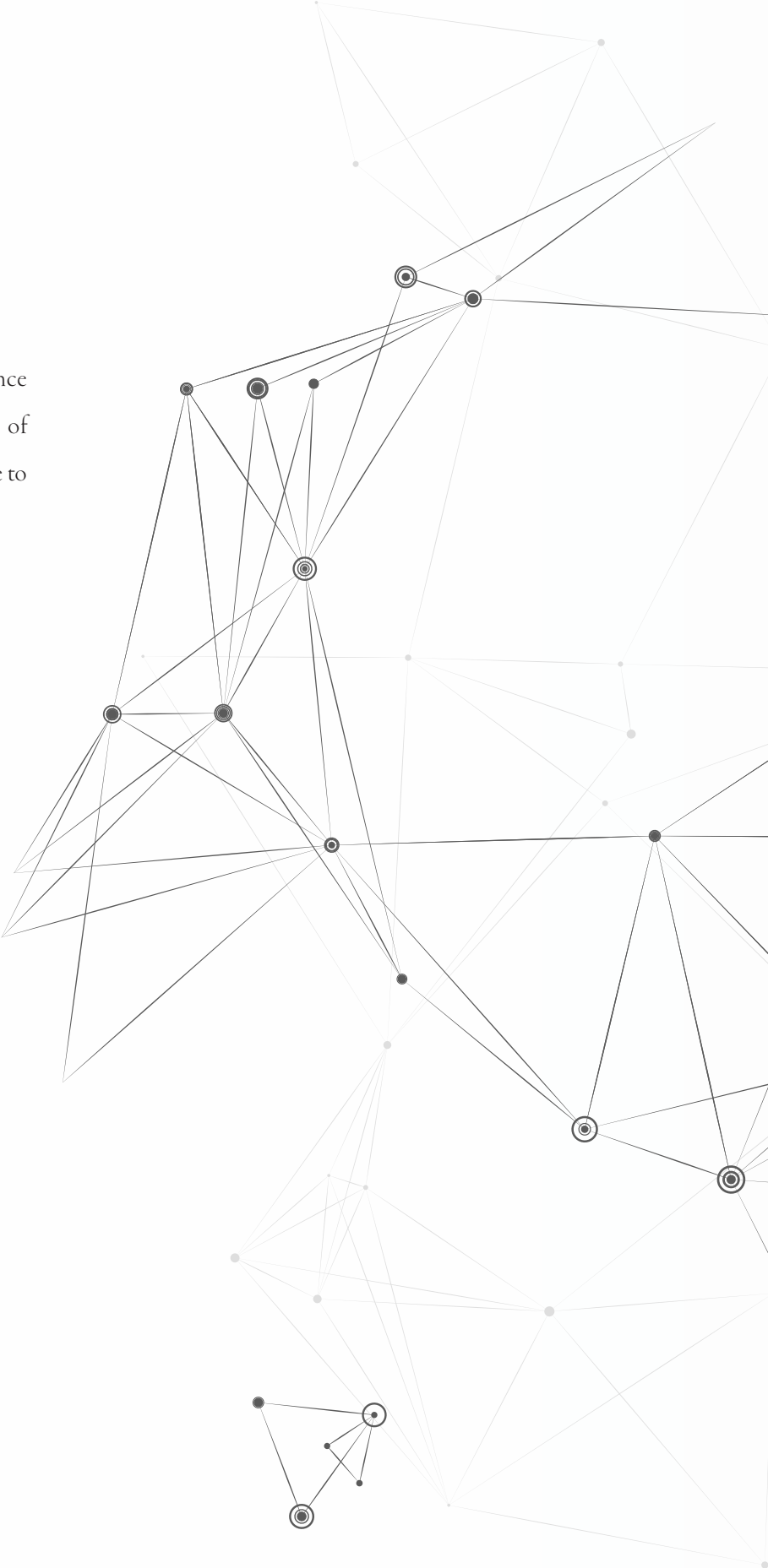
A background network diagram consisting of a complex web of thin grey lines connecting various circular nodes. The nodes vary in size and style, including solid grey circles, circles with a central dot, and circles with concentric rings. The overall layout is abstract and technical, suggesting a network or molecular structure.

Institute for Materials Chemistry and Engineering

KYUSHU UNIVERSITY

 **IMCE**

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
Institute for Materials Chemistry and Engineering
Kyushu University



About Us







Campus

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



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

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.



Dynamic Alliance for Open Innovation Bridging Human, Environment 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



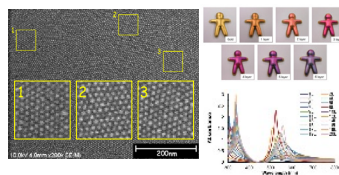
Laboratories

As of April 1st, 2021

Interfacial Reaction between Nanomaterials 2D and 3D Self-assembly of Molecules and Particles

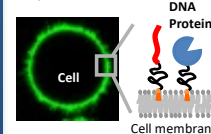
Ag Nanoparticle 2D Crystalline Sheet

- 2D Ag Nanoparticle sheets
- Electromagnetically induced transparency



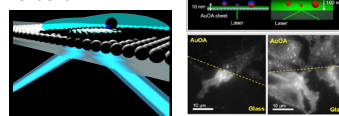
Interfacial design

Surface functionalization of artificial materials and living cells to control biological responses



High-resolution imaging using a gold-nanoparticle sheet

Observation of cell-attached nano-interface (~ 10 nm) which cannot be observed by conventional TIRF



Nanopore Device

- Shape analysis
- Surface molecule analysis

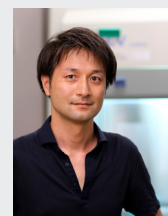


Division of Fundamental Organic Chemistry

Nanomaterials and Interfaces



Professor
Kaoru Tamada



Associate Professor
Yusuke Arima

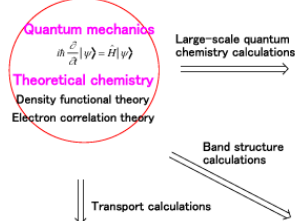
Assistant Professor Sou Ryuzaki

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.

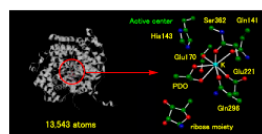
Ito Campus
School of Science, Graduate School of Science

Quantum chemical approach to chemical reactions and electronic properties of molecules and solids

Molecular theory

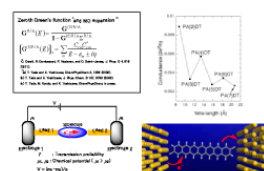


Challenge to enzymatic study

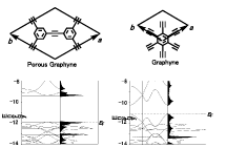


QM/MM method

Conductance of nanowires

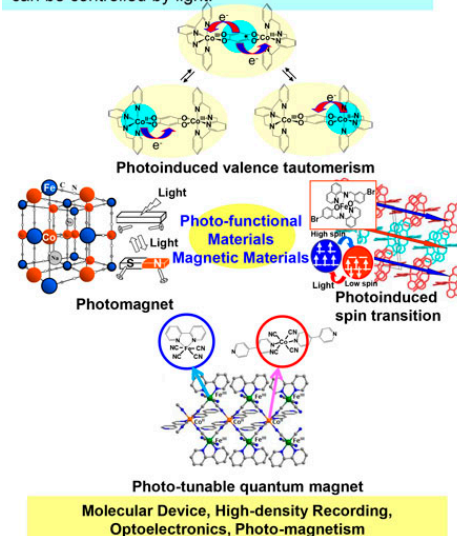


Electronic structure of nanomaterials



Electronic properties from band structure calculations

Development of functional molecular materials, in which magnetic, optical and conducting properties can be controlled by light.



Division of Fundamental Organic Chemistry

Theoretical Chemistry



Professor
Kazunari
Yoshizawa



Associate Professor
Yoshihito Shiota

Assistant Professor Yuta Tsuji

Research Assistant Professor Masataka Yoshida

Research Assistant Professor Shin Nakamura

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.

Division of Fundamental Organic Chemistry

Molecular Materials Chemistry



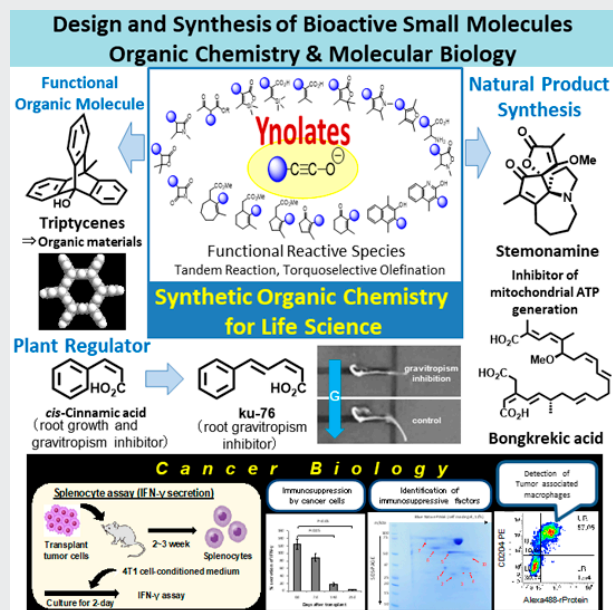
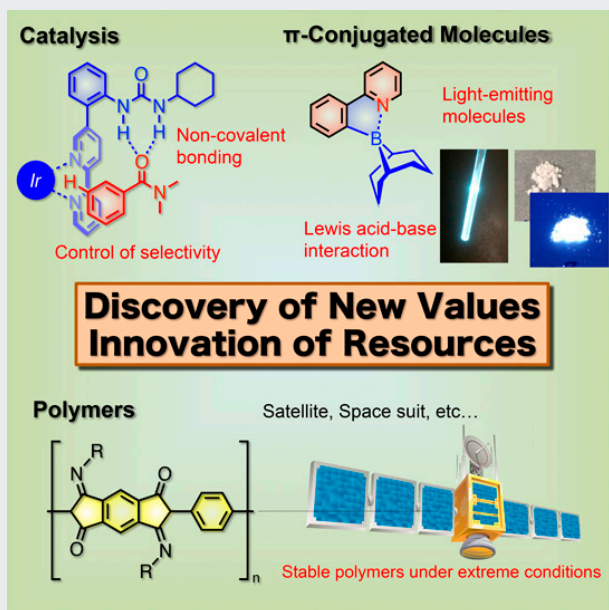
Professor
Osamu Sato

Assistant Professor Shinji Kanegawa

Assistant Professor Wu Shu-Qi

Research Assistant Professor 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.



Division of Fundamental Organic Chemistry

Chemistry of Functional Molecules

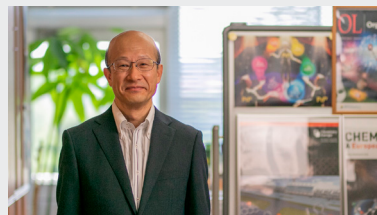


Professor
Yoichiro Kuninobu

Assistant Professor **Takeru Torigoe**
Assistant Professor **Kohei Sekine**

Division of Fundamental Organic Chemistry

Advanced Organic Synthesis



Professor
Mitsuru Shindo



Associate Professor
Arihiro Kano

Assistant Professor **Takayuki Iwata**
Assistant Professor (Dual post) **Junji Tanaka**

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

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

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 triptycenes; 4. molecular release reactions; 5. elucidation of the cancer-induced immunosuppression; 6. generation of anticancer reagents based on the novel mechanistic insights.

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

- 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.

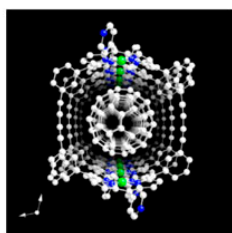


Fig. 1. Self-assembled porphyrin nanotube including linear array of fullerene C_{60} .

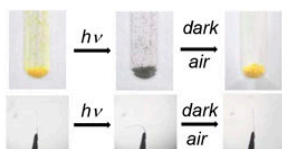
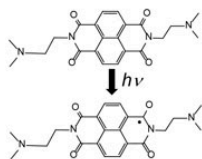


Fig. 2. Color change and crystal bending of naphthalene diimide upon photo-irradiation.

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

Dynamic Chiral Molecules

Addition-type Ozone Oxidation

Chiral Silicon Molecules

Molecular Connector DACN

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

Division of Applied Molecular Chemistry

Chemistry of Molecular Assembly

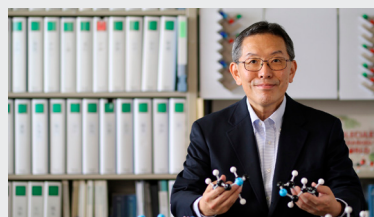


Associate Professor
Fumito Tani

Assistant Professor Kenta Goto

Division of Applied Molecular Chemistry

System of Functional Molecules

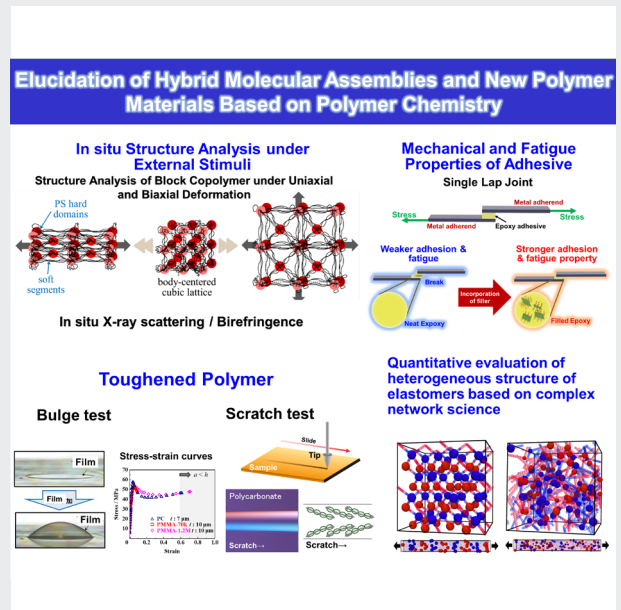
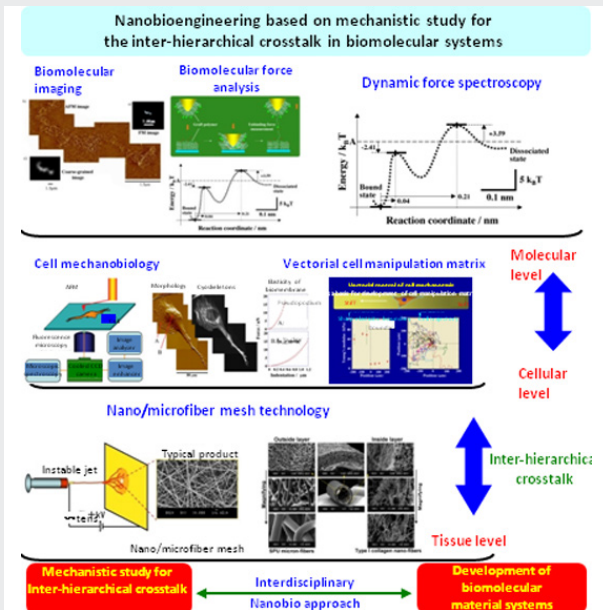


Professor
Kazuhiko Tomooka

Assistant Professor Kazunobu Igawa
Research Assistant Professor Yuya Kawasaki

Synthesis and function of supramolecular structures: molecular tubes, capsules, photo-switchable chiral hosts. Construction of bistable 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.

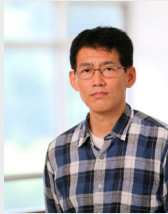
We are working on "development of new and attractive molecules and reactions" in order to open up new fields in synthetic organic chemistry. As a result, we have succeeded in creating unprecedented unnatural chiral molecules such as chiral silicon molecules and dynamic planar-chiral molecules, and elucidating their unique properties. We are also developing a new asymmetric synthesis method and dynamic asymmetric induction method (DYASIN), to obtain optically active chiral molecules. Furthermore, we have succeeded in developing the addition-type ozone oxidation reaction and the non-catalytic click reaction device DACN, and are proceeding with the development of their applications.



Division of Applied Molecular Chemistry
Biomedical and Biophysical Chemistry



Professor
Satoru Kidoaki



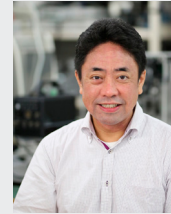
Associate Professor
Hirohiko Ise

Assistant Professor
Kuboki Thasaneeya

Research Assistant Professor
Hiroyuki Ebata

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.

Division of Applied Molecular Chemistry
Hybrid Molecular Assemblies

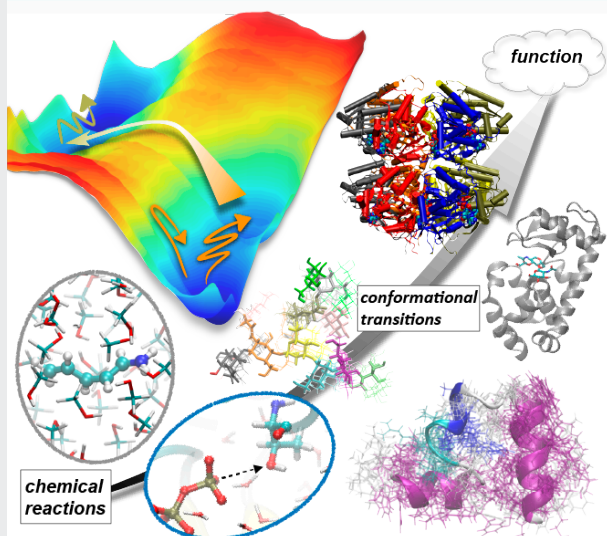


Associate Professor
Ken Kojio

Assistant Professor
Yoshifumi Amamoto

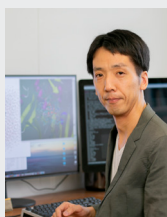
We have tried to make nano-structure controlled brand-new polymer materials with various high properties and functionals based on polymer chemistry, which includes polymer synthesis, elucidation of structure-properties relationship. Followings are some examples. (1) In situ structure analysis under external 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.

Elucidating chemical reactions and conformational transitions that lead to "functions" via *computer simulation and theory*



Division of Applied Molecular Chemistry

Cluster Chemistry

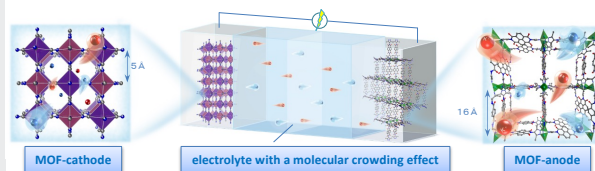


Associate Professor
Toshifumi Mori

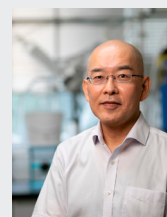
Conformational dynamics and fluctuations are essential for molecules to react and function in condensed phase. As molecular understanding of these motions are difficult to reach via experiments, our lab use computer simulations and theoretical analyses to study chemical reactions and conformational transitions 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.

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

MOLECULAR CROWDING AND ENERGY STORAGE



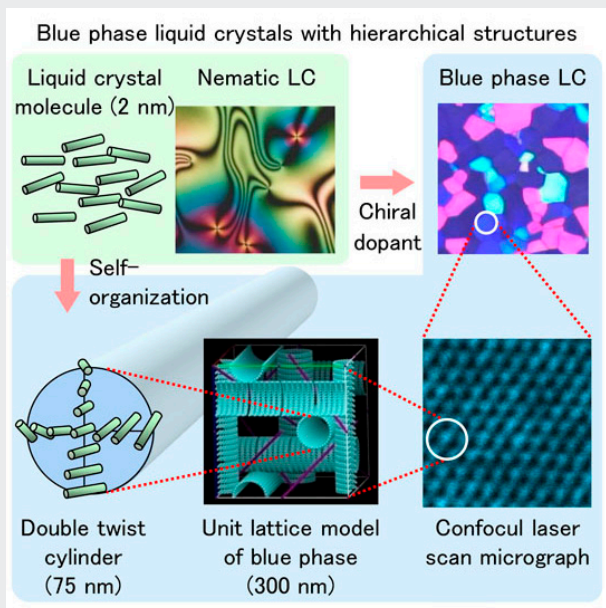
Division of Applied Molecular Chemistry



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



Innovation via Atomic Engineering of Inorganic Nanomaterials

Nanostructure Chemistry

Single crystalline nanowires atom/molecule

3D hetero structure

Atomic scale design of novel nanostructure

Nanoscale Physics

Single nanowire measurement

Electrical/thermal/ionic transport w/o boundary

Discover novel nanoscale property

Nano-devices

Ultra-low energy consumption nanowire sensor

Ultra-fast biomolecules analysis chip

Propose novel nano-devices for Green & Life Innovation

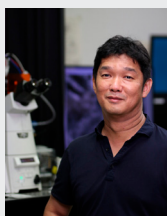
Nano Lett. 15, 6406 (2015), Sci. Rep. 5, 10584 (2014), JACS 136, 14100 (2014), Sci. Rep. 4, 5943 (2014), Sci. Rep. 4, 5252 (2014), Adv. Mater. 25, 5893 (2013), JACS 135, 7033 (2013), ACS Nano 7, 3029 (2013), Sci. Rep. 3, 1657 (2013), Nano Lett. 12, 5684 (2012), JACS 134, 2535 (2012)

Division of Integrated Materials

Design of Nano-systems



Professor
Hirotugu 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.

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

Division of Integrated Materials

Nanostructured Integrated Materials



Professor
(Cross appointment)
Takeshi Yanagida

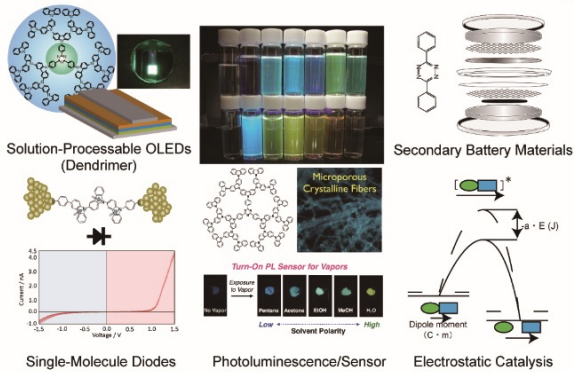


Professor
(Cross appointment)
Ho Johnny
Chung Yin

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.

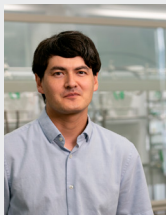
Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

Organic Chemistry Electronic- Photonic- Chemistry



Division of Integrated Materials

Heterogeneous Integrated Materials



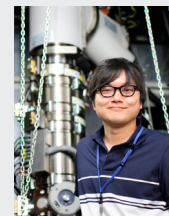
Associate Professor
Ken Albrecht

Division of Integrated Materials

Nanoscale Characterization of Materials



Professor
(Cross appointment)
Mitsuhiro Murayama



Associate Professor
Hikaru Saito

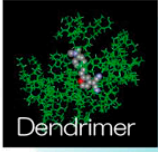
Assistant Professor
Shiro Ihara

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.

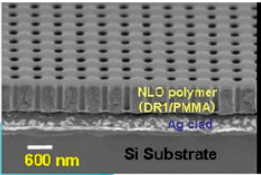
Focus on developing and utilizing advanced transmission electron microscopy, so-called "in-situ nanoimaging" to visualize investigate how materials response to external stimuli, i.e., heat, light, stress; such findings provide direct proof of underlying-mechanisms behind complex phenomena, and enhance 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.

Polymer photonic devices

High performance material



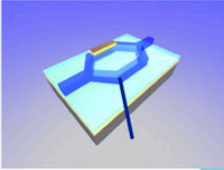
Dendrimer



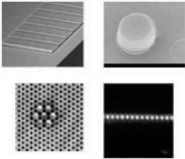
NLO polymer (DR1/PMMA) Ag-cleed
600 nm Si Substrate

Polymer photonics

Precise control of optical function



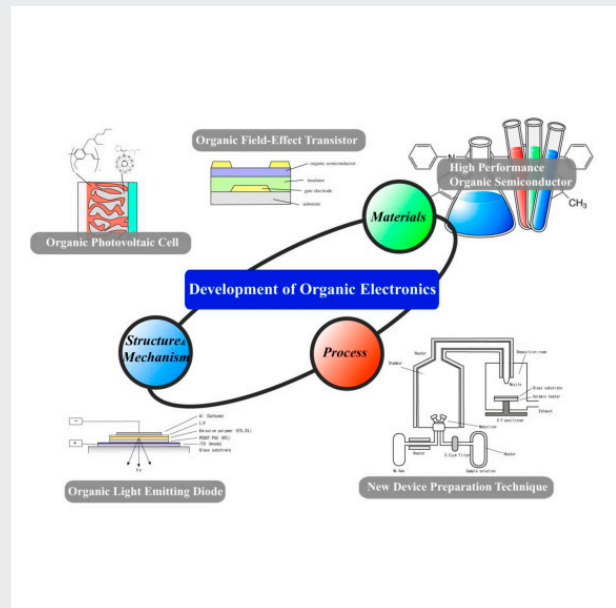
Ultrafast optical modulator



Nanoscale polymer devices

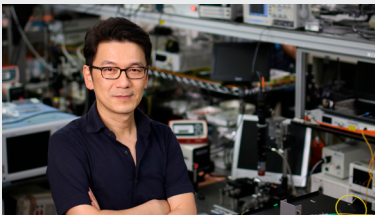
Optical ICT, Sensing, Energy conservation

Nonlinear optical photonic crystal

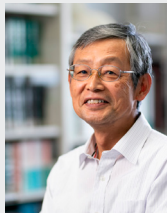


Division of Advanced Device Materials

Nano Scale Evaluation



Professor
Shiyoshi Yokoyama



Associate Professor
(Dual post)
Yoshiaki Takahashi

Assistant Professor **Kazuhiro Yamamoto**

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.

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

Division of Advanced Device Materials

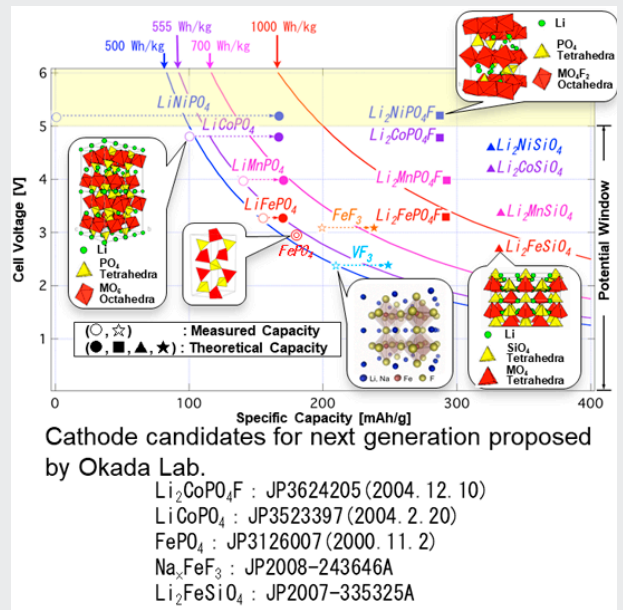
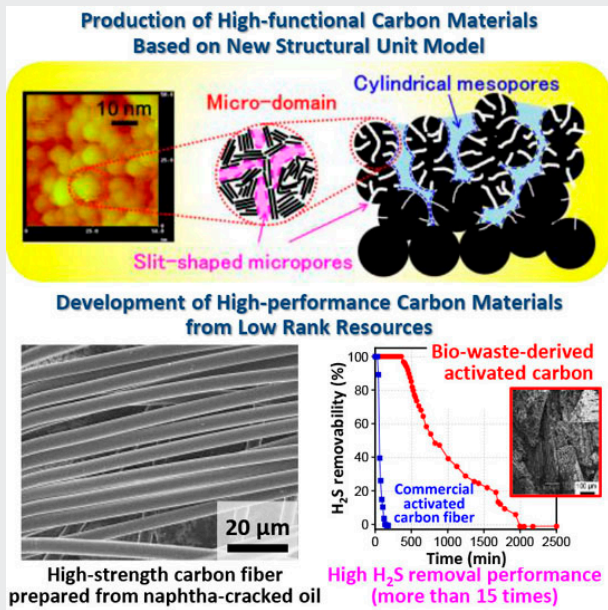
Photonic Materials



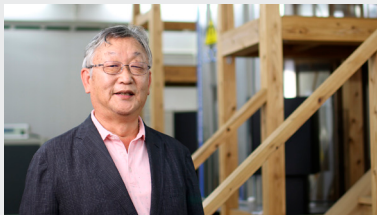
Associate Professor
Katsuhiko Fujita

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.

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences



Division of Advanced Device Materials
Carbon Materials Science



Professor
 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.

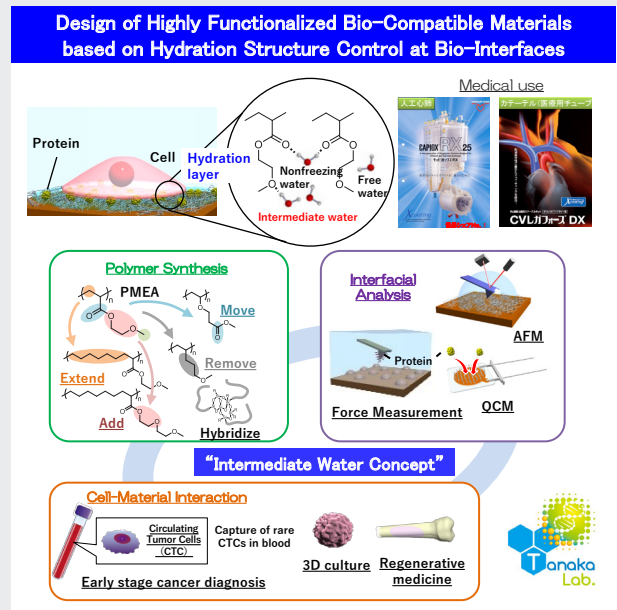
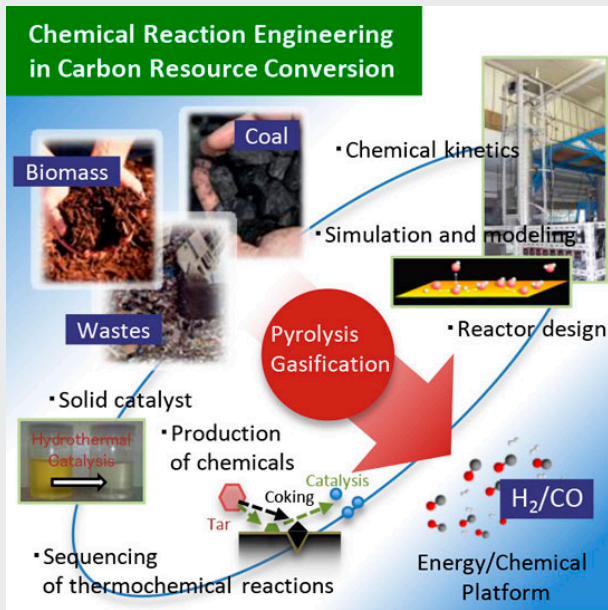
Division of Advanced Device Materials
Energy Storage Materials



Professor
 Shigeto Okada

Assistant Professor Atsushi Inoishi

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.



Division of Advanced Device Materials

Microprocess Control



Professor
Jun-ichiro Hayashi



Associate Professor
Shinji Kudo

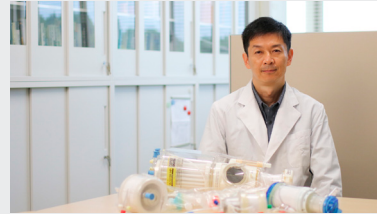
Assistant Professor
Syusaku Asano

Main purpose: development of thermochemical reaction systems for converting carbon resources such as coal, biomass and wastes into H₂/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.

Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

Division of Soft Materials

Soft Materials Chemistry



Professor
Masaru Tanaka



Associate Professor
Takahisa Anada



Research
Associate Professor
Shingo Kobayashi

Assistant Professor
Daiki Murakami

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



Professor (Dual post)
Kaoru Tamada

Assistant Professor (Dual post)

Sou Ryuzaki

Division of Soft Materials

Mechanobio-materials



Professor (Dual post)
Satoru Kidoaki

Assistant Professor (Dual post)

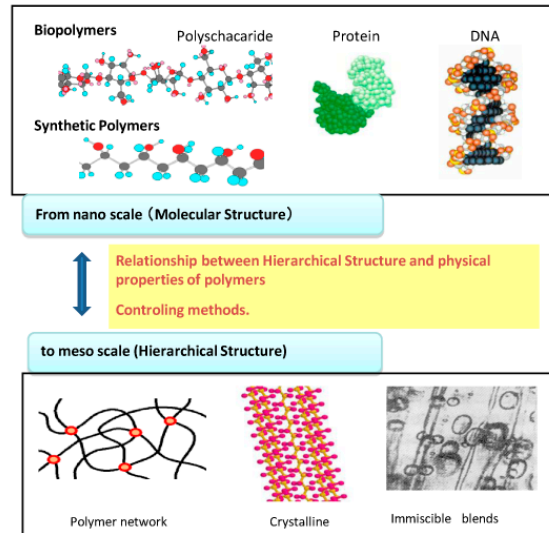
**Kuboki
Thasaneeya**

Division of Soft Materials

Soft Interface Chemistry

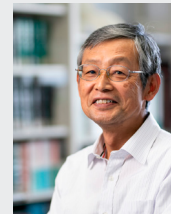
Assistant Professor (Dual post) **Yoshifumi Amamoto**

Physical Properties of Polymeric Materials



Evaluation Center of Materials Properties and Function

Evaluation Office of Materials Properties and Function



Associate Professor
Yoshiaki Takahashi

Assistant Professor **Akihiko Takada**

Hierarchical 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.

Ito Campus


Chikushi Campus
Interdisciplinary Graduate School of Engineering Sciences

Evaluation Center of Materials Properties and Function

Office of Research Support

Assistant Professor	Junji Tanaka
Senior Technician	Mitsukata Umedu
Senior Technician	Keiko Ideta
Senior Technician	Satoko Gondo
Senior Technician	Taisuke Matsumoto
Senior Technician	Takeshi Tanaka

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.



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