	Takehiko SASAZUKI
	The Innovation of Simulation Technology and the Construction of Foundations for Its Practical Use	Norihisa DOI
	Virtual Lab in Nanotechnology Area: Creation of Ultrafast, Ultralow Power, Super-performance Nanodevices and Systems	Hiroyuki SAKAKI
	Virtual Lab in Nanotechnology Area: Creation of Nanodevices and System Based on New Physical Phenomena and Functional Principles	Koji KAJIMURA
	Virtual Lab in Nanotechnology Area: Nano Factory and Process Monitoring for Advanced Information Processing and Communication	Kenji GAMO
	Virtual Lab in Nanotechnology Area: Creation and Application of Nano Structural Materials for Advanced Data Processing and Communication	Hidetoshi FUKUYAMA
	Virtual Lab in Nanotechnology Area: Creation of Bio-Devices and Bio-Systems with Chemical and Biological Molecules for Medical Use	Hiroyuki SASABE
	Virtual Lab in Nanotechnology Area: Creation and Application of "Soft Nano-machine", the Hyperfunctional Molecular Machine	Hirokazu HOTANI
	Virtual Lab in Nanotechnology Area: Creation of Novel Nano-material/System Synthesized by Self-organization for Medical Use	Koji KAYA
	Virtual Lab in Nanotechnology Area: Creation of Nano-Structured Catalysts and Materials for Environmental Conservation	Makoto MISONO
	Virtual Lab in Nanotechnology Area: Development of Advanced Nanostructured Materials for Energy Conversion and Storage	Akira FUJISHIMA
FY 2001	Protein Structure and Functional Mechanisms –Toward Creation of Innovative Medicines, Diagnosis, and Material Production Based on Functional Mechanisms of Proteins–	Tairo OSHIMA
	Translational Research for Intractable Immune Disorders and Infectious Diseases –Aiming at Creation of Novel Strategies Through Elucidation of Molecular Mechanisms of Pathogenesis–	Tadamitsu KISHIMOTO
	New High-Performance Information Processing Technology Supporting Information-Oriented Society –Aiming at the Creation of New High-Speed, Large-Capacity Computing Technology Based on Quantum Effects, Molecular Functions, Parallel Processing, etc.–	Hidehiko TANAKA
	Hydrological System Modeling and Water Resources System –Aiming to Develop Innovative Technological Systems for Predicting, Preserving and Utilizing Water Resources, Based on Consideration of Dynamic Interactions among Climate, Hydrological Cycle and Human Activities–	Katumi MUSIAKE
FY 2000	Development, Differentiation, and Regeneration in Biological Systems	Yoshiki HOTTA
	Plants Function and Their Control	Akinori SUZUKI
FY 1999	Advanced Media Technology for Everyday Living	Makoto NAGAO
FY 1998	Function Evolution of Materials and Devices based on Electron/Photon Related Phenomena	Takuo SUGANO
	Creation and Functions of New Molecules and Molecular Assemblies	Hideki SAKURAI
	Structure and Function of Genomes	Michio OISHI
	Endocrine Disrupters	Tsuguyoshi SUZUKI
	Research and Development of System Technologies for Resource Recycling and Minimum Energy Requirement	Masaru HIRATA
FY 1998	Understanding the Brain	Motoi KUNO
FY 1997	Protecting the Brain	Hideo SUGITA
	Creating the Brain	Shun-ichi AMARI
	Mechanism of Global Change	Tomio ASAI
FY 1995	Genetic Programming	Masami MURAMATSU
	Host Defense Mechanism	Yoshiyuki HASHIMOTO
	Quantum Effects and Related Physical Phenomena	Dr. Shinji KAWAJI
	Single Molecule and Atom Level Reactions	Akio YAMAMOTO
	Phenomena of Extreme Conditions	Masashi TACHIKI
	Understanding the Brain (Mechanisms of Brain)	Masanori OTSUKA
	Social Systems for Better Environment Performance	Yoichi KAYA

*The reported research affiliations are those at the time of the projects completed.

	Project	Strategic Sector	Completed Year	Page
	12	Development of a Technological Infrastructure for the Realization of Quantum Information Processing that Introduces Innovation into Information Communications Technology	FY2010	P.78
	15	Elucidation of a Human Life-Long Learning Mechanism Based on the Knowledge of Brain Science with an Intention to Provide a Solution to the Problems in Education		P.78
	16	Investigation of Sugar Chain Function for Realizing Effective Development of Innovative Drugs for Combating Cancer and Viral Infection and Establishment of Technology for Application	FY2009	P.79
	13	Establishment of Basic Technology for Utilizing Genome Information for Realizing Tailor-Made Medical Treatment without Side Effects Based on Individual Genetic Information		P.79
	17	Establishment of Next Generation Integration Simulation Technology for Realizing Advanced Treatment and Precision Product Design Based on the Phenomena of Atomic/Molecular Level in the Medical Treatment and Information Industry		P.80
	10	Creation of Nanodevice / Material / System for Overcoming Integration / Function Limits in Data Processing and Communications	FY2007	P.80
	11			P.81
	8			P.81
	9			P.82
	15	Creation of Functional Materials/ System that Utilize Nano Biotechnology for Realizing a Noninvasive Medical Treatment System		P.82
	10			P.83
	10			P.83
	11	Creation of Nano Materials/ System for Realizing Environmental Conservation and Advanced Energy Recycling to Minimize Stress on the Environment		P.84
	10			P.84
	17	Technological Innovation through Protein Analysis Based on Genetic Information	FY2008	P.85
	14	Pursuing and Developing Leading-edge Basic Technology to Apply Advanced Medical Care to the Human		P.85
	11	Building High-speed, Large-capacity Information Processing Technology by a New Principle		P.86
	17	Forecasting Water Circulation and Building a Utilization System		P.86
	14	Realization of an Aging Society full of Vitality by Technological Innovation	FY2007	P.87
	17			P.87
	12	Challenge to the Unknown Region with Large Possibility	FY2006	P.88
	14	Technological Innovation by the Development of New Functions in Molecular Level	FY2005	P.88
	15			P.89
	14			P.89
	17	Realization of Environment Friendly Society		P.90
	16	Building up of a Social System Aimed at Resource Recycling and Minimum Energy Requirement		P.90
	7	Elucidation of the Brain Function	FY2004	P.91
	13			P.91
	12			P.92
	13	Realization of Environment Friendly Society		P.92
	23	Challenge to the Unknown Region with Large Possibility	FY2002	P.93
	21			P.93
	19			P.94
	19			P.94
	21			P.95
	19	Elucidation of the Brain Function		P.95
	21	Realization of Environment Friendly Society		P.96

Creation of New Technology Aiming for the Realization of Quantum Information Processing Systems

FY2003

Research Supervisor: **Yoshihisa YAMAMOTO**

Researcher	Position	Research Proposal
Nobuyuki IMOTO	Professor, Osaka University	Novel Quantum Information Processing with Photons
Jaw-Shen TSAI	Research Fellow / Laboratory Head, NEC / RIKEN	Superconducting Qubit System
Fujio SHIMIZU	Research Professor / Researcher, NTT / ILS-UEC	Development of Quantum Computation System with Neutral Atoms
Yoshiro TAKAHASHI	Professor, Kyoto University	Basic Research of Quantum Information Processing Using Atomic Ensemble
Akira FURUSAWA	Professor,The University of Tokyo	Quantum Entanglement Manipulation for Quantum Information Networks

FY2004

Sinji URABE	Professor, Osaka University	Research and Development of Integrated Ion Trap Quantum Computer Systems
Hideo KOSAKA	Associate Professor, Tohoku University	Quantum Media Conversion from a Photon Qubit to an Electron-spin Qubit
Takamasa MOMOSE	Guest Researcher / Professor, National Institute of Information and Communications Technology/The University of British Columbia	Basic Research on Quantum Information Processing Using Molecular Internal States

FY2005

Kyo INOUE	Professor, Osaka University	Quantum Entangled Photons and their Application Systems in the Communication Wavelength Band
Hidetoshi KATORI	Professor, The University of Tokyo	Quantum Metrology with Ultracold Atoms
Masahiro KITAGAWA	Professor, Osaka University	Molecular Spin Quantum Computers
Seiji MIYASHITA	Professor, The University of Tokyo	Quantum-mechanical Cooperative Phenomena and their Applications

Elucidation of Mechanisms Underlying Brain Development and Learning

FY2003

Research Supervisor: **Tadaharu TSUMOTO**

Researcher	Position	Research Proposal
Kuniyoshi L. SAKAI	Associate Professor, The University of Tokyo	Identification of Acquisition Mechanisms Based on Language Function in the Brain
Yoshio SAKURAI	Professor, Kyoto University	Detection of Learning Potential and Neural Plasticity in Aged Brains with the BMI Method
Yoichi SUGITA	Group Leader, National Institute of Advanced Industrial Science and Technology (AIST)	Characteristic Properties and Importance of Perceptual Learning in Infancy
Gentaro TAGA	Professor, The University of Tokyo	Research on Developmental Brain Sciences in Infants
Katsuki NAKAMURA	Director, National Center for Neurology and Psychiatry	The Role of Bodily Movement (action) on the Development of Communication
Tomoo HIRANO	Professor, Kyoto University	Comprehensive Study on Learning Mechanism Dependent on the Cerebellum

FY2004

Tadashi ISA	Professor, National Institute for Physiological Sciences, National Institutes of Natural Sciences	Mechanism of Post-injury Functional Compensation of Neural Circuits
Noriko OSUMI	Professor, Tohoku University	Molecular Mechanisms of Postnatal Neurogenesis and its Influence on Animal Behaviors
Junichi NABEKURA	Professor, National Institute for Physiological Sciences,National Institutes of Natural Sciences	Re-arrangement of Neuronal Circuits during Development and during Recovery from Brain Damage
Hisao NISHIJO	Professor, University of Toyama	Comprehensive Study on Neural Mechanisms of Emotional Development and its Disorders
Takao K. HENSCH	Group Director, RIKEN	Integrated Elucidation of Critical Period Mechanism by Live Brain Imaging

FY2005

Shigeru KITAZAWA	Professor, Juntendo University School of Medicine	Investigation of the Neural Mechanisms that Facilitate Development using AppliedBehavior Analysis
Kazuto KOBAYASHI	Professor, Fukushima Medical University	Mechanisms Underlying Dopaminedependent Control of Development and Execution of Behaviors
Ichiro FUJITA	Professor, Osaka University	Functional Architecture and Postnatal Development of Association Cortex
Keiji WADA	Director, National Center of Neurology and Psychiatry	Bio-communication between “Mother and Child” for Nurturing the Brain

Clarification of the Biological Functions of Sugar Chains and the Use of this Knowledge in Applied Technologies

FY2002

Research Supervisor: **Naoyuki TANIGUCHI**

Researcher	Position	Research Proposal
Yukishige ITO	Chief Scientist, RIKEN	Investigation on the Functions of Glycan Chains in Glycoprotein Quality Control
Reiji KANNAGI	Chief, Aichi Cancer Center Research Institute	Elucidating the Functional Roles of Glycoconjugates in Cell-Cell Interactions During Cancer Progression
Makoto KISO	Professor, Gifu University	Studies on Development of Novel Glycotherapeutics to Control Infection and Symbiosis
Nobuto KOYAMA	General Manager, Takara Bio Inc.	Prevention against and Treatment for Cancer and Viral Diseases
Yasuo SUZUKI	Professor, Chubu University	Functional Glycomics of Viral Infection and its Application for the Development of Antiviral Agents
Shoko NISHIHARA	Professor, Soka University	Elucidation of the Roles of Glycans using RNAi Technology

FY2003

Kohji ITOH	Professor, The University of Tokushima	Development of Recombinant Lysosomal Enzyme Replacement Therapy for Brain Diseases Based on the Specific Functions of Oligosaccharides
Jin-ichi INOKUCHI	Professor, Tohoku Pharmaceutical University	Molecular Pathogenesis of Type 2 Diabetes via Insulin Signaling in Membrane Microdomains
Hiroshi NAKADA	Professor, Kyoto Sangyo University	Analysis of Immunosuppressive Effect by Mucins in Tumor-bearing State and Clinical Application
Kazuya NOMURA	Associate Professor, Kyushu University	Strategic Analysis of Carbohydrate Functions through Gene Knockouts
Taeko MIYAGI	Director, Miyagi Cancer Center Research Institute	Molecular Mechanisms of Aberrant Expression of Sialidase in Cancer and Dia betes and their Regulation for Therapeutic Purposes
Yoko FUJITA-YAMAGUCHI	Professor, Tokai University	Production of Single Chain Antibodies against a Variety of Carbohydrate Epitopes

FY2004

Taroh KINOSHITA	Professor, Osaka University	Relating Sugar Chains' Structures and Localization with their Biological Functions
Takeshi TSUBATA	Professor, Tokyo Medical and Dental University	Studies on the Roles of Carbohydrate-mediated Signaling in Acquired Immunity and its Application to Disease Control
Yoshio HIRABAYASHI	Team Leader, RIKEN	Expression and Regulation of Neuronal Function through Glycosylation System
Koichi HONKE	Professor, Kochi University	Functions of Glycoconjugates in the Membrane Microdomains in Pathophysiological Processes

Basic Technology to Establishing Tailor-Made Medicine by Utilizing Genome Information

FY2002

Research Supervisor: **Takehiko SASAZUKI**

Researcher	Position	Research Proposal
Johji INAZAWA	Professor, Tokyo Medical and Dental University	Establishment of High-resolution Microarray CGH and Exploring Cryptic Chromosome Alterations in Cancer and in Patients with Genetic Diseases
Norihiro KATO	Director, International Medical Center of Japan	Multi-phased Investigation of Genomic Epidemiology in Hypertension and its Associated Disorders
Jun TAKEDA	Professor, Gifu University	Molecular Dissection of the HNF-transcription Network and Identification of Genes Responsible for Type 2 Diabetes Mellitus
Tatsushi TODA	Professor, Kobe University	Identification of Genes and Drug Development for Parkinson's Disease based on Genome Analysis
Hiroyuki MANO	Professor, Jichi Medical School	Characterization Human Disorders with a High-throughput Analysis of the Regulatory Mechanism for Gene Expression

FY2003

Tadao ARINAMI	Professor, The University of Tsukuba	Collaborative Study to Identify Schizophrenia Susceptibility Genes
Ituro INOUE	Professor, Tokai University	Identification of Susceptibilities of Sub-common Disease and Development of Personalized Medicine
Norio TERAMAE	Professor, Tohoku University	Gene Diagnosis based on Self-assembled Bio-molecular Systems and Fluorescent Small Ligands
Fumihiko MATSUDA	Professor, Kyoto University	Trans-ethnic Genomics Study of Multigenic Disorders by Japan/France International Collaboration

FY2004

Hiroyuki ABURATANI	Professor, The University of Tokyo	Comprehensive Analysis of Chromosomal Copy Numbers and Allelic Gene Expression
Seishi OGAWA	Associate Professor, The University of Tokyo	Identification of Genetic Basis for Development of GVHD
Atsushi MARUYAMA	Professor, Kyushu University	Genotyping Method on the Basis of Molecular-chaperone Engineering
Masaki MORI	Professor, Osaka University	Global Analysis of Factors Related to Carcinogenesis, Progression and Treatment Sensitivity of Colorectal Cancer

*The reported research affiliations are those at the time of the projects completed.

The Innovation of Simulation Technology and the Construction of Foundations for Its Practical Use

FY2002

Research Supervisor: **Norihisa DOI**

Researcher	Position	Research Proposal
Seiichi KOSHIZUKA	Professor, The University of Tokyo	Multi-physics Simulator Using Particle Method
Kimiaki SAITO	Chief Senior Scientist, Japan Atomic Energy Agency	Development of Super Parallel Computing Simulation Systems for Improving the Quality of Radiotherapy
Masao DOI	Professor, The University of Tokyo	Research and Development of the Multi-Scale Modeling of Rheological Phenomena in Biological Systems
Akira NISHIDA	Visiting Researcher, Chuo University	Development of Software Infrastructure for Large Scale Scientific Simulation
Satoshi WATANABE	Professor, The University of Tokyo	Development of Simulators for Nano-scale Measurements of Materials Properties

FY2003

Hirokazu ANAI	Senior Researcher, Fujitsu Limited	Construction of a Platform for Robust Optimization based on Symbolic-numeric Hybrid Computation
Kiyohito ISHIDA	Professor, Tohoku University	Development of the Integrated Design System for Materials Microstructure and Properties
Takashi SASAKI	Professor, KEK	Development of Software Framework for Simulation in Radiotherapy
Naoki TAKANO	Professor, Ritsumeikan University	Multi-professional Simulator for Biomedical Study of Human Bone
Umpei NAGASHIMA	Principal Research Scientist, National Institute of Advanced Industrial Science and Technology (AIST)	Development of Large Scale Molecular Orbital Calculation System on Grid
Toshiaki HISADA	Professor, The University of Tokyo	Development of Multi-scale and Multi-physics Simulator of Heart for Disease Care and Drug Discovery

FY2004

Shin'ichi OISHI	Professor, Waseda University	Study on Validated Numerical Simulation for Linear Systems
Shigenori TANAKA	Professor, Kobe University	Development of Bio-Simulation Systems Based on the Fragment Molecular Orbital Method
Takashi TANAKA	Professor, Kyushu University	Realtime Simulation of the Space Weather
Masaru TOMITA	Director General/Professor, Keio University	Development of Modeling/Simulation Environment for Systems Biology
Tomoyuki HIGUCHI	Vice Director General/Professor,Research Organization of Information and Systems	Development of Advanced Data Assimilation and Adaptive Simulation Methods
Takeo FUJIWARA	Professor, The University of Tokyo	Novel Methodology of Electronic Structure Calculations by Combining Several Different Aspects

Creation of Ultrafast, Ultralow Power, Super-performance Nanodevices and Systems

FY2002

Research Supervisor: **Hiroyuki SAKAKI**

Researcher	Position	Research Proposal
Hidefumi AKIYAMA	Associate Professor, The University of Tokyo	Quantum Wire Lasers with Novel Device Performances
Chihaya ADACHI	Professor, Kyushu University	Realization of Organic Laser Diodes and the Device Physics
Shigehisa ARAI	Professor, Tokyo Institute of Technology	Realization of Functional Photonic Devices Based on Low-Dimensional Quantum Structures
Shunsuke OHTANI	Professor, University of Electro-Communications	Nano-processes by Slow Highly Charged Ion-impact
Hitoshi KAWAGUCHI	Professor, Nara Institute of Science and Technology	Creation of Ultrafast Optical Memory with Shift Register Function
Mitsumasa KOYANAGI	Professor, Tohoku University	Novel Nonvolatile Memory with Resonant Magnetic Tunneling Nanodots
Junsaku NITTA	Professor, Tohoku University	Semiconductor Spin Engineering
Akira FUJIMAKI	Professor, Nagoya University	Single-Flux-Quantum Terahertz Electronics
Kazuhito FURUYA	Professor, Tokyo Institute of Technology	Ballistic Electron Devices of Super-Hetero Nano-Structures
Akihiko YOSHIKAWA	Professor, Chiba University	New Evolution in Nano-processes /Nano-devices Focused on MBE-grown InN-based III-Nitrides

Creation of Nanodevices and System Based on New Physical Phenomena and Functional Principles

FY2001

Research Supervisor: **Koji KAJIMURA**

Researcher	Position	Research Proposal
Koichiro INOMATA	Fellow, National Institute for Material Science	Development of Fundamental Technology for Spin Quantum Dot Memories
Yoshihiro IWASA	Professor, Tohoku University	Nanoclusters: Control of Configuration, Rotation, and Electronic States in Device Structures
Hideyo OKUSHI	Scientific Adviser, Nanotechnology Research Institute, National Institute of Advanced Industrial Science and Technology (AIST)	Development of Diamond Ultraviolet Nanodevices Taking Advantage of Highly Condensed Excitonic States
Satoshi KAWATA	Professor, Osaka University	Nonlinear Nano-Photonics
Kazuhiro KOMORI	Group Leader, National Institute of Advanced Industrial Science and Technology (AIST)	Coherent Quantum-Control and Information-Processing Technology
Hiroaki MISAWA	Professor, Hokkaido University	Development of Nanofabrication Technology by Entangled Photon Beams

FY2002

Hajime ISHIHARA	Professor, Osaka Prefecture University	Creation of Novel Functional Devices Using Nanoscale Spatial Structures of the Radiation Field
Kingo ITAYA	Professor, Tohoku University	Atom Processes in Solid/Liquid Interfacial Reactions: Elucidation and Application
Hideaki TAKAYANAGI	Professor, Tokyo University of Science	Implementation of the Entangled States Using Superconducting Flux Qubits
Kazuhiko MATSUMOTO	Professor, Osaka University	Carbon Nanotube Single Electron/Spin Measuring System

FY2003

Hiroshi AKOH	Deputy Director, Correlated Electron Research Center, National Institute of Advanced Industrial Science and Technology (AIST)	Gigantic Spin Tunnel Functionality Atomically-controlled by Perovskite Interface Engineering

Nano Factory and Process Monitoring for Advanced Information Processing and Communication

FY2002

Research Supervisor: **Kenji GAMO**

Researcher	Position	Research Proposal
Koji ISHIBASHI	Chief Scientist, RIKEN	Development of Fabrication Processes for Quantum Nanodevices in Carbon Nanomaterials
Masakazu ICHIKAWA	Professor, The University of Tokyo	Formation and Characterization of Ultra-small Nanodots with Ultra-high Density
Tomokazu IYODA	Professor, Tokyo Institute of Technology	Creation and Transcription of Reliable Macromolecular Templates based on Phase-separated Nano-structures
Hideki KAWAKATSU	Professor, The University of Tokyo	Ultrafast Ultraparallel Nanomechanics
Hiroo KINOSHITA	Professor, University of Hyogo	Surface Observation and Metrology of High-Performance Material by Extreme Ultraviolet Microscope with Phase-Shifting Interferometer (EUVM/PSI)
Hiroshi DAIMON	Professor, Nara Institute of Science and Technology	Development of Atomic Stereomicroscope for the Analysis of Nanostructure
Shinji MATSUI	Professor, University of Hyogo	High-functional Nano-three-dimensional Device and Process

FY2003

Yoshikazu HOMMA	Professor, Tokyo University of Science	In Situ Characterization of Carbon Nanotube Growth Process for the Physical Property Control

*The reported research affiliations are those at the time of the projects completed.

Creation and Application of Nano Structural Materials for Advanced Data Processing and Communication

FY2002

Research Supervisor: **Hidetoshi FUKUYAMA**

Researcher	Position	Research Proposal
Takekazu ISHIDA	Professor, Osaka Prefecture University	Basic and Applied Researches of Nanofabricated Superconductors
Hayao KOBAYASHI	Guest Professor, Nihon University	Construction of Nanostructured Molecular Assemblies with Novel Electronic Functions
Hisanori SHINOHARA	Professor, Nagoya University	Syntheses, Characterization and Application of Novel Carbon Nanotube Materials
Kazuyoshi TANAKA	Professor, Kyoto University	Construction of Nano-electronic Devices Based on Precise Molecular Design
Atsushi NAKAJIMA	Professor, Keio University	Nano-scale Designed Surface Orientated Towards Novel Optomagnetomaterials
Naoto NAGAOSA	Professor, The University of Tokyo	Coherence Control of Correlated Electron Systems
Masahiro YAMASHITA	Professor, Tohoku University	Development and Application of Nano-Molecular Quantum Magnets

FY2003

Yoshihiro ASAI	Group Leader, National Institute of Advanced Industrial Science and Technology (AIST)	Contact Effects and Transport Properties of Single Molecules
Sadamichi MAEKAWA	Professor, Tohoku University	Principles of Nano-devices Based on the Internal Degrees of Freedom of Electrons

Creation of Bio-Devices and Bio-Systems with Chemical and Biological Molecules for Medical Use

FY2001

Research Supervisor: **Hiroyuki SASABE**

Researcher	Position	Research Proposal
Taizo UDA	Professor, Prefectural University of Hiroshima	Generation of "Super Catalytic Antibodies" as Biological Nano-Materials for Health and Welfare
Atsuhiro OSUKA	Professor, Kyoto University	Giant Porphyrin Arrays as Meso-Scopic Structural Motif of Molecular Electronics
Teruo OKANO	Professor, Chief, Tokyo Women's Medical University	Development of a Novel Tissue Reconstruction Technique and the Next Generation Biosensors
Yoshio OKAHATA	Professor, Tokyo Institute of Technology	Design of Multifunctional Quartz-Crystal Microbalance Multisensors for Quantitative Detection of Biomolecular Interactions
Kazunori KATAOKA	Professor, The University of Tokyo	Development of Novel Nano-structured Device for Gene and Drug Delivery
Toshihiro YAMASE	Professor, Tokyo Institute of Technology	Molecular Machinery based on Polyoxometalates as Nano-sized Clusters

FY2002

Mitsuru AKASHI	Professor, Osaka University	Development of Anti-retroviral Vaccine Using Polymeric Nanoparticles
Takehiko KITAMORI	Professor, The University of Tokyo	Creation and Application of Nano Bio-Physico-Chemical Architectures
Masaaki SHIMIZU	Director, Fuji Xerox Co., Ltd.	Development of Molecules Cognition System by Infinitesimal Bio-Sensors Aiming for Electronic-cell
Koji SUZUKI	Professor, Keio University	Creation of "Nanochemical Probes" and their Biomedical Sensing Application
Mitsuo SEKINE	Professor, Tokyo Institute of Technology	Creation of Innovative Artificial Nucleic Acids Capable of Control and Detection of Genome — Based on the Most Advanced Technology for the Synthesis of Nucleic Acids —
Hideaki MATSUOKA	Professor, Tokyo University of Agriculture and Technology	The High Throughput Creation of Disease Model Cells and the Analysis of their Function
Kazuko MATSUMOTO	Ex-Professor, Waseda University	Delayed Fluorescence Bio-Imaging Using Metal-Complex Probes

FY2003

Yoshiki KATAYAMA	Professor, Kyushu University	Novel Cell-selective Gene Delivery System Using Intracellular Signal-responsive Molecular System
Kei YURA	Senior Scientist, Japan Atomic Energy Agency	A Method to Deduce Atomic Resolution Structures out of Low Resolution Supra-molecule Images in Biological Systems

Creation and Application of "Soft Nano-machine", the Hyperfunctional Molecular Machine

FY2002

Research Supervisor: **Hirokazu HOTANI**

Researcher	Position	Research Proposal
Shin-Ichi AIZAWA	Professor, Prefectural University of Hiroshima	Quest for the Origin of the Flagellar Motility
Hiroyasu ITOH	Senior Researcher, Hamamatsu Photonics K.K.	Creation of Nano Mechano-chemical Machines based on Protein Molecular Motors
Toshiya ENDO	Professor, Nagoya University	Molecular Mechanisms of the Functions of Protein Translocators
Ritsu KAMIYA	Professor, The University of Tokyo	Principle and Assembly of Bio-nanomachines that Produce Vibration
Tokuko HARAGUCHI	Senior Research Scientist,National Institute of Information and Communications Technology	Construction of an Artificial Cell Nucleus as a Gene-delivery System
Yoshie HARADA	Professor, Kyoto University	Studies on the Molecular Motors Working along the DNA
Yoshinori FUJIYOSHI	Professor, Kyoto University	Development of Observation Methods for Cellular Systems
Toshio YANAGIDA	Professor, Osaka University	Nano-machines Modeled after Fluctuations and Flexibility of Bio-systems

FY2003

Masamitsu FUTAI	Professor, Iwate Medical University	Studies on the Mechanism of Proton Pump ATPase as Highly Efficient Nanomotors

FY2004

Shoji TAKADA	Associate Professor, Kyoto University	Hierarchal Modeling of Bio-nanomachines: From Dynamical Structure to Function

Creation of Novel Nano-material/System Synthesized by Self-organization for Medical Use

FY2002

Research Supervisor: **Koji KAYA**

Researcher	Position	Research Proposal
Kohzo ITO	Professor, The University of Tokyo	Production of Functional Biomaterials with Topological Gel for Medical Use
Tomoji KAWAI	Professor, Director, Osaka University	Creation of Bio-mimetic Intellectual Material based on Programmed Self-assembly
Kazue KURIHARA	Professor, Tohoku University	Nanostructuring of Liquids at the Solid-Liquid Interfaces
Kiyotaka SHIBA	Chief, Japanese Foundation for Cancer Research	Development of a Programmable Artificial Protein System for Nano-biotechnology
Masatsugu SHIMOMURA	Professor, Tohoku University	Fabrication of Nanostructured Medical Devices Based on Self-organized Polymer Materials
Fumio TOKUNAGA	Professor, Osaka University	Protein Module: From Nano Assembling to Micro Multiplication
Keisuke TOMINAGA	Professor, Kobe University	Reaction Dynamics in Nano-Scale
Yoshihide HAYASHIZAKI	Chief Scientist, RIKEN	Development and Medical Application of "NanoLEGO" from Biomolecule Selected by Genome-wide Screening
Makoto FUJITA	Professor, The University of Tokyo	Development of Self-organizing Molecular Systems for Chemical Translation of Biological Functions
Ichiro YAMASHITA	Chief Researcher, Matsushita Electric Industrial Co., Ltd.	Nano Integration Process by the Biomolecule Nanotechnology

*The reported research affiliations are those at the time of the projects completed.

Creation of Nano-Structured Catalysts and Materials for Environmental Conservation

FY2002

Research Supervisor: **Makoto MISONO**

Researcher	Position	Research Proposal
Yasuhiro UOZUMI	Professor, National Institutes of Natural Sciences / Team Leader, RIKEN	Transition Metal Catalysts with Defined Nano-structure to Transform Organic Compounds in Water
Toshio OKUHARA	Professor, Hokkaido University	Developments of Highly Functional Oxide Clusters for Green Chemical Synthesis
Kazuyuki KURODA	Professor, Waseda University	Creation of Highly Controlled Nano-space Materials
Takashi TATSUMI	Professor, Tokyo Institute of Technology	Creation of Green Catalysts through Free Interconversion of Organic-Inorganic Composite Phase
Wang Jae CHUN	Senior Associate Professor, International Christian University	Creation of Highly Efficient Well-defined Metal Oxide Surfaces
Yasushi TSUJI	Professor, Kyoto University	Creation of Molecular Catalysts with Controlled Nanometer Space in Homogeneous Phase
Yasutake TERAOKA	Professor, Kyusyu University	Nano-structured Catalytic Systems Using Perovskite-type Oxides
Isao MOCHIDA	Professor, Kyusyu University	Novel Catalytic Functions of Carbon Nano-fibers with Optimized Surface Structure
Tatsuaki YASHIMA	Guest Researcher, Miyazaki University	Selectivity Control Procedures and Their Use in Hydrocarbon Partial Oxidations Over Orderly Substituted Mixed Oxides at Nanometer Level Scale

FY2003

Kimihisa YAMAMOTO	Professor, Keio University	Nano-catalyst Based on Fine-controlled Metal Assembling

FY2004

Shinichiro NAKAMURA	General Manager, Computational Science Laboratory, Mitsubishi Chemical Group Science and Technology Research Center, Inc.	Study of Nano-Environment to Realize the Optimum Molecular Properties

Development of Advanced Nanostructured Materials for Energy Conversion and Storage

FY2002

Research Supervisor: **Akira FUJISHIMA**

Researcher	Position	Research Proposal
Kiyoshi KANAMURA	Professor, Tokyo Metropolitan University	Creation of Energy-conversion Devices Using Multi-dimensionally Ordered Matrices
Tsuyoshi KIJIMA	Professor, Miyazaki University	Development of Highly Functional Nanotubular Materials and Their Application to Energy Conversion Processes
Akihiko KUDO	Professor, Tokyo University of Science	Development of Nano-structured Photocatalysts with Visible Light Response for Water Splitting
Hideomi KOINUMA	Visiting Professor, The University of Tokyo	Development of Field Effect Induced Optically Functional Devices by the Integrated Nano-technology
Kunihito KOUMOTO	Professor, Nagoya University	Creation of Thermoelectric Oxide Materials with Layered Structures through Nano-Block Integration
Takayoshi SASAKI	Managing Director, National Institute for Materials Science	Fabrication of Nanostructured Materials with Photo-functonalities Via Self-assembly
Yoshihiro NAKATO	Visiting Professor, Kwansei Gakuin University/ Professor Emeritus, Osaka University	Efficient Solar Water Splitting by a Composite Semiconductor Electrode with Interfacial Nanostructuring
Kaname MATSUMOTO	Professor, Kyushu Institute of Technology	Development of High Critical Current Superconducting Materials by Nano-Structure Control
Jun-ichi YAMAKI	Professor, Kyushu University	Study on Electric-Energy Storage Devices Made by Nano-Scale Materials

FY2004

Tamio IKESHOJI	Director, National Institute of Advanced Industrial Science and Technology (AIST)	Nano-simulation of Electrochemical Two-phase Interfaces

Protein Structure and Functional Mechanisms

Research Supervisor: **Tairo OSHIMA**

FY2001

Researcher	Position	Research Proposal
Kazuhiro IWAI	Professor, Osaka City University	Analysis of the Ubiquitin-Mediated Regulation of Protein Functions
Masatsune KAINOSHO	Visiting Professor, Tokyo Metropolitan University	Developing a New Approach for High-throughput, High-accuracy NMR Structural Analyses of Genomic Proteins
Yuji C. SASAKI	Chief Scientist, Japan Synchrotron Radiation Research Institute	Analysis of Dynamical Function/Structure of Protein Molecules From Single-Molecular Experiment With X-rays
Yoshinori SHICHIDA	Professor, Kyoto University	Structural and Functional Analyses of G Protein-Coupled Receptors Using Rhodopsin as a Model Receptor
Kazuhiro NAGATA	Professor, Kyoto University	Quality Control Mechanism of Newly Synthesized Proteins in the Endoplasmic Reticulum
Toshio HAKOSHIMA	Professor, Nara Institute of Science and Technology	Structural Basis of Protein Functions and their Regulation by Dynamic Complex Formation

FY2002

Hidenori ICHIJO	Professor, The University of Tokyo	Molecular Mechanisms of Recognition and Conversion of Stress Signaling
Koreaki ITO	Visiting Professor, Osaka University	Principles and Regulatory Devices that Govern the Dynamic Behaviors of Proteins in the Cell
Yuji GOTO	Professor, Osaka University	The Molecular Pathogenesis of Amyloidosis
Hiroyuki SORIMACHI	Project Leader, The Tokyo Metropolitan Institute of Medical Science	Elucidation of Physiological Functions of Intracellular Modulator Proteases
Akihito YAMAGUCHI	Professor, Osaka University	Studies on the Structure and Function of Xenobiotic Efflux Proteins
Tamotsu YOSHIMORI	Professor, Osaka University	Intracellular Traffic System Organized by Proteins and Membranes
Kazuyoshi YONEZAWA	Professor, Kobe University	Identification and Functional Analysis of Proteins Mediating Cell Growth Control

FY2003

Hiroyuki ARAKI	Professor, National Institute of Genetics	Structure and Function of the Protein Complexes in the Synthesis of Nucleic Acids
Noriyuki SAGATA	Professor, Kyushu University	Analysis of the Structure and Function of Cell Cycle and Checkpoint Regulators
Masashi SUZUKI FFRPs	Group Leader, National Institute of Advanced	DNA-recognition and Ligand-binding by the Feast/Famine Regulatory Proteins, Industrial Science and Technology (AIST)
Teizo FUJITA	Professor, Fukushima Medical University	Analyzing Interaction among Protein Molecules in Host Defense and the Mechanism to Exert Function

Translational Research for Intractable Immune Disorders and Infectious Diseases

Research Supervisor: **Tadamitsu KISHIMOTO**

FY2001

Researcher	Position	Research Proposal
Yoshihiro KAWAOKA	Professor, The University of Tokyo	Understanding the Replication Cycle of Influenza Virus and its Application
Tsukasa SEYA	Professor, Hokkaido University	Innate Immunity in Association with Human Incurable Diseases
Toshiyuki TAKAI	Professor, Tohoku University	Conquest of Immune Disorders by Analyzing Immunoglobulin-Like Receptor (IgLR) Functions
Kenji NAKANISHI	Professor, Hyogo College of Medicine	Therapeutic Approach to Innate Type Atopy by Focusing on IL-18
Kensuke MIYAKE	Professor, The University of Tokyo	Molecular Mechanisms Underlying Recognition/Signaling of Endotoxin

FY2002

Hiroshi KIYONO	Professor, The University of Tokyo	Immunobiology of M Cells for the Development of Mucosal Vaccine
Shigeo KOYASU	Professor, Keio University	Infectious Disease Control by Understanding the Strategy of Pathogenic Microbes Affecting Host Immune System
Nobuo SAKAGUCHI	Professor, Kumamoto University	New Strategy against Infectious and Immune Diseases by Developing Generation of High Affinity Antibodies
Yasuo CHINZEI	Visiting Professor, Mie University	Molecular Mechanisms of Malarial Parasite Infection of the Host Liver and Development of Novel Anti-malarial Strategies Preventing Malarial Transmission
Atsushi MIYAJIMA	Professor, The University of Tokyo	Studies on Hematopoiesis and Immune Reactions in Liver

FY2003

Hitoshi KIKUTANI	Professor, Osaka University	Roles of Semaphorin Molecules in the Immune System
Shimon SAKAGUCHI	Professor, Kyoto University	A Novel Strategy of Immunoregulation with Regulatory T Cells
Chihiro SASAKAWA	Professor, The University of Tokyo	Studies of the Mechanisms of Mucosal Infection and Modulation of the Host Defense System by Pathogenic Bacteria, and its Application for Controlling Infectious Disease
Shinya YAMANAKA	Professor, Kyoto University	Generation of Ideal Pluripotent Stem Cells for Clinical Application

*The reported research affiliations are those at the time of the projects completed.

New High-Performance Information Processing Technology Supporting Information-Oriented Society

Research Supervisor: **Hidehiko TANAKA**

FY2001

Researcher	Position	Research Proposal
Kohei M. ITOH	Associate Professor, Keio University	Development of All Silicon Quantum Computers
Mitsuteru INOUE	Research Professor, Toyohashi University of Technology	Ultra-Fast Peta-Byte Information Storage
Hiroshi NAKASHIMA	Professor, Kyoto University	Dependable Mega-Scale Computing Based on Ultra Low Power Technology
Masami HAGIYA	Professor, The University of Tokyo	Polymorphic Molecular Interaction for Constructing Huge Memory

FY2002

Yoshiki KINOSHITA	Director, Research Center for Verification and Semantics, National Institute of Advanced Industrial Science and Technology (AIST)	Solving the Description Explosion Problem in System Verification through Structural Transformation
Shuichi SAKAI	Professor, The University of Tokyo	Base Technologies for Dependable Information Processing
Kazuo TORAICHI	Distinguished Professor, University of Tsukuba	Multimedia Content Coding based on the Fluency Information Theory
Shunichi MUTO	Professor, Hokkaido University	Elemental Technologies for Quantum Information Networks

FY2003

Kazuhiko KATO	Professor, University of Tsukuba	Building Autonomous Federated Computing Systems
Toshihiro MATSUI	Acting Director, Digital Human Research Center, National Institute of Advanced Industrial Science and Technology (AIST)	Distributed Realtime Information Processing for Humanoid
Haruo YOKOTA	Professor, Tokyo Institute of Technology	High Performance Dependable Advanced Storage Systems

Hydrological System Modeling and Water Resources System

Research Supervisor: **Katumi MUSIAKE**

FY2001

Researcher	Position	Research Proposal
Taikan OKI	Professor, The University of Tokyo	Modeling Global Hydrological Cycles and World Water Resources Coupled with Human Activities
Masahide KIMOTO	Professor, The University of Tokyo	A Simulation and Predictability Study of Broad-Scale Hydrological Cycle Using a Hierarchy of Numerical Models
Tetsuya KUSUDA	Guest Professor, Kyushu University	Sustainable Watershed Management in the Yellow River
Michiaki SUGITA	Professor, University of Tsukuba	The Rangelands Atmosphere-Hydrosphere-Biosphere Interaction Study in Northeastern Asia
Kaoru TAKARA	Professor, Kyoto University	System Modeling Approaches for Assessment of Interactions Between Social Changes and Water Cycle
Kenji NAKAMURA	Professor, Nagoya University	Study on the Interaction of Atmospheric Boundary Layer and Precipitation System in Wet and Dry Region and Improvement of Precipitation Forecast

FY2002

Takeshi OHTA	Professor, Nagoya University	Parameterization of the Relationships between the Water Cycle System and Plant Eco-physiological Properties in Boreal Forest Areas
Kenichi OKAMOTO	Professor, Osaka Prefecture University	Production of High Precision and High Resolution Global Precipitation Map by Using Satellite Data
Manabu KANDA	Associate Professor, Tokyo Institute of Technology	Water and Energy Forcing due to Urbanization in Land-Atmosphere-Coastal System
Hajime TANJI	Team Leader, National Agriculture and Food Research Organization (NARO), National Institute for Rural Engineering (NIRE)	Water Use and Management System of the Mekong River
Naoyuki FUNAMIZU	Professor, Hokkaido University	Development of Sustainable Sanitation System and Its Implementation to Asian Countries
Hiroaki FURUMAI	Professor, The University of Tokyo	Risk-based Management of Self-regulated Urban Water Recycle and Reuse Systems

FY2003

Yuichi ONDA	Associate Professor, University of Tsukuba	Field and Modelling Studies on the Effect of Forest Devastation on Flooding and Environmental Issues
Toshio KOIKE	Professor, The University of Tokyo	Development of a Physical Down Scaling Method for Water Cycle
Masakazu SUZUKI	Professor, The University of Tokyo	Effects of Rainfall Variability on Water Cycle and Ecosystem in Tropical Forest under Asian Monsoon Climate
Kengo SUNADA	Professor, University of Yamanashi	Sustainable Water Policy Scenario for River Basins with Rapidly Increasing Population – countermeasure strategy to global hydrological variation in monsoon Asia –
Toshi NAGATA	Professor, The University of Tokyo	Development of Stable Isotope Indices for Assessing Health and Sustainability of Watershed Ecosystems

Development, Differentiation, and Regeneration in Biological Systems

FY2000

Research Supervisor: **Yoshiki HOTTA**

Researcher	Position	Research Proposal
Tadashi UEMURA	Professor, Kyoto University	Single-cell Patterning: Investigation of Regulatory Mechanisms of Cell Polarization
Hideyuki OKANO	Professor, Keio University	Study on the Development and Regeneration of the Central Nervous System Based on the Stem Cell Biology
Hitoshi OKAMOTO	Group Director, RIKEN	Genetic Dissection of Neural Network Formation
Satoru KOBAYASHI	Professor, National Institutes of Natural Sciences	Clarification of the Mechanisms Underlying Germ Cell Formation and its Application to Mammalian Development
Tadaomi TAKENAWA	Professor, The University of Tokyo	Signaling of Cell Migration and its Role in Organ Formation, and Application to Regeneration
Hiroshi HAMADA	Professor, Osaka University	Molecular Mechanism Generating Morphological Asymmetries
Kunihiro MATSUMOTO	Professor, Nagoya University	Molecular Mechanism of Morphogenesis and Cell Differentiation during Development

FY2001

Takashi KADOWAKI	Professor, The University of Tokyo	Mechanism and Regulation of Adipocyte de-differentiation or “transformation”
Hitoshi SAKANO	Professor, The University of Tokyo	Generation and Regeneration of Olfactory Neural Network
Noriyuki SATOH	Professor, Kyoto University	Large-Scale Analysis of Novel Function of Specific Developmental Genes
Masaharu NODA	Professor, National Institutes of Natural Sciences	Molecular Mechanisms Underlying Regional Specification, Topographic Projection and Regeneration of the Optic Nerve

FY2002

Keiichi NAKAYAMA	Professor, Kyushu University	Activation of Regeneration by Promoted Reentry into Cell Cycle
Yasushi HIROMI	Professor, National Institute of Genetics	Organizing the Nervous System through Intracellular Pattering
Fumio MATSUZAKI	Group Director, RIKEN	Genetic Programs for Neuronal Diversity and Brain Formation

Plants Function and Their Control

FY2000

Research Supervisor: **Akinori SUZUKI**

Researcher	Position	Research Proposal
Hidetoshi IIDA	Professor, Tokyo Gakugei University	Molecular Mechanisms of Gravity Sensing in Plants
Junko KYOZUKA	Associate Professor, The University of Tokyo	Analysis of Molecular Mechanisms Controlling Key-Processes in Plant Reproductive Development
Takao KONDO	Professor, Nagoya University	Circadian Clocks of Cyanobacteria and Plants
Kazuki SAITO	Professor, Chiba University	Dynamics of Plant Assimilatory Metabolism in The Post-Genome Era
Kazuyoshi TAKEDA	Professor, Okayama University	Development and Control of Genomic Functions in Barley
Yasunori NAKAMURA	Professor, Akita Prefectural University	Metabolic Engineering of Starch Biosynthesis
Minoru MURATA	Professor, Okayama University	Molecular Analysis of Chromosome Functional Elements and Construction of Artificial Chromosomes in Plants

FY2001

Kiyotaka OKADA	Professor, Kyoto University	Intercellular Signaling in Plant Development
Junji TAKABAYASHI	Professor, Kyoto University	Regulation of Plant-Induced Defense Mechanisms Against Herbivores
Naoko K. NISHIZAWA	Professor, The University of Tokyo	Regulation of Iron Nutrition in Plants
Hiromichi MORIKAWA	Professor, Hiroshima University	Structure and Function of Novel Unknown Nitrogen Compounds Formed by Plants
Kyo WAKASA	Professor, Tokyo University of Agriculture	Regulation and Utilization of Primary and Secondary Metabolic Pathways in the Tryptophan Biosynthetic System

FY2002

Masayuki ISHIKAWA	Senior Researcher, National Institute of Agrobiological Sciences	Molecular Mechanisms of Tobacco Mosaic Virus Multiplication
Masayoshi KAWAGUCHI	Associate Professor, The University of Tokyo	Molecular Basis of Symbiotic Network
Masaru OHME (Masaru TAKAGI)	Group Leader, National Institute of Advanced Industrial Science and Technology (AIST)	Functional Network of Plant Specific Transcription Factors
Ikuko HARA (Ikuko NISHIMURA)	Professor, Kyoto University	Improvement in Quality and Quantity of Seed Proteins
Toshihiko HARA	Professor, Hokkaido University	Photo-stress in the Cryosphere and Maintenance Mechanisms of Boreal Forest

*The reported research affiliations are those at the time of the projects completed.

Advanced Media Technology for Everyday Living

Research Supervisor: **Makoto NAGAO**

FY1999

Researcher	Position	Research Proposal
Katsushi IKEUCHI	Professor, The University of Tokyo	Automatically Generating Multimedia Contents of Cultural Heritage through Observation
Toru ISHIDA	Professor, Kyoto University	Universal Design of Digital Cities
Nick CAMPBELL	Chief Researcher, Advanced Telecommunications Research Institute International	Expressive Speech Processing
Naomi MIYAKE	Professor, Chukyo University	Collaborative Learning Support System for the Advanced Media Society
Tomio WATANABE	Professor, Okayama Prefectural University	E-COSMIC: Embodied Communication System for Mind Connection

FY2000

Masatsugu KIDODE	Professor, Nara Institute of Science and Technology	Advanced Computing and Communicating Techniques for Wearable Information Playing
Susumu TACHI	Professor, The University of Tokyo	Telexistence Communication Systems
Jun-ichi TSUJII	Professor, The University of Tokyo	Research on Advanced Technologies for Enhancing Information Mobility
Koiti HASHIDA	Deputy Division Director, National Institute of Advanced Industrial Science and Technology	Human-Centered Intelligent Information Access

FY2001

Satoru IKEHARA	Professor, Tottori University	Analogical Mapping Method for Machine Translation and Sentence Generation based on Semantic Typology
Takeo KANADE	Division Director, National Institute of Advanced Industrial Science and Technology	Research on Digital Human Technologies
Akihiko TAKANO	Professor, National Institute of Informatics	Interactive Methods in Information Space Based on Association

Function Evolution of Materials and Devices based on Electron/Photon Related Phenomena

Research Supervisor **Takuo SUGANO**

FY1998

Researcher	Position	Research Proposal
Yoshinobu AOYAGI	Professor, Tokyo Institute of Technology	Study on Coherent Quantum Dynamics in Solid State Devices
Hideo IHARA (Yasumoto TANAKA)	Group Leader, National Institute of Advanced Industrial Science and Technology	Creation of the Best Performance Superconductor
Hiroshi KAWARADA	Professor, Waseda University	Fine Structured Diamond Electron Devices Formed by Controlling Surface Adsorbates
Yoshiro HIRAYAMA	Manager, NTT Basic Research Laboratories	Interacting Carrier Electronics
Koichiro HOH	Professor, The University of Tokyo	Quantum-Scale System Integration

FY1999

Shunri ODA	Professor, Tokyo Institute of Technology	NeoSilicon: A Novel Functional Material for Future Electronics
Masahiro KITAGAWA	Professor, Osaka University	Nuclear Spin Network Quantum Computers
Yoshiaki NAKANO	Professor, The University of Tokyo	Innovative Photon-Controlling Devices Based on Artificial Optical Properties of Semiconductors
Arao NAKAMURA	Professor, Nagoya University	Photonic Function of Materials with Nanometer-Sized Structures
Roy LANG	Professor, Tokyo University of Agriculture and Technology	Interactive Control of Photonic and Electronic Wave Packets

FY2000

Yoshishige SUZUKI	Professor, Osaka University	Spin-Injection as a Base of the Spin-Charge Coupled Electronic Devices
Kazuo NAKAMURA	Deputy Director-General, National Institute for Materials Sciences	The Control of Optical States for Practical Quantum Cryptography
Susumu NODA	Professor, Kyoto University	Ultimate Control of Light by Photonic Bandgap Crystals and Its Application to Novel Functional Devices
Eiichi HANAMURA	Professor, Chitose Institute of Science and Technology	Opto-Electronics Using Strongly Correlated Electronic System of Perovskite-type Transition-Metal Oxides

Creation and Functions of New Molecules and Molecular Assemblies

Research Supervisor: **Hideki SAKURAI**

FY1998

Researcher	Position	Research Proposal
Yoshiaki KOBUKE	Professor, Nara Institute of Science and Technology	Total Construction of Energy Conversion and Signal Transduction Systems in Biology
Tamotsu TAKAHASHI	Professor, Hokkaido University	Development of Next Generation Process of Transformation
Kazuo TACHIBANA	Professor, The University of Tokyo	Functional Control of Membrane-bound Proteins based on Assembly Formation
Kazunari DOMEN	Professor, Tokyo Institute of Technology	Development of Inorganic Supramolecular Systems for Energy Conversion
Michiya FUJIKI	Professor, Nara Institute of Science and Technology	Syntheses of the Cooperative Hyper Helical Polymers and Understanding of Structure-Property-Functionaly Relationship

FY1999

Isao KUWAJIMA	Professor, The Kitasato University	Total Synthesis of Natural Products of Highly Ordered Structure; Exploration and Creation of Anticancer-Active Sub
Keisuke SUZUKI	Professor, Tokyo Institute of Technology	Development of Efficient Synthetic Routes to Hybrid Natural Products of Biological Importance
Junzo TANAKA	Center Chief, National Institute for Materials Science	Self-Organization of Inorganic Nanocrystals and Polymers, and Creation of Materials Derived from Living Tissues
Shunichi FUKUZUMI	Professor, Osaka University	Development of Efficient and Selective Catalytic Systems Composed of Organic and Inorganic Complexes in Photoinduced Electron
Ken-ichi YOSHIKAWA	Professor, Kyoto University	Self-Evolutional Nano-Structure in Polymer Systems: Exotic Functions with Unique High-Ordered Structure

FY2000

Tsutomu KATSUKI	Professor, Kyushu University	Construction of Multifunctional Catalysts for New-Generation Synthesis
Toshimi SHIMIZU	Center Chief, National Institute of Advanced Industrial Science and Technology	Functional High-Axial-Ratio Nanostructure Assembly for Nano-Space Engineering
Koji TANAKA	Professor, National Institutes of Natural Sciences	Construction of Molecular Device for Chemical Energy Conversion
Yoshito TOBE	Professor, Osaka University	Creation of Giant Pi-Electronic Systems Composed by Carbon Atoms of Mixed Hybridization
Hachiro NAKANISHI	Professor, Tohoku University	Preparation and Characterization of Organic Nanocrystals and their Hetero-Nanostructures

Structure and Function of Genomes

Research Supervisor: **Michio OISHI**

FY1998

Researcher	Position	Research Proposal
Fumitoshi ISHINO	Professor, Tokyo Medical and Dental University	Mammalian-specific Genomic Function
Takehiko SHIBATA	Director, RIKEN	The Regulation of Genomic Plasticity through Genetic Recombination
Shigekazu NAGATA	Professor, Osaka University	Apoptosis and Genome
Kenichi MATSUBARA	Academic Counselor, International Institute for Advanced Studies	Functional Genomics in Organogenesis
Hirotada MORI	Professor, Nara Institute of Science and Technology	Systematic Functional Analysis of Escherichia Coli Genome

FY1999

Yoichi TAYA	Division Chief, National Cancer Center Research Institute	Mechanism of Genome Protection Through p53
Fumio HANAOKA	Director, RIKEN	Molecular Mechanism of Maintenance of Genomic Information
Yoshinobu BABA	Professor, Nagoya University	Nanochip Technology and its Application to Genome Analysis
Yasushi HIRAOKA	Group Leader, National Institute of Information and Communications Technology	Analysis of Nuclear Structures Ensuring the Genome Stability
Minoru YOSHIDA	Director, RIKEN	Chemical and Genetic Studies on Localization and Modification of Nuclear Factors

FY2000

Shunichi TAKEDA	Professor, Kyoto University	Development of a New Method to Improve the Efficiency of Gene Targeting in Higher Eukaryotic Cells
Yo-ichi NABESHIMA	Professor, Kyoto University	Systematic Study of Genome Function by Analysing Klotho Mutant Mice, an Animal Model for Human Aging
Norio NIIKAWA	Professor, Nagasaki University	Isolation and Analysis of Disease-Related Genes Through Chromosomal Translocation and Minute Deletion
Takeshi YAGI	Professor, Osaka University	Genomic Structure and Function of Clustered Cadherin Family

*The reported research affiliations are those at the time of the projects completed.

Endocrine Disrupters

Research Supervisor: **Tsuguyoshi SUZUKI**

FY1998

Researcher	Position	Research Proposal
Yoshio UMEZAWA	Professor, The University of Tokyo	Methods of Analysis for Chemicals that Promote/Disrupt Cellular Signaling
Fujio KAYAMA	Professor, Jichi Medical School	Interaction between Plant-derived and Man-made Xenoestrogens
Osamu TSUTSUMI	Professor, The University of Tokyo	Effects of Endocrine Disrupters on Reproductive Functions in Mammals including Humans
Chiharu TOHYAMA	Director, National Institute for Environmental Studies	Elucidation of Endocrine Disrupting Mechanism of Dioxin and Related Compounds for Health Risk Assessment
Hajime NAWATA	Professor, Kyushu University	Nuclear Receptor- Transcription Cofactors Complex and Endocrine Disrupters
Yoshiaki FUJII-KURIYAMA	Guest Professor, University of Tsukuba	Mechanisms of Action of Endocrine Disrupters and Development of Monitoring System for Endocrine Disrupters
Ken-ichirou MOROHASHI	Professor, Okazaki National Research Institutes	Elucidation of Mechanisms of Sexual Differentiation

FY1999

Hiroyoshi ARIGA	Professor, Hokkaido University.	Oncogene Products DJ-1 and AMY-1 Participate in Abnormalities of Spermatogenesis Caused by Endocrine Disrupting Chemicals
Taisen IGUCHI	Professor, National Institutes of Natural Sciences	Developmental Effects of Endocrine Disrupting Chemicals on Animals: Special Reference to Developmental Endocrinology
Teruaki IWAMOTO	Proffessor, St. Marianna University School of Medicine	Effects of Endocrine Disruptors on Male Reproductive Function
Masahiko KURODA	Assistant professor, Tokyo Medical University	Effects of Endocrine Disrupters on Meiosis and Homologous Recombination
Yo-Ichiro KURODA	Guest Researcher, Tokyo Metropolitan Institute for Neuroscience	Effects of Endocrine Disruptors on Functional Developments of the Brain and their Molecular Mechanisms

FY2000

Itsuo KATAKUSE	Professor Emeritus, Osaka University	Development of High Sensitive Mass Spectrometer and Analysis of Endocrine Disrupters
Suguru KAWATO	Professor, The University of Tokyo	Environmental Hormones Disrupting Actions of Neurosteroids in the Brain
Ken TAKEDA	Professor, Tokyo University of Science	Novel Types of Endocrine Disrupters in Atmosphere
Yoshitaka NAGAHAMA	Professor, National Institutes of Natural Sciences	Molecular Mechanisms of Endocrine Disrupter Action in Fish Reproductive Endocrine Systems
Kaoru MIYAMOTO	Professor, University of Fukui	Establishment of Databases for Genes Affected by Low Doses of Endocrine Disrupters in Reproductive System

Research and Development of System Technologies for Resource Recycling and Minimum Energy Requirement

Research Supervisor: **Masaru HIRATA**

FY1998

Researcher	Position	Research Proposal
Zempachi OGUMI	Professor, Kyoto University	Elucidation of Interfacial Ion Transfer for High-power Energy Conversion Devices
Toshihiro ONA	Associate Professor, Kyushu University	Development of Forest Resources with High Performance for Paper Recycling
Masami FUKUDA	Professor, Hokkaido University	Permafrost Disturbance and Induced Emission of Green-house Gases — Tasks for predictive and controlling technique establishment —
Jun MAGOSHI	Researcher, National Institute of Agrobiological Sciences	Energy Efficient Polymer Processing Development
Kouichi YAMADA	Professor, Shinshu University	A Sustainable CO_2 Fixation System by Afforestation on Arid Land

FY1999

Yutaka IKUSHIMA	Deputy Director, National Institute of Advanced Industrial Science & Technology	Development of Resourse Recycling and Low Emission Type Material Production using Environmentally Friendly Function Fluid
Kenjiro SUZUKI	Professor, Shibaura Institute of Technology	Micro Gas Turbine/Solid Oxide Fuel Cell Hybrid Cycle for Distributed Energy System
Masamitsu FUNAOKA	Professor, Mie University	Functionality Control and Circulation of Phytomaterials
Itaru YASUI	Vice-Rector, United Nations University	Development of Information Technology for Public Acceptance on Environment
Masahiro WATANABE	Professor, Yamanashi University	Development of High-Temperature-Operating Direct Methanol Fuel Cells

FY2000

Haruo INOUE	Dean, Faculty of Urban Environmental Sciences, Tokyo Metropolitan University	Development of Artificial Photosynthetic System Using Water as Electron Source
Ken-ichiro OTA	Professor, Yokohama National University	Design of Quasi-3-dimensional Interface for Electrochemical Energy Conversion
Hikaru KOBAYASHI	Professor, Osaka University	Thin Layer Silicon Solar Cells Using New Chemical Bonds
Hitoshi TAKAMURA	Associate Professor, Tohoku University	Development of High Performance Natural Gas Reforming System for Home Use Fuel Cells
Atsushi TSUTSUMI	Associate Professor, The University of Tokyo	Energy and Material Co-production Systems for Minimizing the Exeregy Loss and CO_2 Emission
Hiroshi TSUNO	Professor, Kyoto University	Development of Resources Recycling Type Urban Wastewater and Solid Waste Processing System

Understanding the Brain

Research Supervisor: **Motoi KUNO**

FY1998

Researcher	Position	Research Proposal
Shiro KONISHI	Chief and Professor, Mitsubishi Kagaku Institute of Life Sciences	Quest for Molecular Mechanisms Underlying Synaptic Plasticity in Inhibitory Synapses and Its Therapeutic Applications
Takao SHIMIZU	Professor, The University of Tokyo	Dual Receptor System of Lipid Mediators in the Brain Function
Masanori TAIRA	Associate Professor, The University of Tokyo	Systematic Identification and Functional Assay of Regulatory Genes for Early Brain Development
Tadaharu TSUMOTO	Professor, Osaka University	Mechanisms Underlying Involvement of Neural Activities in Network Formation

FY1999

Ryuichi SHIGEMOTO	Professor, National Institutes of Natural Sciences	Assembly and Disassembly of Functional Membrane Molecules and Regulatory Mechanism for Neurotransmission
Jun TANJI	Professor, Tohoku University	Revealing Functional Organization of Prefrontal Cortex as a Control System for Behavioral Control
Hiromu YAWO	Professor, Tohoku University	Presynaptic Mechanisms of Learning and Memory

Protecting the Brain

Research Supervisor: **Hideo SUGITA**

FY1997

Researcher	Position	Research Proposal
Takaaki KIRINO	Professor, The University of Tokyo	Molecular Basis for Delayed Neuronal Death
Tetsuya SUHARA	Senior Researcher, National Institute of Radiological Sciences (NIRS)	Aberrant Neural Transmission in Schizophrenia
Tsutomu TANABE	Professor, Tokyo Medical and Dental University	Ca Channel Gene Mutations and Neurological Disorder
Yoshihide TSUJIMOTO	Professor, Osaka University	Study of Molecular Pathogenesis of Spinal Muscular Atrophy
Keiichi NAKAYAMA	Professor, Kyushu University	Investigation into the Mechanism of Neuronal Growth Regulation
Nozomu MORI	Director, National Institute for Longevity Sciences (NILS)	Molecular Basis of the Loss of Neuronal Plasticity in the Aged Brain

FY1998

Tetsuya TERASAKI	Professor, Tohoku University	Brain Barrier Efflux Transport as a System for Cerebral Detoxification
Masaya TOHYAMA	Professor, Osaka University	Development of a Novel Therapeutic Strategy to Prevent Ischemia Mediated Neuronal Cell Death
Kazuo NAGASHIMA	Professor, Hokkaido University	Analysis of the Mechanism of Virus-induced Brain Damage and the Development of Effective Therapy for Viral Disorders in the Central Nervous System
Yusaku NAKABEPPU	Professor, Kyushu University	Mechanisms Protecting Brain and Neuronal Cells from Damage Caused by Reactive Oxygen Species

FY1999

Kiichi ARAHATA (Ichizo NISHINO)	Director, National Center of Neurology and Psychiatry	cDNA Microarray for Genetic Muscular Disorders; a Novel Molecular Pathological Approach
Akira KAKIZUKA	Professor, Kyoto University	Development of Novel Strategies for the Treatment of Neurodegenerations, based on Molecular Mechanical Analyses
Kiyotoshi KANEKO	Director, National Center of Neurology and Psychiatry	Identification of New Player(s) in Prion Replication; toward the Development of Novel Therapeutic Approaches

*The reported research affiliations are those at the time of the projects completed.

Creating the Brain

Research Supervisor: **Shun-ichi AMARI**

FY1997

Researcher	Position	Research Proposal
Kazuyuki AIHARA	Professor, The University of Tokyo	Modeling Spatio-temporal Computation Dynamics in the Brain and its Hardware Implementation
Tsunehiro TAKEDA	Professor, The University of Tokyo	Analysis of Human Higher Brain Functions
Mitsumasa KOYANAGI	Professor, Tohoku University	A New Image Processing System for Brain-like Information Processing
Kuniyoshi L. SAKAI	Associate Professor, The University of Tokyo	The Construction of a Language Acquisition Device Based on Language Function in the Brain
Hideki KAWAHARA	Professor, Wakayama University	Development of a Speech and Sound Manipulation System based on Principles of Auditory Scene Analysis

FY1998

Soichi NAGAO	Associate Professor, Jichi Medical School	Elucidation of the Cerebellar Mechanism in Motor Learning Control
Yoshihiko NAKAMURA	Professor, The University of Tokyo	Development of Brain-Informatics Machines through Dynamical Connection of Autonomous Motion Primitives
Tomoki FUKAI	Professor, Tamagawa University	Modeling the Neural Substrates for Temporal Information Processing
Masaaki HONDA	Professor, Waseda University	Task Planning Mechanism of Speech Motor Control

FY1999

Masatoshi ISHIKAWA	Professor, The University of Tokyo	Artificial Hand-brain System Based on Sensory-Motor Fusion Theory
Kenji DOYA	Supervisor, Advanced Telecommunications Research Institute International	Metalearning, Neuromodulation and Emotion
Yoko YAMAGUCHI	Team Leader, RIKEN	Design Theory of Emergent Intelligence based on the Information Dynamics in the Hippocampus

Mechanism of Global Change

Research Supervisor: **Tomio ASAI**

FY1997

Researcher	Position	Research Proposal
Shiro IMAWAKI	Professor, Kyushu University	Kuroshio Fluctuation Prediction Experiment
Yukihiro NOJIRI	Head, National Institute for Environmental Studies	Ocean Time Series Observation for Biogeochemical Process Study in the Northwestern Pacific
Yasuo FUKUI	Professor, Nagoya University	Development of Vertical Profile Measurement System Equipped with a Superconductive Receiver for Ozone and Other Minor Constituents
Yoshiaki HONDA	Associate Professor, Chiba University	Project for Establishment of Plant Production Estimation Using Remote Sensing
Masaaki WAKATSUCHI	Professor, Hokkaido University	Clarification of the Actual Condition of Sea Ice in the Sea of Okhotsk and its Role in the Climate System

FY1998

Tohru ASANO (Tohru NAKASHIZUKA)	Professor, Research Institute for Humanity and Nature	Research and Observation on the Mechanisms of Atmosphere-Ecosphere Interaction in Tropical Forest Canopy
Mitsuo UEMATSU	Associate Professor, The University of Tokyo	Variability in Marine Aerosol Properties and Its Impact on Climate Change
Toshio KOIKE	Professor, The University of Tokyo	Development of Modeling and Satellite Remote Sensing of Atmosphere-Land Interaction
Masanori YOSHIZAKI	Head of Department, Meteorological Research Institute	Studies on Structure and Formation/Development Mechanisms of Mesoscale Convective Systems

FY1999

Yoshizumi KAJII	Professor, Tokyo Metropolitan University	Investigation of Atmospheric Reaction Mechanism Using Chemical Perturbation Technique
Toshiro SAINO	Professor, Nagoya University	Development of a Real-time Ocean Primary Productivity Observation System for Advanced Utilization of Ocean Color Satellites
Teruyuki NAKAJIMA	Professor, The University of Tokyo	Asian Atmospheric Particle Environment Change Studies
Hirokazu YOSHIMURA	Associate Professor, The University of Tokyo	Influence of the Solar Irradiance and Magnetic Field on the Variability of the Earth

Genetic Programming

Research Supervisor: **Masami MURAMATSU**

FY1995

Researcher	Position	Research Proposal
Ken-ichi ARAI	Professor, The University of Tokyo	Molecular Mechanisms of Activation of Replication Machinery and Gene Expression During Growth Factor-Induced Cell Proliferation
Takeo KISHIMOTO	Professor, Tokyo Institute of Technology	Cell Proliferation Control
Yuji KOHARA	Professor, National Institute of Genetics	Genetic Program for Development of the Nematode C.Elegans
Yo-ichi NABESHIMA	Professor, Kyoto University	Molecular Mechanism of Aging
Hiroshi HAMADA	Professor, Osaka University	Molecular Mechanism for Left-Right Determination
Yoshihide HAYASHIZAKI	Project Director, RIKEN	The Development of a High-Speed Genome Scanning Method and its Application to Explore Groups of Genes Controlling Genetic Back-ground in Various Organisms
Yukio FUJIKI	Professor, Kyushu University	Dynamics of Organelle Assembly and Regulation of Cell Function
Kunihiro MATSUMOTO	Professor, Nagoya University	Novel Signal Transduction Pathways Regulating Cell Development

FY1996

Makoto ASASHIMA	Professor, The University of Tokyo	Molecular Mechanisms of Organogenesis in vitro
Akira ISHIHAMA	Vice-Director, Professor, National Institute of Genetics	Global Regulation for the Formation of Gene Transcription Hierarchy
Mitsuo OSHIMURA	Professor, Tottori University	Molecular Mechanisms of Genomic Imprinting
Masatsune KAINOSHO	Professor, Tokyo Metropolitan University	Advanced Stable Isotope Aided NMR Techniques and Their Applications to Structural Biology
Kazuhiko KINOSHITA	Professor, Okazaki National Research Institutes	Programming Basis of Unidirectional Reactions
Masashi SUZUKI	Group Leader, National Institute of Advanced Industrial Science and Technology	Structural Biological Study of Transcription Network of Hyper-Thermophilic Archaeabacteria
Tetsuo NODA	Professor, Tohoku University, Member and Chief, Cancer Institute	Attempts to Identify Novel Genes Regulating a Process of Human Colorectal Carcinogenesis Using Mouse Molecular Genetics
Mitsuhiro YANAGIDA	Professor, Kyoto University	Analysis of Higher Order Complexes Essential for Chromosome Regulation during the Cell Cycle

FY1997

Koreaki ITO	Professor, Kyoto University	Cellular Mechanisms That Support Transmembrane Dynamism of Proteins
Fuyuhiko INAGAKI	Professor, Hokkaido University	Regulation of Signal Transduction Network by Domain Engineering
Tuneko OKAZAKI	Professor, Fujita Health University	Construction of Mammalian Artificial Chromosomes (MACs) and Application of the MACs to Make Transgenic Animals
Shigeaki KATO	Professor, The University of Tokyo	Nuclear Steroid Hormone Receptor Controlling Gene Expression
Taka-aki TAMURA	Professor, Chiba University	Regulation of Gene Expression by Nuclear Factors
Masamitsu FUTAI	Professor, Osaka University	Function and Biogenesis of Acidic Organelles
Shinya YOSHIKAWA	Professor, Himeji Institute of Technology	Structural Biological Analysis of the Mechanism of Proton Pumpings in Mitochondria

Host Defense Mechanism

Research Supervisor: **Yoshiyuki HASHIMOTO**

FY1995

Researcher	Position	Research Proposal
Shizuo AKIRA	Professor, Osaka University	Studies on Host Defense Mechanisms by Gene Targeting
Masamitsu IINO	Professor, The University of Tokyo	Calcium Signalling Research with Advancement of Imaging and Molecular Genetic Methods
Hajime IWAMURA	Professor, Kyoto University	Chemical Approaches to the Elucidation of Plant Defense Mechanisms
Ko OKUMURA	Professor, Juntendo University	Construction of the Molecular Network among Immune, Neuro and Endocrine Systems
Mari KANNAGI	Professor, Tokyo Medical and Dental University	Mechanisms of Immune Destruction in Persistent Human Virus-associated Diseases and Its Prevention
Toshiyuki TAKAI	Professor, Tohoku University	Analysis of Immunoregulatory Mechanism via Fc Receptors
Kazuhiro NAGATA	Professor, Kyoto University	Stress Response as an Universal Defense Mechanism
Shunji NATORI	Invited Researcher, RIKEN	Insect Defense Molecules and Future Drugs Based on Them

FY1996

Kazuo SUGAMURA	Professor, Tohoku University	Molecular Mechanism of Cytokine Dysfunction and Gene Therapy
Keiji TANAKA	Department Director, The Tokyo Metropolitan Institute of Medical Science	Molecular Mechanisms of Immunological Recognition by a Supramolecular System
Masaru TANIGUCHI	Professor, Chiba University	Molecular Mechanism on Autoimmune Regulation
Shoji FUKUSHIMA	Professor, Osaka City University	Cancer Risk from Chemicals in Our Environment: Experimental Approaches to Carcinogenic Assessment
Susumu MAEDA	Chief Scientist, RIKEN	Analysis of molecular mechanism of the host response to insect viruses and its application
Kouji MATSUSHIMA	Professor, The University of Tokyo	Molecular Analysis of the Mechanism of Inflammation Focusing on Interleukin 8 and Cell Adhesion Molecules

FY1997

Shunsuke ISHII	Chief Scientist, RIKEN	Research on Transcriptional Regulation via Mediators
Yuko OHASHI	Associate director for research, National Institute of Agrobiological Sciences	Gene Silencing in Plant Self-defense Mechanisms
Yasunobu OKADA	Professor, Okazaki National Research Institutes	Molecular Mechanisms of Cell Volume Regulation and the Protection against Volume Regulatory Dysfunction
Toshisuke KAWASAKI	Professor, Kyoto University	Studies on the Carbohydrate Mediated Host Defense System
Takehiko SASAZUKI	Director, International Medical Center of Japan	Molecular Basis for the Framework Formation of Immune System and for the Regulation of Immune Response
Yuichi SUGIYAMA	Professor, The University of Tokyo	Molecular Basis for the Xenobiotic Detoxification System
Hiromitsu NAKAUCHI	Professor, The University of Tokyo	Molecular Mechanisms for Differentiation and Self-renewal of the Hemato Poietic Stem Cell

*The reported research affiliations are those at the time of the projects completed.

Quantum Effects and Related Physical Phenomena

Research Supervisor: **Shinji KAWAJI**

FY1995

Researcher	Position	Research Proposal
Masakazu AONO	Professor, Osaka University, Chief Scientist, RIKEN	Exploring Novel Functions of Artificial Nanostructures
Sukekatsu USHIODA	Professor, Tohoku University	Exploration of the Electronic and Optical Properties of Surface Nano-Structures by STM Light Emission Spectroscopy and Near-Field Optical Spectroscopy
Hiroyuki SASABE	Professor, Chitose Institute of Science and Technology	Hyper-Structured Molecules for Organic Quantum Device Applications
Akira SHIMIZU	Associate Professor, The University of Tokyo	Manipulation of Quantum Fields
Tetsuo TSUTSUI	Professor, Kyushu University	Construction of Novel Emissive Systems Using Self-Organization of Molecules
Osamu TERASAKI	Associate Professor, Tohoku University	New Arrayed Clusters in Microporous Materials: Syntheses, Structures and Physical Properties
Masataka HIROSE	Professor, Hiroshima University	Silicon Quantum Nanodevices for Information Processing
Koichi MUKASA	Professor, Hokkaido University	Spin Investigation-Development of Spin SPM and Control of Spin States

FY1996

Yasuhiro IYE	Professor, The University of Tokyo	Spin Quantum Phenomena in Nanostructures
Youiti OOTUKA	Professor, University of Tsukuba	Small Metallic Tunnel Junctions -Physics and Applications
Yasuo OKA	Professor, Tohoku University	Studies of Giant Magneto-Optical Properties in Nanostructured Magnetic Semiconductors
Susumu KOMIYAMA	Professor, The University of Tokyo	Exploration of Far-infrared-radiation Techniques Based on Quantum Structures and Investigation of Quantum Phenomena
Shoji YAMANAKA	Professor, Hiroshima University	Design and Synthesis of New Nano-Porous Materials with Physical Properties Modifiable by Chemical and Physical Dopings to the Interstices
Masaaki YOKOYAMA	Professor, Osaka University	Molecular-scale Structure Control of the Organic Thin Film/Metal Interface and Photocurrent Multiplication-type Photo-sensing Device

FY1997

Ienari IGUCHI	Professor, Tokyo Institute of Technology	Quantum Effects of Anisotropic Superconductors and Evolution of Novel Electromagnetic Wave Functions
Mutsuo OGURA	Labo-Leader, Electrotechnical Laboratory	Coherent Quantum Effects in Quantum Nano-Structure with Atomic Layer Precision
Kohei SANUI	Professor, Sophia University	Self-Organized Quantum Confinement Structures
Kohzo HAKUTA	Professor, University of Electro-Communications	Nonlinear Optics in Quantum Solid
Mikio YAMASHITA	Professor, Hokkaido University	Optical-wave Technology in the Cycle-time Region and Its Application to Single Atomic and Single Molecular Dynamic Phenomena

Single Molecule and Atom Level Reactions

Research Supervisor: **Akio YAMAMOTO**

FY1995

Researcher	Position	Research Proposal
Yasuhiro AOYAMA	Professor, Kyushu University	Construction of Novel Organic Zeolite Catalysts
Yasuhiro IWASAWA	Professor, The University of Tokyo	Chemical Design of Advanced Structures and Reaction Control at Surfaces
Yuji OHASHI	Professor, Tokyo Institute of Technology	X-Ray Analysis of Molecular Structure in Excited State
Eishun TSUCHIDA	Professor, Waseda University	Oxygenics
Tohru FUKUYAMA	Professor, The University of Tokyo	Stereoselective Synthesis of Complex Organic Molecules Based on catalyst with Ultrafine Structures
Kaoru YAMANOUCHI	Professor, The University of Tokyo	Control of Photochemical Reactions in a Femto-second Time Scale
Hisashi YAMAMOTO	Professor, Nagoya University	Highly Selective Molecular Synthesis of Next Generation

FY1996

Toshihiro ANDO	Senior Research Scientist, National Institute for Materials Science	Synthesis and Chemical Modification of Diamond Surfaces; Diamond Surface Reactions and their Mechanisms
Hideomi KOINUMA	Professor, Tokyo Institute of Technology	Combinatorial Molecular Layer Epitaxy of Low Dimensional Superstructures
Shu KOBAYASHI	Professor, The University of Tokyo	Development of New Reactions toward Efficient Synthesis of Structually Distinct Molecules
Isao SAITO	Professor, Kyoto University	Design of Bio-functional Molecules and Reaction Control based on Molecular Recognition
Masato TANAKA	Director, National Institute of Advanced Industrial Science and Technology	Creation of New Substances and Reactions via Activation of Inter-heteroatom Bonds
Yoshiaki NAKAHARA	Professor, Tokai University	Synthetic Approaches to the 20kDa molecules of Glycoprotein

FY1997

Masahiro IRIE	Professor, Kyushu University	Development of Photochromic Systems with Perfect Performance
Okitsugu KAJIMOTO	Professor, Kyoto University	Chemical Reactions in Supercritical Fluids under the Controlled Microscopic Molecular Environment
Hiroharu SUZUKI	Professor, Tokyo Institute of Technology	Design and Construction of Multimetallic Reaction Sites and Development of Metal Cluster-catalyzed Reactions
Masahiro HIRAMA	Professor, Tohoku University	Supramolecular Natural and Non-natural Products – Reaction Control and Molecular Design
Makoto FUJITA	Professor, The University of Tokyo	Self-organizing Molecular Systems Utilizing Transition Metals
Kazuko MATSUMOTO	Professor, Waseda University	Development of Metal-Complex Probes for Biomolecule Analysis

Phenomena of Extreme Conditions

Research Supervisor: **Masashi TACHIKI**

FY1995

Researcher	Position	Research Proposal
Katsutoshi AOKI	Chief Senior Researcher, National Institute of Materials and Chemical Research	Pressure-Tuned Quantum-Mechanical Phenomena in Hydrogen-Bonded Systems
Kenji ABIKO	Associate Professor, Tohoku University	Science of Ultra-High Purity Base Metals
Kazuo KADOWAKI	Professor, University of Tsukuba	Elucidation of Critical States of Superconductors under Extreme Physical Environment
Koichi KITAZAWA	Professor, The University of Tokyo	Microscopic Resolution of Phase and Amplitude of Electronic Wave in Solids
Ken-ichi KONDO	Professor, Tokyo Institute of Technology	Shock-Wave Dynamics and Stimulated New Chemical Processes
Mikio TAKANO	Professor, Kyoto University	Synthesis of Antiferromagnetic Quantum Spin Ladder Compounds and Their Novel Properties
Hiroshi TSUNEMI	Professor, Osaka University	Development of Fine Pixel Size CCD for X-ray Measurement
Satoshi MORI	Professor, The University of Tokyo	Strategies of the Plants Tolerant to the Critical Stress Soils

FY1996

Takehiko ISHIGURO	Professor, Kyoto University	Exactly Aligned High Magnetic Field Study of Low-Dimensional Metals and Superconductors
Shoichi ENDO	Professor, Osaka University	Generation of Complex Extreme Conditions of Pressure, Magnetic Field and Low Temperature to Search for New Phenomena
An-Pang TSAI	Team Leader, National Institute for Materials Science	Fabrication of Quasicrystals and Investigation of Physical Properties
Masatoshi SATO	Professor, Nagoya University	Search and Design for Low Dimensional Anomalous Metals
Kenji SUMIYAMA	Professor, Nagoya Institute of Technology	The Extreme Control of Structure and Magnetism in Alloy Cluster Assembled Materials
Tsutomu YAMASHITA	Professor, Tohoku University	High Frequency Devices with Cuprate Single Crystal Superconductors

FY1997

Minoru AKAISHI	Supervising Researcher, National Institute for Materials Science	Experimental Study for Elucidating Genesis of Natural Single and Polycrystalline diamonds Using High Pressure Process
Mitsuo ATAKA	Group Leader, National Institute of Advanced Industrial Science and Technology	Protein Crystal Grouwth under Virtual Gravity Generated by Use of Magnetic Force
Tadayuki IMANAKA	Professor, Kyoto University	Isolation and Application of Microorganisms from Extreme Subterranean Environment
Yasuo ENDOH	Professor, Tohoku University	Dynamical Structure Exploration of Orbital - Novel Degree of Freedom -
Kazumasa TOGANO	Director, National Institute for Materials Science	Achievement of Large Undercooling and Formation of New Functional Materials
Hiroyuki FUJITA	Professor, The University of Tokyo	Visualization and Control of Physical Phenomena in Extremely High and Localized Electric Fields
Mitsuhiro MOTOKAWA	Honorary Professor, Tohoku University	Creation of Novel Materials in High Magnetic Fields

Understanding the Brain (Mechanisms of Brain)

Research Supervisor: **Masanori OTSUKA**

FY1995

Researcher	Position	Research Proposal
Hideyuki OKANO	Professor, Osaka University	Elucidation of Regulatory Mechanisms of Cell Fate Decisions during Neural Development
Motoya KATSUKI	Professor, The University of Tokyo	Brain Research by Gene Manipulated Mice
Ichiro KANAZAWA	Professor, The University of Tokyo	Analysis of Genes Expressed in a Single Neurons of the Human Brain
Yoshikazu SHINODA	Professor, Tokyo Medical and Dental University	Neural Mechanisms of Distributed Hieralchical Systems for Sensori-motor Transformation
Yoshitaka FUKADA	Professor, The University of Tokyo	Photoreception in Brain for Circadian Rhythm
Ichiro FUJITA	Professor, Osaka University	Across-level Approach to Brain Mechanism of Visual Recognition
Yoshiki HOTTA	Director-general, National Institute of Genetics	Molecular Analyses of a Cell Fate Decision Gene, gcm (glial cells missing) of Drosophila, and Its Mammalian Homologues

FY1996

Yasuo IHARA	Professor, The University of Tokyo	Studies on Neuronal Death in Alzheimer's Disease
Kenji KAWANO	Director, National Institute of Advanced Industrial Science and Technology	Neuronal Mechanism for Motor Commands
Keiji TANAKA	Group Director, RIKEN	Imaging Study of Human Cortical Columns Involved in Higher Mental Functions
Masaharu NODA	Professor, National Institutes of Natural Sciences	Molecular Mechanisms of the Neural Network Formation
Hajime FUJISAWA	Professor, Nagoya University	Molecular Basis of Neuron Network Formation
Masayoshi MISHINA	Professor, The University of Tokyo	Genes for Development and Function of the Brain

FY1997

Masumi ICHIKAWA	Chief Researcher, Tokyo Metropolitan Institute for Neuroscience	Analysis of Synaptic Mechanism in Pheromonal Memory
Yoshihiro URADE	Head, Osaka Bioscience Institute	Molecular Mechanism of Meninges-neuronal Interaction
Seiji OZAWA	Professor, Gunma University	Molecular Mechanisms of Synaptic Plasticity and Brain Functions
Tatsuya HAGA	Professor, Gakushuin University	Tetiary Structure of G Protein-Coupled Receptors
Fumio MATSUZAKI	Group Director, RIKEN	Genetic Programs and Plastic Mechanisms of the Nervous System
Fujio MURAKAMI	Professor, Osaka University	Molecular Mechanisms of Axon Guidance and Neuronal Plasticity

*The reported research affiliations are those at the time of the projects completed.

Social Systems for Better Environment Performance

Research Supervisor: **Yoichi KAYA**

FY1995

Researcher	Position	Research Proposal
Hajime AKIMOTO	Program Director, Frontier Research System for Global Change	Formation and Deposition of Ozone and Acidic Species in East Asia and Their Environmental Impact
Takao KASHIWAGI	Professor, Tokyo University of Agriculture and Technology	Development of a Metabolistic System for Energy and Resources Saving City
Yukio KUBO	Former Professor, Keio University	Measurement and Controlling System of Urban Heat Island
Kazuhiko KOBAYASHI	Laboratory Chief, National Institute of Agro-Environmental Sciences	Experiment and Modeling of Rice Ecosystems Under High Atmospheric CO_2
Hiroshi SAKUGAWA	Professor, Hiroshima University	Forest Decline Study-Measurement, Behavior, and Control of Atmospheric Pollutants
Yoshiharu DOI	Chief Scientist, RIKEN	Research and Development of Environmentally Preferred Polymers
Junko NAKANISHI	Professor, Yokohama National University	Establishment of a Scientific Framework for the Management of Toxicity of Chemicals Based on Environmental Risk-Benefit Analysis
Takaaki MAEKAWA	Professor, University of Tsukuba	Basic Studies for Remediation of the Water Environment by Enrichment of Microbial Functions

FY1996

Hajime KAYANNE	Associate Professor, The University of Tokyo	Ecotechnology for the Design of Coral Reef Bioreactor to Fix CO_2
Takamitsu SAWA	Professor, Kyoto University	Towards an Optimal Framework for the Preservation of Global Environment
Tatsuya NOIKE	Professor, Tohoku University	Energilization and Resource Recovery of Municipal Solid Wastes Using New Generation Technologies on Global Environmental Protection
Tohru MORIOKA	Professor, Osaka University	Construction of Cycle Oriented Complex at Social Experimental Sites and Development of Environmental Technologies
Osami YAGI	Professor, The University of Tokyo	Fundamental Studies on Bioremediation Technologies of Contaminated Soil Environment
Naohiro YOSHIDA	Professor, Tokyo Institute of Technology	Isotopomer Analysis of Environmental Materials for their Source Determination
Yoshimasa WATANABE	Professor, Hokkaido University	New Water Metabolic System of Cities Based on Wise Use

FY1997

Kikuo IWATA	Professor, Gakushuin University	A Development of the Urban Traffic System for Improvement of Environment Quality
Motoyuki GODA	Director, Policy Research Institute	Modeling a Self-contained Community with Social, Ecological and Material Balance in the Rural Environment
Akira KOHYAMA	Professor, Kyoto University	R & D of Environment Conscious Multi-Functional Structural Materials for Advanced Energy Systems
Masayoshi SADAKATA	Professor, The University of Tokyo	The Development of Dry Desulfurization Process for Developing Countries by Appropriate Chain Reactions
Yasunori MATSUFUJI	Professor, Kyushu University	Study for Therapeutic Brick House System Setting Up
Kunio YOSHIKAWA	Professor, Tokyo Institute of Technology	High Efficiency Power Generation from Coal and Wastes Utilizing High Temperature Air Combustion Technology

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