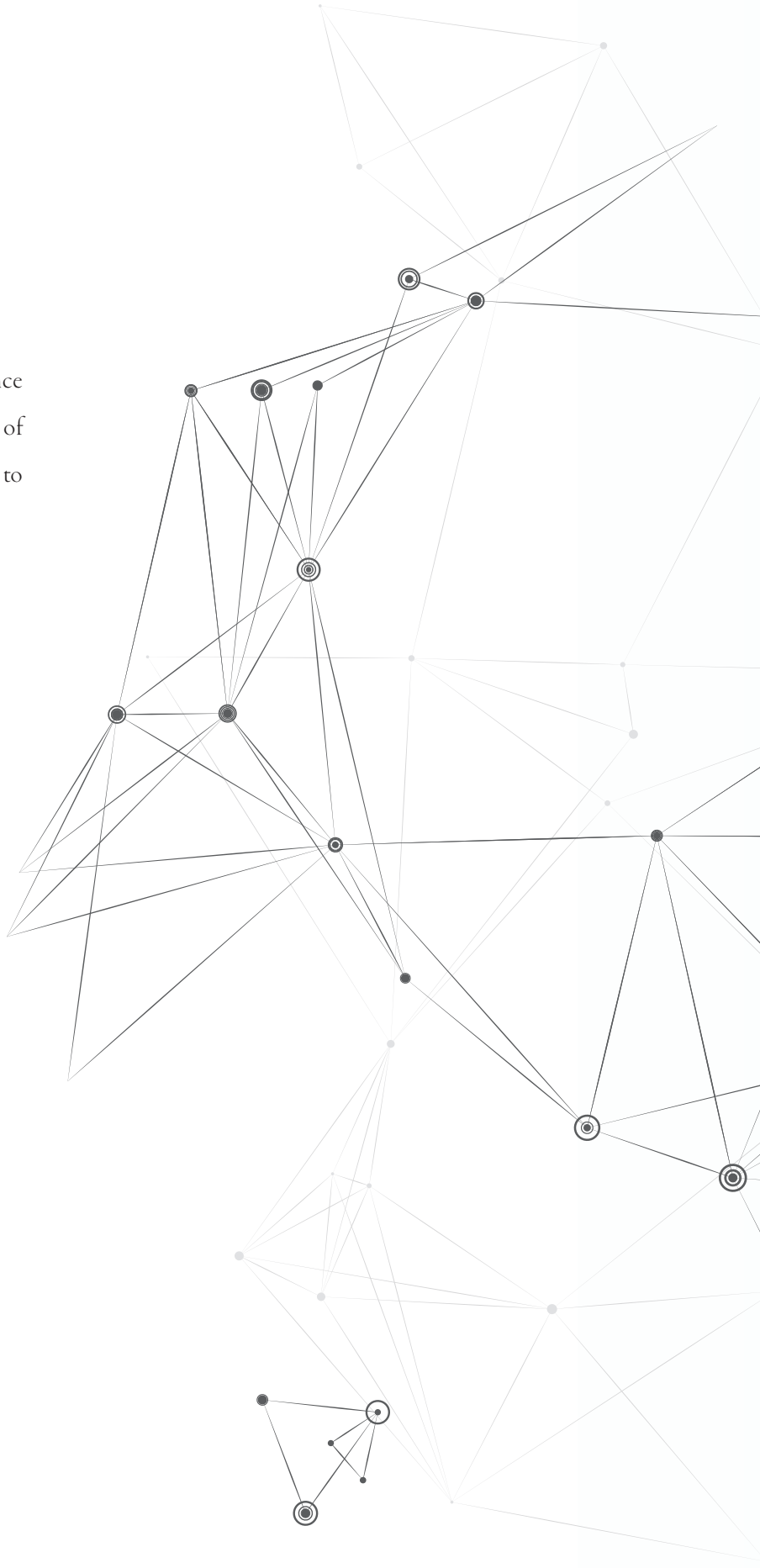
Institute for Materials Chemistry and Engineering

KYUSHU UNIVERSITY

We promotes research related to the basic science and application of the structure and functions of materials from an atomic, molecular and nanoscale to a macroscale.



Greetings from the Director

The institute for Materials Chemistry and Engineering, IMCE, was founded on April 1st, 2003, by merging and reorganizing Institute of Advanced Material Study and Institute for Fundamental Research of Organic Chemistry. Ever since the foundation, we have been doing chemical and chemistry-based research works keeping the original mission of producing high quality results and thereby leading materials chemistry. IMCE is also expected to play the following roles: (1) COE of advanced and inter-disciplinary research in fields of science and technology of materials/devices, (2) promotion of collaboration with and contribution to chemical and other industries, and (3) contribution to innovation in life and green science/technology.

IMCE consists of five divisions; four divisions (Fundamental Organic Chemistry, Applied Molecular Chemistry, Integrated Materials, Advanced Device Materials) that correspond to a hierarchical order of material, and a brand-new/international division of Soft Materials. IMCE has professors, associate professors and assistant professors (total number about 50), postdoc fellows and technical staff, who produced more than 2000 referred original research papers and reviews in FY2011–2020, which have been cited more than 34000 times in total.

IMCE has been contributing to inter-university activities for promoting chemical/materials science and technology. IMCE has been in alliance with four research institutes; Institute for Multidisciplinary Research for Advanced Materials (Tohoku University), Laboratory for Chemistry and Life Sciences, Institute of Innovative Research (Tokyo Institute of Technology), The Institute of Scientific and Industrial Research (Osaka University) and playing roles of a core of “Network Joint Research Center for Materials and Devices,” and “Dynamic Alliance for Open Innovation Bringing Human, Environment and Materials.” IMCE is also a member of Integrated Research Consortium on Chemical Science and Technology (the other contributors; Institute for Catalysis (Hokkaido University), Research Center for Materials Science (Nagoya University), International Research Center for Elements Science Institute for Chemical Research (Kyoto University)).

IMCE is really keen in enhancing and expanding research collaboration with research institutes and industries over the world as well as recruiting capable researchers. Any inquiries and questions are welcome. We believe our contributions to your institutes with effective/sustainable win-win relationship.

Kazunari Yoshizawa
Director

About Us

Organization

The institute consists of five divisions and the Center for Evaluation.

- Division of Fundamental Organic Chemistry
- Division of Applied Molecular Chemistry
- Division of Integrated Materials
- Division of Advanced Device Materials
- Division of Soft Materials
- Evaluation Center of Materials Properties and Function

Campus

Research activities are carried out in two areas, Chikushi Campus and Ito Campus.

Admission

The laboratories of the IMCE are affiliated with one of the academic departments. Students in the undergraduate and graduate master's/ doctoral programs conduct their research in one of the following departments or academic divisions, respectively.

Laboratories in Ito campus

Graduate School of Engineering / School of Engineering
Graduate School of Science / School of Science

Laboratories in Chikushi campus

Interdisciplinary Graduate School of Engineering Sciences
Graduate School of Integrated Frontier Sciences

Inter-university Research Project

Network Joint Research Center for Materials and Devices

The IMCE has been designated as a network-style research core for the government-sponsored Joint Usage/Research Center Program. This designation is shared with other centers located across Japan, including the RIES of Hokkaido University, the IMRAM of Tohoku University, the LCS of Tokyo Institute of Technology and the ISIR of Osaka University. The IMCE serves as a hub, where researchers in materials and devices can go beyond the framework of national, public or private universities.

Crossover Alliance to Create the Future with People, Intelligence and Materials

While promoting collaborative research in the area of materials, devices, and systems, we are building a new framework for new collaborative research and practical education in order to facilitate the developmental and dynamic exchange of different fields and human resources.

Integrated Research Consortium on Chemical Sciences

We promote comprehensive research projects based on the creation of new materials. Under its strategic governance, the center develops research results into new science and industry through industry-government-academia and international collaboration. We also aim to foster the next generation of leading researchers through activities that transcend the boundaries of universities. Cooperation partner: Institute for Catalysis, Hokkaido University; RCMS, Nagoya University; IRCELS, Kyoto University.

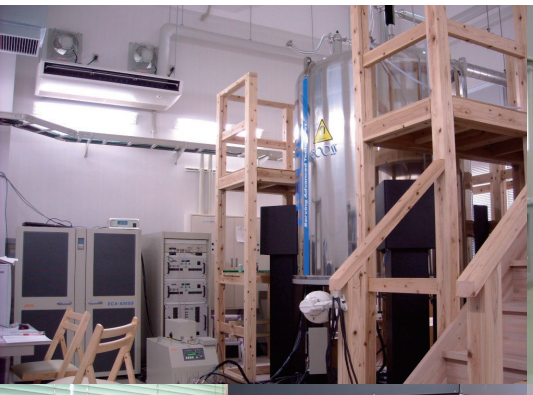
Shared Equipment

We are accepting requests for analysis of shared equipment. Many researchers from within and outside the university, as well as from private companies, use the Center. For more information, please contact the Evaluation Center of Materials Properties and Function.

https://shien.cm.kyushu-u.ac.jp

Main shared equipment

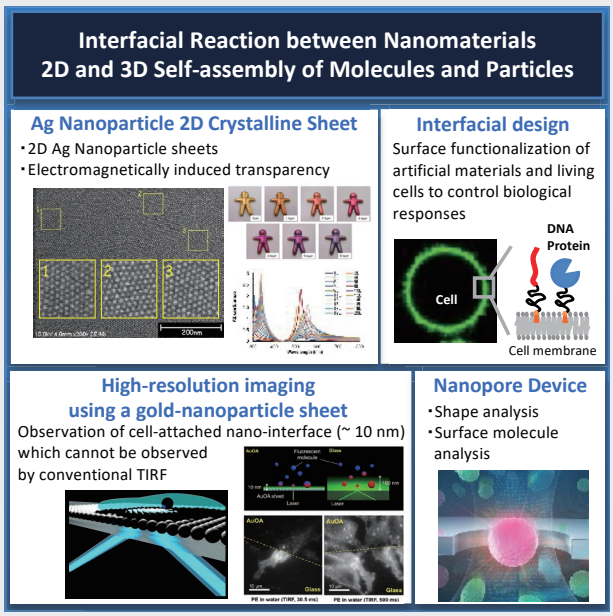
NMR	TEM
Solid states NMR	SEM
SCXRD	MS
XRD	ESR
SAXS	EB Lithography





Laboratories

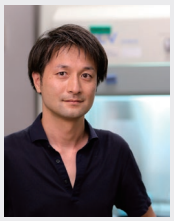
As of October 1st, 2022



Division of Fundamental Organic Chemistry

Nanomaterials and Interfaces

Professoer
Kaoru Tamada



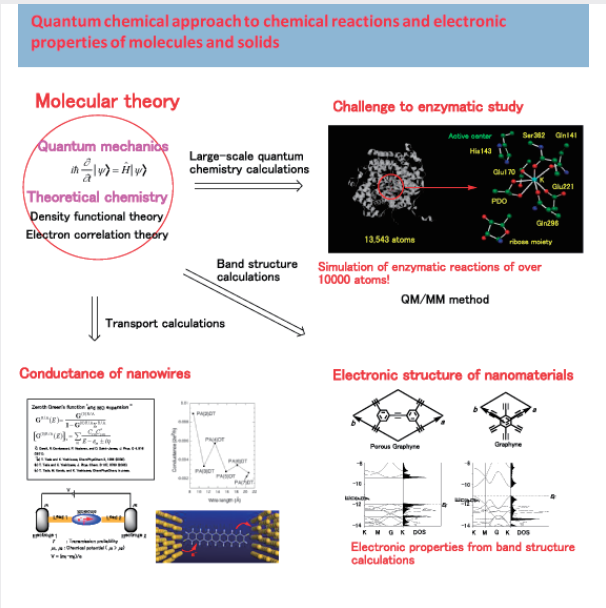
Associate Professor
Yusuke Arima

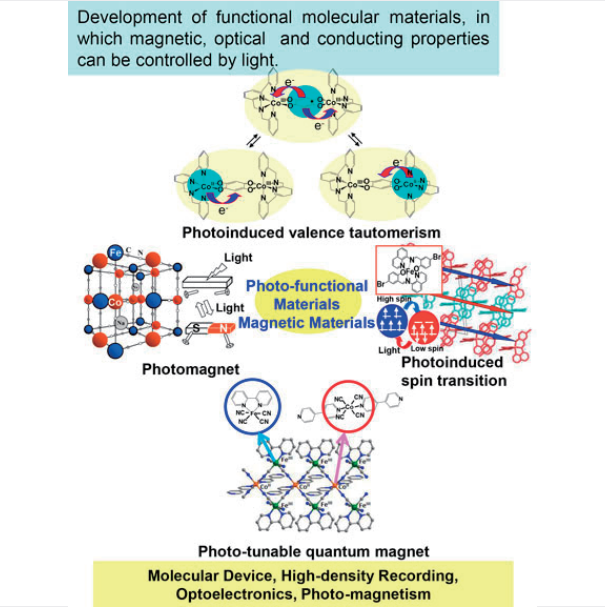
Assistant Professor
(Special Project)
Lee Shi Ting

Assistant Professor
(Special Project)
Yuto Kajino

Our group is studying about the interfacial phenomena between metals, metal oxides, semiconductors and soft materials in nanoscale. Our research target is not only to investigate new physicochemical phenomena on cutting edge of interdisciplinary field of science, but also to develop the new concept for future green and bio-technologies. Our topics include (1) Collective plasmon excitation on 2D crystalline sheets composed of Au and Ag nanoparticles, (2) High sensitive biosensor and high resolution bioimaging by use of localized surface plasmons, (3) Surface plasmon enhanced optoelectric devices such as LED and photovoltaic cells.

Ito Campus
School of Science, Graduate School of Science





Division of Fundamental Organic Chemistry

Theoretical Chemistry

Professoer
Kazunari Yoshiszawa

Associate Professor
Yoshihito Shiota

Assistant Professor
Yosuke Sumiya

Our research group uses quantum mechanics to look at the electronic properties and reactivity of molecules and molecular assemblies. We are interested in a detailed understanding of structure-function relationships in a wide range of subjects in chemistry, material science, and biochemistry. The creation of new concepts and findings based on quantum chemistry is our main interest.

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Division of Fundamental Organic Chemistry

Molecular Materials Chemistry

Professoer
Osamu Sato

Assistant Professor
Shinji Kanegawa

Assistant Professor
Wu Shu-Qi

Assistant Professor
(Special Project)
Su Shengqun

A reversible tuning and a persistent modification of physical properties by external stimuli are one of the main challenges in materials science.Especially, photo-control over the physical properties is important from the viewpoint of the practical application as well as the basic science. The photo-tunable compounds can be used future memory devices, optical switches and so on. Along this line, we are currently studying photo-tunable molecular magnets, valence tautomeric compounds, spin-crossover complexes and photonic crystals.

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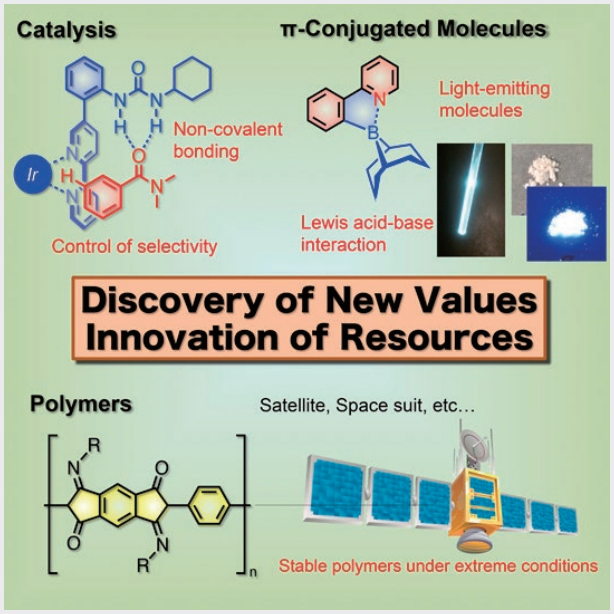

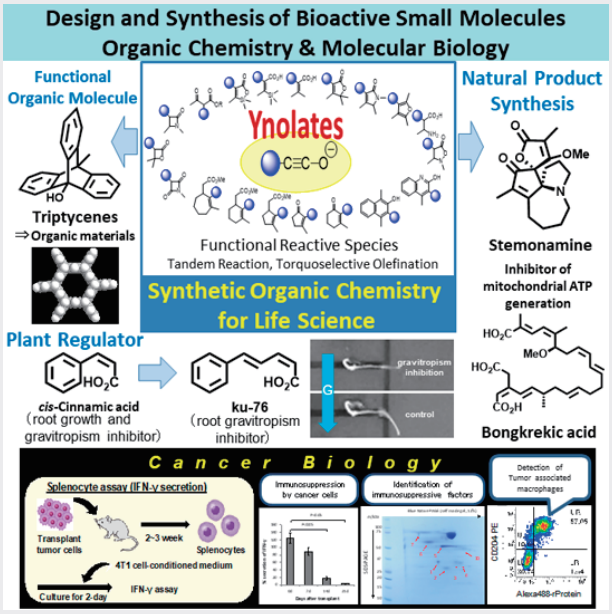

Division of Fundamental Organic Chemistry

Chemistry of Functional Molecules

Professoer
Yoichiro Kuninobu

Assistant Professor **Takeru Torigoe**

Assistant Professor **Kohei Sekine**

We create novel transition metal catalysts which can realize high activity and selectivity, and develop highly efficient and practical synthetic organic reactions, such as C-H transformations. We also create high-performance organic functional materials, such as ϖ-conjugated molecules and polymers. We aim to solve energy and environmental problems through these projects. 1. Creation of high-performance catalysts 2. Development of novel and practical synthetic organic reactions, such as C-H bond transformations 3. Creation of novel organic functional materials

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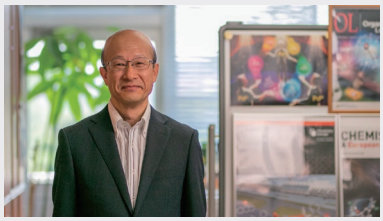
Division of Fundamental Organic Chemistry

Advanced Organic Synthesis



Professoer
Mitsuru Shindo

Associate Professor
Arihiro Kano

Assistant Professor **Takayuki Iwata**

Our research group designs and synthesizes useful bioactive organic molecules based on synthetic organic chemistry, and develops novel and effective synthetic methods. Recent studies: 1. synthesis of apoptosis inhibitors, antitumor agents, and plant growth regulators; 2. new synthetic methods using ynolates; 3. synthesis of functional iptycenes; 4. molecular release reactions; 5. elucidation of the cancer-induced immunosuppression; 6. generation of anticancer reagents based on the novel mechanistic insights.

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○Synthesis and function of supramolecular structures.
○Photoinduced electron transfer and high charge mobility in porphyrin-fullerene supramolecules.
○Synthesis and photoelectronic properties of novel polycyclic π–electronic compounds.
○Photomechanical effect and photochemical reaction of aromatic diimides.

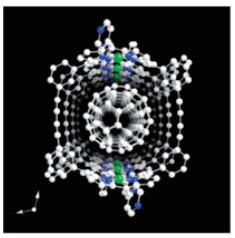


Fig . 1. Self-assembled porphyrin nanotube including linear array of fullerene C_{60}.

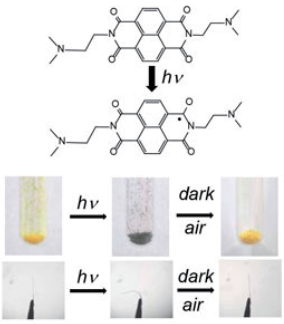
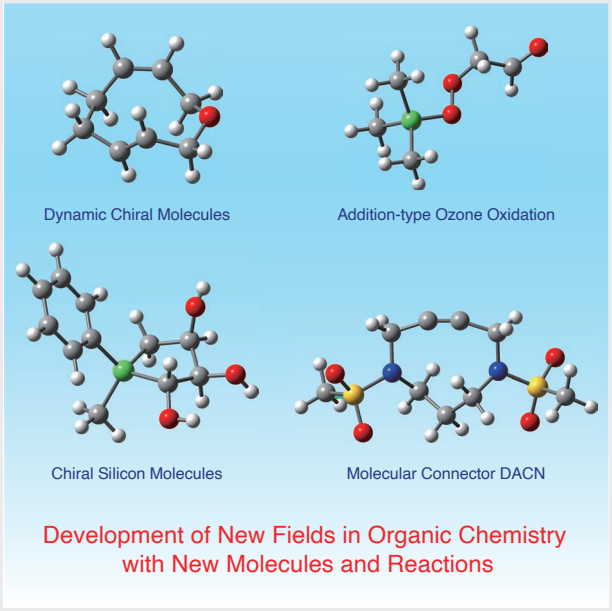


Fig . 2. Color change and crystal bending of naphthalene diimide upon photo-irradiation.

supramolecular assembly, π-electronic systems, porphyrins, fullerenes, photoinduced electron transfer, aromatic diimides, photomechanical effect,



Development of New Fields in Organic Chemistry with New Molecules and Reactions

Division of Applied Molecular Chemistry

Chemistry of Molecular Assembly

Associate Professor **Fumito Tani**

Assistant Professor **Kenta Goto**

Synthes is and function of supramolecular structures: molecular tubes, capsules, photo-swichable chiral hosts. Construction of bi-stable molecular aggregates via cooperative hydrogen bonding: Exploration of their nonlinear phenomena. Organic synthesis via photochemical reactions. Synthesis and properties of new cyclophanes and their application to molecular wires. Synthesis, structure, and function of thermo-responsive triblock polymers.

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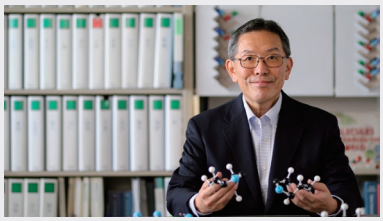
Division of Applied Molecular Chemistry

System of Functional Molecules



Professoer **Katsuhiko Tomooka**

Assistant Professor (Special Project) **Yuya Kawasaki**

Three-dimensional molecular design is important for creation of novel molecular functionality. We are focusing on the design of unique chiral molecules and the construction of novel chiral architecture based on these. Our recent works are 1) asymmetric synthesis of chiral organosilicon compounds and creation of novel chiral material based on this, 2) Creation of planar chiral heterocylic compounds and development of novel chiral-technology based on this.

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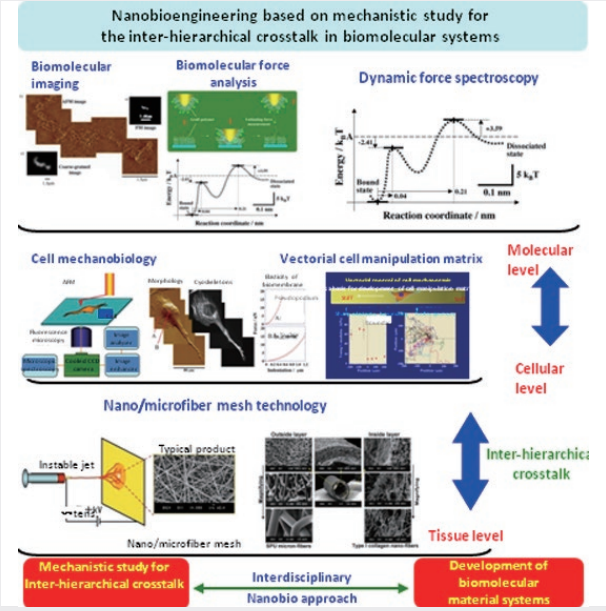

Division of Applied Molecular Chemistry

Biomedical and Biophysical Chemistry

Professoer
Satoru Kidoaki

Associate Professor
Hirohiko Ise

Assistant Professor
Kuboki Thasaneeya

Our lab works for the development of high-functional biomaterials/ biomolecular systems such as cell manipulation matrices and molecular recognition devices. To effectively design such the systems, deep understandings for the biophysical principles on various aspects of the biosystems are required. We are trying to elucidate the inter-hierarchical crosstalk mechanisms in the biosystems, and to apply those to develop the novel nanobiotechnology.

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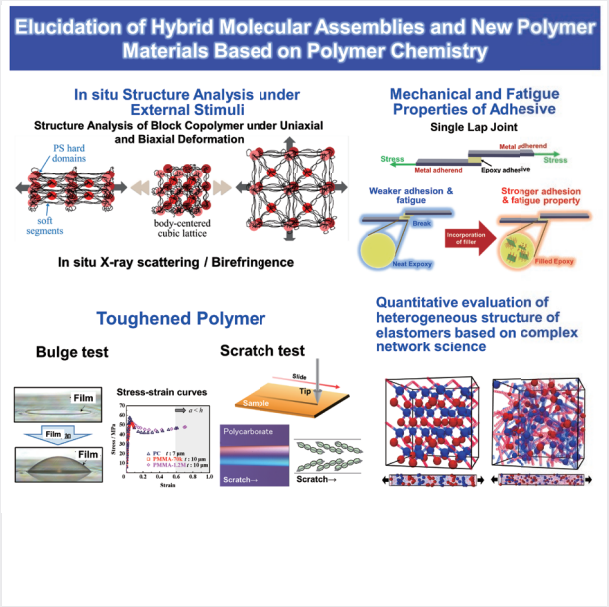
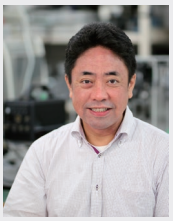


Division of Applied Molecular Chemistry

Hybrid Molecular Assemblies



Associate Professor
Ken Kojio

We have tried to make nano-structure controlled brand-new polymer materials with various high properties and functionals based on polymer chemistry, which includes polymer synthesis, elucidation of structure-properties relationship. Followings are some examples. (1) In situ structure analysis under external stimuli of crystalline and amorphous polymers, and elastomers using synchrotron X-ray scattering/diffraction measurement, birefringence measurement, and infrared spectroscopy, (2) mechanical and fatigue properties of single lap-joints of adhesive, (3) preparation of toughened polymers, (4) quantitative evaluation of heterogeneous structure of elastomers based on complex network science.

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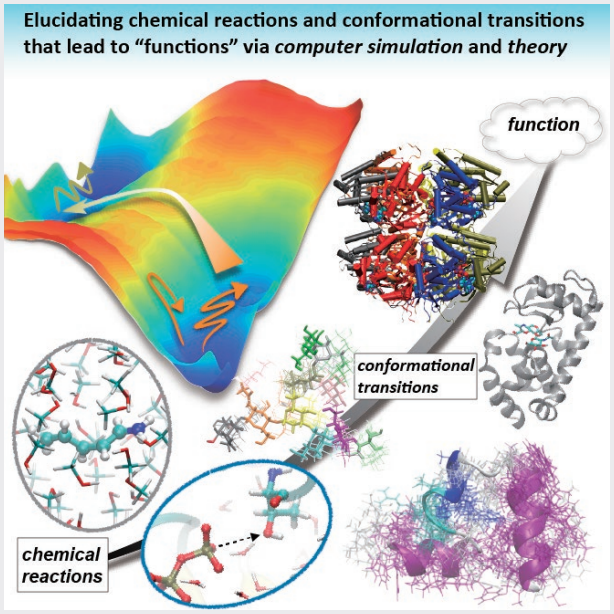
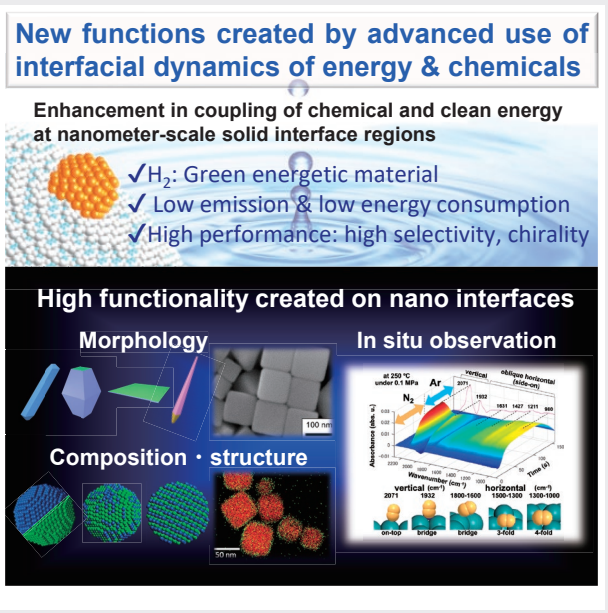
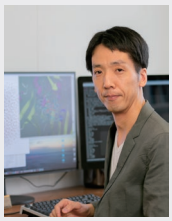




Division of Applied Molecular Chemistry

Cluster Chemistry



Associate Professor
Toshifumi Mori

Assistant Professor (Special Project)
Kyohei Kawashima

Conformational dynamics and fluctuations are essential for molecules to react and function in condensed phase. As molecular understanding of these motions are difficult to reach via experiments, our lab use computer simulations and theoretical analyses to study chemical reactions and conformational transitions of molecules in solution. The goal is to elucidate the molecular mechanisms that lead to functions of biomolecules and macromolecules. We also develop theoretical approaches to reveal the hierarchy of events that occur in condensed phase.

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Division of Applied Molecular Chemistry

Inorganic Materials Chemistry

Professor
Miho Yamauchi

Assistant Professor
Masaki Donoshita

Assistant Professor (Special Project)
Akina Yoshizawa

Assistant Professor (Special Project)
Tomohiro Noguchi

Our group are developing new functional chemicals and materials that take advantage of the characteristics of various elements. In particular, we are developing the nanoscale materials which exhibit high functionality in physical properties such as energy/chemical conversion (catalysis), energy storage (hydrogen storage), and mass transport (ion/atom diffusion, quantum diffusion) to build a sustainable chemical process that saves energy and resources.

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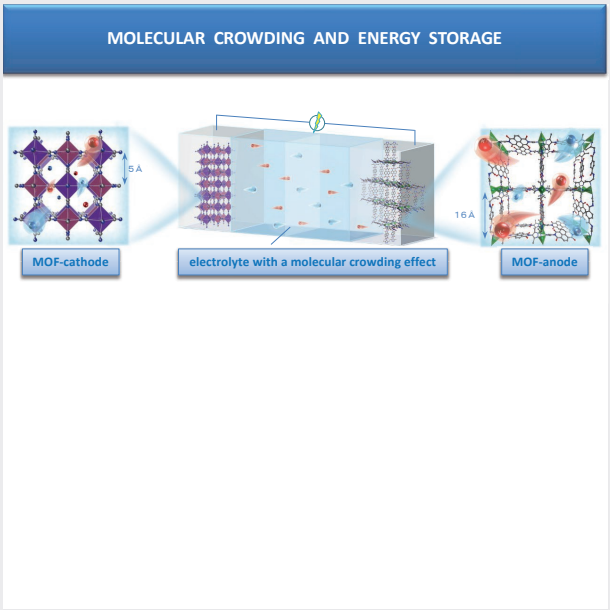
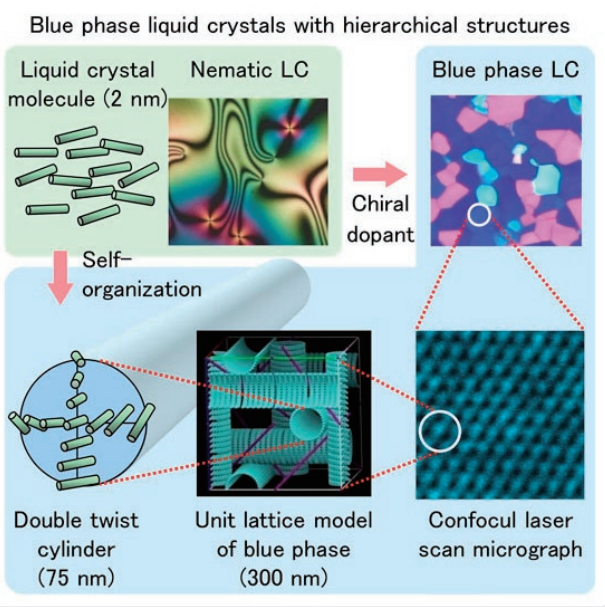
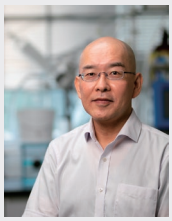




Division of Applied Molecular Chemistry



Associate Professor
Masato Ito

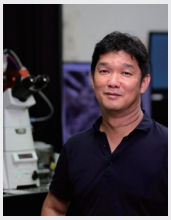
Our research interests center on the application of biologically inherited system to energy storage. Life has selected specific elements including sodium, potassium and chlorine as a charge carrier to maintain homeostasis and adapt to environmental stress by adjusting its membrane potential. We are currently studying physicochemical properties of novel aqueous as well as solid electrolyte composed of these privileged elements and biomolecules. Our ultimate goal is to develop a robust and easier-to-recycle secondary battery, which may contribute to the promotion of distributed energy resources.

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

Division of Integrated Materials

Design of Nano-systems

Professoer
Hirotsugu Kikuchi



Associate Professor
Yasushi Okumura

Assistant Professor
Shizuka Anan

Research Assistant Professor
Hiroyuki Matsukizono

Molecular self-assembly, which is an interdisciplinary subject extending over chemistry, physics and biology, derives the spontaneous nano-ordering being able to contribute much to key technologies of the bottom-up type electric and photonic devices. The focus of our studies is creating novel soft-matter with unique photonic structures and functionality through chemical and physical programming of topological frustration for the molecular assembling geometry of liquid crystals and polymers. We have developed novel functional materials showing fast electro-optics and photo-controllable photonic band.

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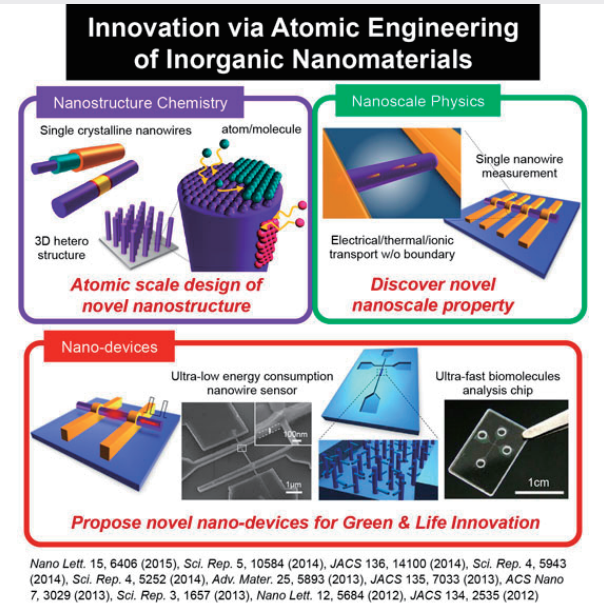
Interdisciplinary Graduate School of Engineering Sciences



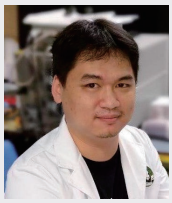
Nano Lett. 15, 6406 (2015), *Sci. Rep.* 5, 10584 (2014), *JACS* 136, 14100 (2014), *Sci. Rep.* 4, 5943 (2014), *Sci. Rep.* 4, 5252 (2014), *Adv. Mater.* 25, 5893 (2013), *JACS* 135, 7033 (2013), *ACS Nano* 7, 3029 (2013), *Sci. Rep.* 3, 1657 (2013), *Nano Lett.* 12, 5684 (2012), *JACS* 134, 2535 (2012)

Division of Integrated Materials

Nanostructured Integrated Materials

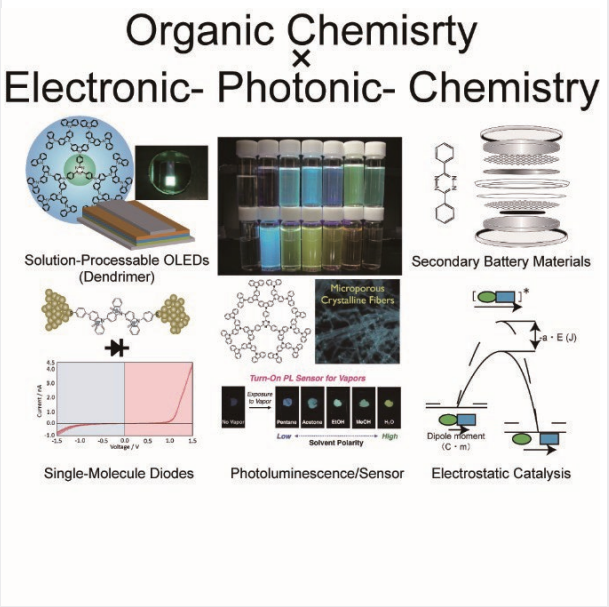
Professoer
(Cross appointment)
Takeshi Yanagida

Professoer
(Cross appointment)
Ho Johnny Chung Yin



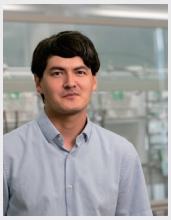
Associate Professor
Yip Sen Po

Our laboratory aims to 1) synthesize novel nanostructured materials, 2) explore the novel nanoscale physical properties using single nanoscale object device, and 3) develop these novel materials for real industrial applications.



Division of Integrated Materials

Heterogeneous Integrated Materials



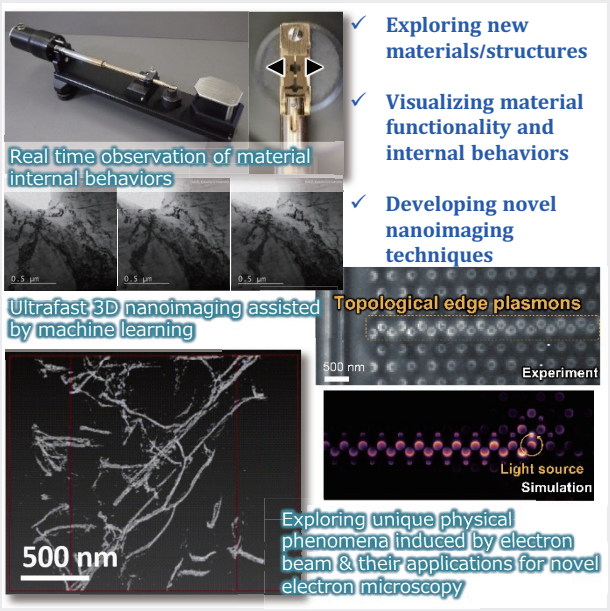
Associate Professor
Ken Albrecht

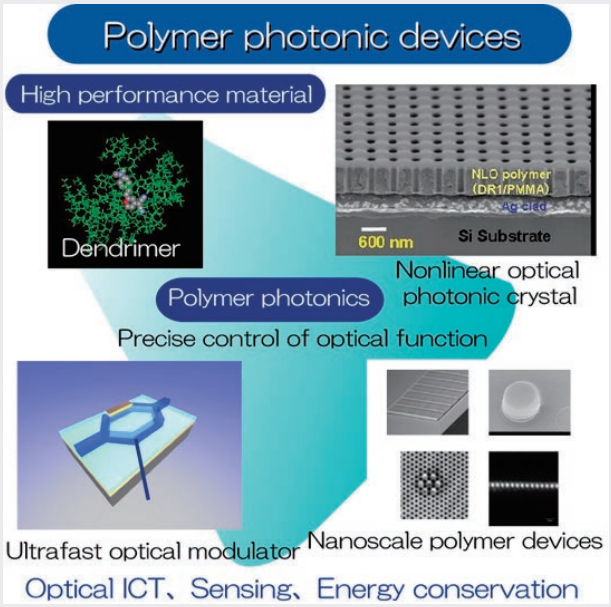
Assistant Professor
(Special Project)
Kohei Nakao

Our laboratory aims to synthesize new materials based on synthetic organic chemistry, polymer chemistry, and electrochemistry. In particular we are developing 1) solution-processable organic-electronics materials for OLED application, and 2) cathode materials for next-generation secondary batteries.

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

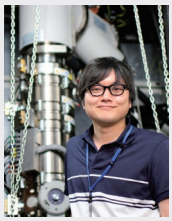




Division of Integrated Materials

Nanoscale Characterization of Materials

Professoer
(Cross appointment)
Mitsuhiro Murayama



Associate Professor
Hikaru Saito

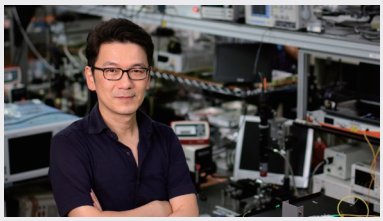
Assistant Professor
Shiro Ihara

Focus on developing and utilizing advanced transmission electron microscopy, so-called “in-situ nanoimaging” to visualize investigate how materials response to external stimuli, i.e., heat, light, stress; such findings provide direct proof of underlying-mechanisms behind complex phenomena, and enhance understanding of macro-scale properties. Real-time nanoimaging demands hundreds or thousands of times faster data acquisition methods than conventional TEM imaging, which motivates us to strive novel methodology developments such as machine-learning-assisted image denoising for ultrafast 3D nanoimaging. Our unique imaging capabilities/expertise will unveil various physical/chemical phenomena at the nanoscale.

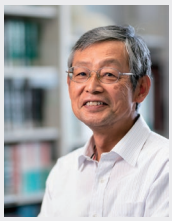
Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

Division of Advanced Device Materials

Nano Scale Evaluation



Professoer
Shiyoshi Yokoyama



Associate Professor
(Dual post)
Yoshiaki Takahashi

Assistant Professor (Dual post)
Akihiko Takada

Research Associate
Qiu Feng

Our research project is focused on creation of organic and polymer photonic materials and devices based on molecular building blocks and nano-micro-scale device fabrications. Research interest is in the demonstrating the potential of high-performance polymer materials for revolutionary components and devices. These include polymer photonic crystal devices leading to a large reduction in operating energies.

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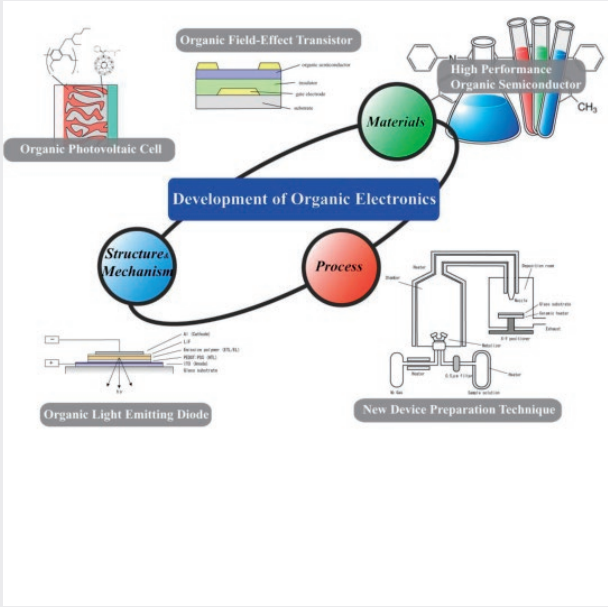

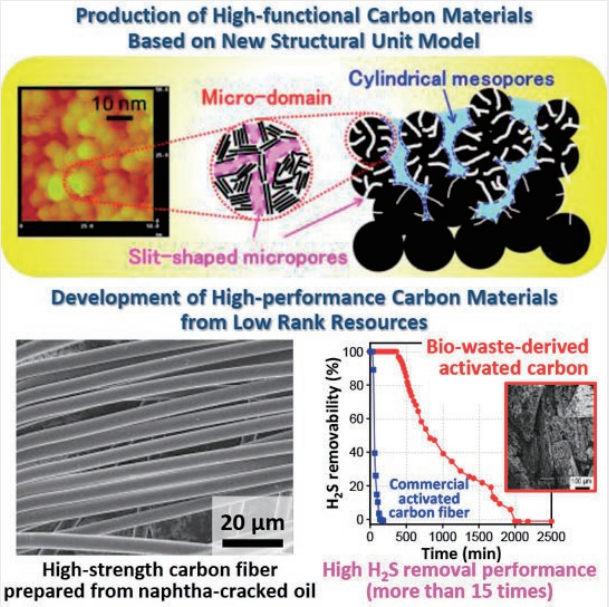

Division of Advanced Device Materials

Photonic Materials

Associate Professor
Katsuhiko Fujita

This research section has been pioneering the R&D of organic electronics including organic electroluminescence (EL) devices, organic solar cells, organic transistors and organic memories. The R&D activity is divided to three groups, device structure, high performance materials and fabrication processes to understand comprehensive organic electronics. Organic semiconductors have significant advantages, ex. flexibility and printability. Utilizing the advantages, new classes of electronic devices are being developed.

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Division of Advanced Device Materials

Carbon Materials Science

Professoer
Seong Ho Yoon

Associate Professor
Jin Miyawaki

Assistant Professor
Koji Nakabayashi

We develop new functional carbon materials for effective usages of energy resources and study their industrial applications. For example, we fabricate carbon nano-fibers (CNFs) having different shape, size, and surface properties, and optimize them for applications such as FC, LIB, and capacitor. We have found remarkably improved performance and durability for systems using our newly developed carbon materials, and have presented many patents and scientific papers. We are actively collaborating with various companies, and working on commercialization of our products.

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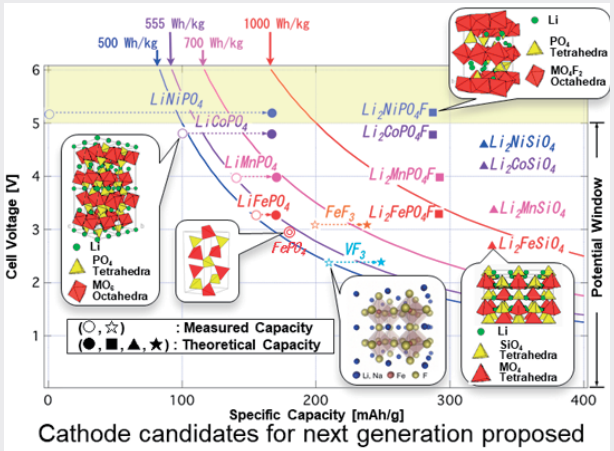
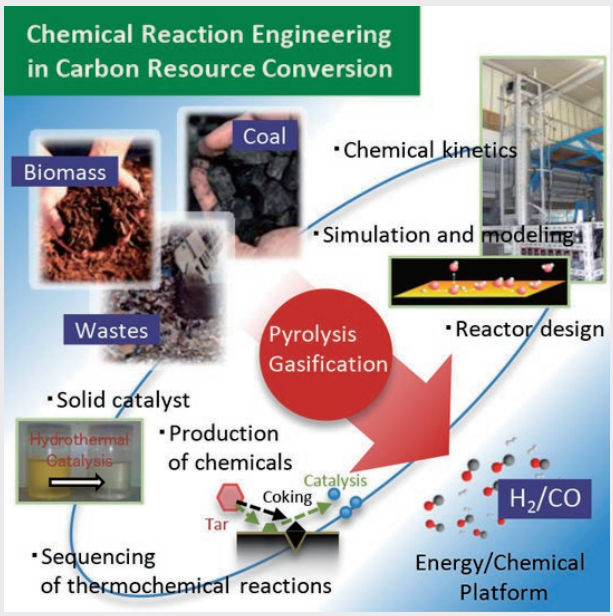


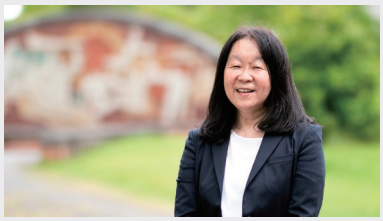
Cathode candidates for next generation proposed by Okada Lab.

Li_2CoPO_4F : JP3624205 (2004. 12. 10)
$LiCoPO_4$: JP3523397 (2004. 2. 20)
$FePO_4$: JP3126007 (2000. 11. 2)
Na_xFeF_3 : JP2008-243646A
Li_2FeSiO_4 : JP2007-335325A



Division of Advanced Device Materials

Energy Storage Materials



Professoer
(Cross appointment)
Hikari Sakaebe

Assistant Professor **Atsushi Inoishi**

Assistant Professor
Special Project
Dimov Nikolay Kirilov

To create high-performance electrochemical energy conversion devices, our laboratory covers fundamental studies as well as the foundation for practical applications. From the viewpoint of materials chemistry and electrochemistry, we create novel battery materials, which are based on the understanding of physicochemical phenomena, in order to improve the performance of power storage devices. In particular, we focus on high-power lithium ion batteries for use in hybrid vehicles, which will reduce environmental burdens. In addition, we fundamentally study on the design of electrode reactions for innovative energy conversion devices with high environmental compatibility for next generation.

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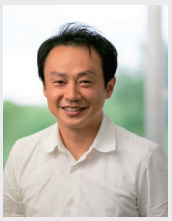
Graduate School of Integrated Frontier Sciences

Division of Advanced Device Materials

Microprocess Control

Professoer
Jun-ichiro Hayashi



Associate Professor
Shinji Kudo

Assistant Professor **Syusaku Asano**

Main purpose: development of thermochemical reaction systems for converting carbon resources such as coal, biomass and wastes into H_2/CO that is to be the common energy/material platform in future sustainable carbon cycle chemistry (SC3) systems. Current topics: detailed chemical kinetic analysis and modeling, sequencing of parallel/consecutive thermo-chemical reactions of coal and biomass, conversion of heavy oil and tar in nano/sub-nano spaces, radi-cal-driven rapid gasification of carbonized solids, pre-cise control of chemical vapor infiltration processes.

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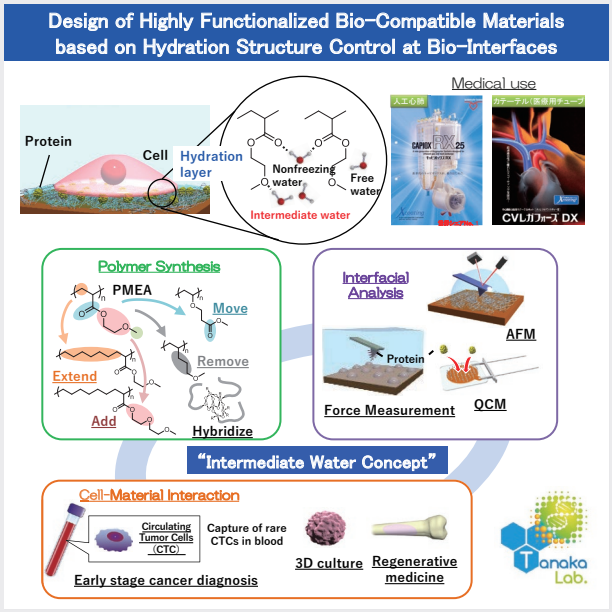
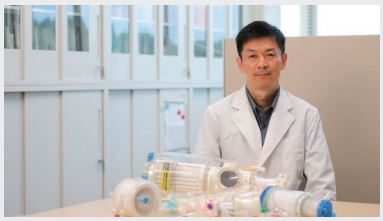


Division of Soft Materials

Soft Materials Chemistry



Professoer
Masaru Tanaka

Associate Professor
Takahisa Anada

Research Associate Professor
Shingo Kobayashi

Assistant Professor (Special Project)
Syohei Shiomoto

In order to attain the high "quality of life (QOL)"in aged society, the breakthrough in the research field of biomaterials (bio-compatible materials) is required. Our research aim to clarify the origin of bio-compatibility based on the role of hydrated water on bio/material interfaces, and to develop novel biomaterials with extremely high bio-compatibility, selective control of cell behavior.

Ito Campus
School of Engineering, Graduate School of Engineering

Division of Soft Materials

Nano-Bio Device

Professoer (Dual post)
Kaoru Tamada

Ito Campus

Division of Soft Materials

Mechanobio-materials

Professoer (Dual post)
Satoru Kidoaki

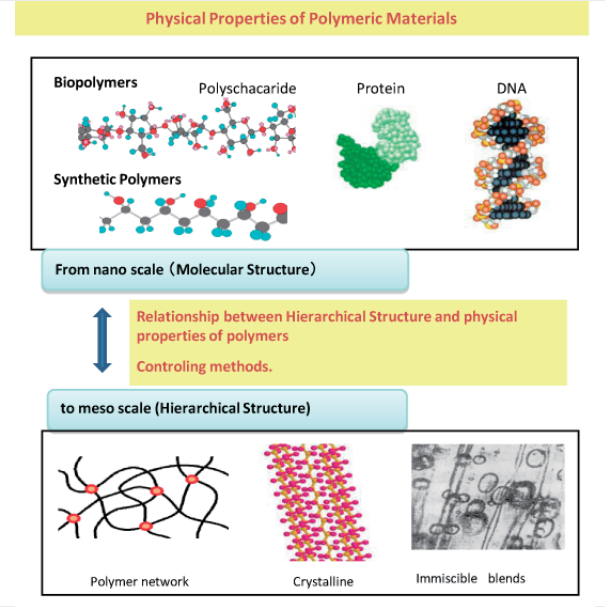
Assistant Professor (Dual post)
Kuboki
Thasaneeya

Ito Campus

Division of Soft Materials

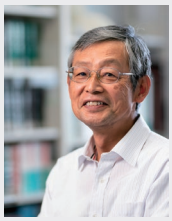
Soft Interface Chemistry

Ito Campus



Evaluation Center of Materials Properties and Function

Evaluation Office of Materials Properties and Function



Associate Professor **Yoshiaki Takahashi**

Assistant Professor **Akihiko Takada**

Hierachical structures and physical properties of polymers as well as those of analogous soft matters are studied by microscopic observations, thermal analysis, rheological and scattering experiments. Solution Properties of natural polymers in ionic liquids is also studied in our group.

Evaluation Center of Materials Properties and Function

Office of Research Support

Senior Technician **Mitsukata Umedu**

Senior Technician **Keiko Ideta**

Senior Technician **Taisuke Matsumoto**

Senior Technician **Takeshi Tanaka**

Technician **Kanako Imamura**

The laboratory supports the activities of the Institute, including the Joint Research Center for Materials and Devices, manages and operates the large shared equipment of the Institute, and manages the environment and safety of the Institute. Each staff member has a high level of knowledge about the instruments and analytical methods they are in charge of, and provides analytical support to researchers and students inside and outside the institute, including instruction on measurement methods and education on analytical methods, as well as actively responding to technical consultations and contract analysis of advanced measurements from inside and outside the institute.

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

Institute for Materials Chemistry and Engineering, Kyushu University

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