

Institute for Materials Chemistry and Engineering, Kyushu University

- **Chikushi Campus** 6-1 Kasuga-koen, Kasuga-city, Fukuoka 816-8580  
Fukuoka Airport→(Subway Kuko Line)→Hakata Station→(Transfer JR Kagoshima Line)→Onojo Station→Chikushi Campus
- **Ito Campus** 744 Motooka, Nishi-ku, Fukuoka 819-0395  
Fukuoka Airport→(Subway Kuko Line)→[Meinohama Station→(Transfer JR Chikuhi Line.)]→Kyudai-Gakkentoshi Station  
→(Transfer Showa Bus)→Ito Campus



## Director's greeting

Jun-ichiro HAYASHI

The Institute for Materials Chemistry and Engineering, IMCE, was founded on April 1, 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; around 45 in recent 5 years), postdoc fellows and technical staff, who produced more than 1,200 referred original research papers and reviews in FY2010–2015. The rate of “adjusted Top 10% papers” for IMCE is 15.2%, and this may be an indication of the averaged quality and contribution to materials chemistry of our research works.

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.

Jun-ichiro Hayashi  
Director  
Institute for Materials Chemistry and Engineering  
Kyushu University

## History

1944	Research Institute for Wood, Kyushu Imperial University (3 divisions) founded.
April 1949	Reorganized as the Kyushu University Research Institute for Production Science (5 divisions).
May 1987	Reorganized as the Kyushu University Institute of Advanced Material Study (3 research divisions (13 research fields) + 2 temporary divisions)
April 1, 1993	Kyushu University Institute for Fundamental Research of Organic Chemistry (3 research divisions) founded.
April 1, 2003	Institute for Materials Chemistry and Engineering established following the merger and reorganization of the Kyushu University Institute of Advanced Material Study and the Kyushu University Institute for Fundamental Research of Organic Chemistry.
April 1, 2010	The IMCE has been designated as a network-style research core for the government-sponsored Joint Usage/Research Center Program.
April 1, 2014	Division of Soft Materials established.

## Campus



IMCE is engaged in research activities in the two campus Chikushi and Ito.



Chikushi Campus



Ito Campus

## Organization

### Division of Fundamental Organic Chemistry

In addition to clarifying the characteristics of organic molecules, especially substances that exhibit specific optical, magnetic, conductive or other physical properties, the aim of the Division of Fundamental Organic Chemistry is to develop molecules that exhibit distinctive functions through establishing design principles using theoretical chemistry and property analysis, and realizing empirically these principles. The division is also engaged in the development of ultra-efficient and highly-selective reactions of organic molecules, and the development of highly-controlled methods of material transformation.

### Division of Applied Molecular Chemistry

The aim of the Division of Applied Molecular Chemistry is to establish the basic chemistry of atomic clusters, molecular clusters and supermolecules - which are unexplored areas of materials chemistry at the atomic and molecular levels - and to apply this to the design of molecular structures and electronic structures, synthesis, the development of physical properties and reactivity, and to functional molecules. Through the advanced control of physical properties and reactivity at the molecular level, the division aims to build macromolecules with higher-order structures, and to establish bottom-up nanotechnology. By creating molecules and molecular clusters that have new functional characteristics, and by evaluating the properties of these, the division aims to expand into nanomolecular materials.

### Division of Integrated Materials

By freely using such techniques as molecular nanotechnology, the microfabrication of bulk materials and self-organization, the Division of Integrated Materials aims to create and apply hybrid materials that are positioned on the edge of conventional academic fields, such as organic-inorganic-bio and carbon-organic materials. In particular, the aim of the division is to develop new functional materials by blending dissimilar functions such as electronic functions and bio functions, and to establish a base for practical application. In addition to using the fusion of various types of materials to promote the development of physical/chemical/bio functional materials that are also biocompatible and compatible with the environment, the division is also engaged in the careful evaluation of the physical properties of each material.

### Division of Advanced Device Materials

The Division of Advanced Device Materials aims to realize nanostructured bulk materials and to realize advanced devices through the measurement and functional analysis of the microstructures of precisely built molecular and atomic clusters, and through the development of processes to realize ordered arrays. In particular, with a focus on inorganic nanomaterials, the aim of the division is the clarification of the correlation between structure and function, the development of new optical materials that use nanoparticles, and the establishment of a fundamental engineering for the process design and controls that are necessary for the achievement of large-scale ordered arrays of nanostructures.

### Division of Soft Materials

Through precise control of emerging functions and complex hierarchical structures of soft materials such as polymers, gels, colloids, liquid crystals etc, the division of soft materials aims to develop innovative and inventive technology on biocompatible materials, functional interfacial materials, nanobio-devices, and cell manipulation materials. In addition, this division pushes on constructing the international hub for extensive collaborations with overseas active research groups.

### Evaluation Center of Materials Properties and Function

The center is engaged in the management and operation of large equipment for shared use, with an intensive allocation of technical staff with advanced expertise. This allows the implementation of advanced analysis of molecules and materials, as well as related education and instructions.

The center also carries out diverse activities pertaining to the environmental and safety management of the institute.

## Master's degree and doctoral degree

The IMCE conducts its activities as a part of the graduate schools of Sciences, Engineering and Interdisciplinary Engineering Sciences, respectively across the Ito and Chikushi campuses.

Laboratories in Ito campus :

- Graduate School of Engineering, Department of Chemistry and Biochemistry /
- Graduate School of Sciences, Department of Chemistry

Laboratories in Chikushi campus :

- Interdisciplinary Graduate School of Engineering Sciences, Department of Molecular and Material Sciences /
- Interdisciplinary Graduate School of Engineering Sciences, Department of Applied Science for Electronics and Materials /
- Graduate School of Integrated Frontier Sciences, Department of Automotive Science

## 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

Cooperation partner: RIES, Hokkaido University; IMRAM, Tohoku University; LCS, Tokyo Institute of Technology; ISIR, Osaka University.

### ◆ Integrated Research Consortium on Chemical Sciences

Cooperation partner: Institute for Catalysis, Hokkaido University; RCMS, Nagoya University; IRCELS, Kyoto University.

## Division of Fundamental Organic Chemistry Nanomaterials and Interfaces

Ito Campus

**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.

**LED, Photovoltaic Cell**  
• LEDs and PV Cells based on Plasmonics

**High-resolution imagings using a gold-nanoparticle sheet**  
• Observation of a cell-attached nanointerface (~10 nm) which cannot be observed by TIRF microscope.

Professor Kaoru TAMADA  
Associate Professor Yusuke ARIMA  
Assistant Professor Sou RYUZAKI

Interfacial Science, Nanomaterials, Plasmonics

## Division of Fundamental Organic Chemistry Theoretical Chemistry

Ito Campus

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

**Molecular theory**  
Quantum mechanics  
Theoretical chemistry  
Density functional theory  
Electron correlation theory

**Challenge to enzymatic study**  
Simulation of enzymatic reactions of over 10000 atoms!  
QM/MM method

**Conductance of nanowires**  
Band structure calculations  
Transport calculations

**Electronic structure of nanomaterials**  
Electronic properties from band structure calculations

Professor Kazunari YOSHIZAWA  
Associate Professor Yoshihito SHIOTA  
Assistant Professor Yuta TSUJI  
Research Assist. Prof. Yuta HORI  
M.H.MAHYUDDIN

Theoretical Chemistry, Enzyme Chemistry, Material Chemistry

## Division of Applied Molecular Chemistry Chemistry of Molecular Assembly

Ito Campus

**Synthesis and function of supramolecular structures.**  
• Photoinduced electron transfer and high charge mobility in porphyrin-fullerene supramolecules.  
• Synthesis and photoelectronic properties of novel polycyclic  $\pi$ -electronic compounds.  
• Photomechanical effect and photochemical reaction of aromatic diimides.

Associate Professor Fumito TANI  
Assistant Professor Kenta GOTO

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,  $\pi$ -electronic systems, porphyrins, fullerenes, photoinduced electron transfer, aromatic diimides, photomechanical effect,

Organic Chemistry, Structural Organic Chemistry,  $\pi$ -Electronic Systems

## Division of Applied Molecular Chemistry System of Functional Molecules

Chikushi Campus

**Chemistry of Unnatural Chiral Molecules**

**Planar Chirality of Heterocycles**

**Central Chirality of Silicon**

**Development of Novel Molecular Transformation**

**Addition-type Ozone Oxidation**

Professor Katsuhiko TOMOOKA  
Associate Professor Masato ITO  
Assistant Professor Kazunobu IGAWA  
Research Assist. Prof. Yuya KAWASAKI

Organic Chemistry, Synthetic Chemistry, Structural Chemistry, Medicine, Chiral Material

## Division of Fundamental Organic Chemistry Molecular Materials Chemistry

Ito Campus

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

Professor Osamu SATO  
Assistant Professor Shinji KANEGAWA  
Research Assist. Prof. Su Shengqun

Photoinduced valence tautomerism  
Photo-functional Materials  
Magnetic Materials  
Photomagnet  
Photoinduced spin transition  
Photo-tunable quantum magnet  
Molecular Device, High-density Recording, Optoelectronics, Photo-magnetism

Photochemistry, Materials Chemistry, Photomagnetic memory

## Division of Fundamental Organic Chemistry Chemistry of Functional Molecules

Chikushi Campus

**Catalysis**  
Non-covalent bonding  
Control of selectivity

**$\pi$ -Conjugated Molecules**  
Light-emitting molecules  
Lewis acid-base interaction

**Discovery of New Values Innovation of Resources**

**Polymers**  
Satellite, Space suit, etc...  
Stable polymers under extreme conditions

Professor Yoichiro KUNINOBU  
Assistant Professor Takeru TORIGOE  
Kohei SEKINE

Synthetic Organic Chemistry, Organometallic Chemistry, Materials Chemistry

## Division of Applied Molecular Chemistry Biomedical and Biophysical Chemistry

Ito Campus

**Nanobiotechnology based on mechanistic study for the inter-hierarchical crosstalk in biomolecular systems**

Biomolecular Imaging  
Biomolecular force analysis  
Dynamic force spectroscopy

Cell mechanobiology  
Vectorial cell manipulation matrix

Nano/microfiber mesh technology  
Typical product  
Nano/microfiber mesh

Mechanistic study for inter-hierarchical crosstalk  
Interdisciplinary Nanobio approach  
Development of biomolecular material systems

Professor Satoru KIDOAKI  
Associate Professor Hirohiko ISE  
Assistant Professor Kuboki THASANEYYA

Bioengineering, Biophysical Chemistry, Cell Manipulation Engineering

## Division of Applied Molecular Chemistry Hybrid Molecular Assemblies

Ito Campus

**Molecular Systems for New Polymer Materials**

Hierarchical Structure in Soft-materials  
Functional Films with Precise Polymerization Technique  
Stereo-regular Structure

Nano-fibers  
Polymer Crystals  
Ordered Structure  
Helical Structure

Surface/Interface Structure and Properties of Polymer Brushes  
Functional Polymer Hybrids  
Inorganic Nano-tubes  
Inorganic Nano-micelle

Professor Atsushi TAKAHARA  
Associate Professor Ken KOJIO  
Research Assoc. Prof. Ryoosuke MATSUNO  
Assistant Professor Yoshifumi AMAMOTO  
Research Assist. Prof. Masaru MUKAI

Polymer Chemistry, Surface Chemistry, Soft Materials

## Division of Fundamental Organic Chemistry Advanced Organic Synthesis

Chikushi Campus

**Design and Synthesis of Bioactive Small Molecules**  
Organic Chemistry & Molecular Biology

Functional Organic Molecule  
Triptycenes  
Synthetic Organic Chemistry for Life Science  
Natural Product Synthesis  
Stemonamine  
Inhibitor of mitochondrial ATP generation  
Plant Regulator  
cis-Cinnamic acid  
Agrochemicals  
DDS, Inhibitor of Glycolysis, Cancer Therapeutic Target Pathway  
2-DG

Professor Mitsuru SHINDO  
Associate Professor Arihiro KANO  
Assistant Professor Takayuki IWATA  
Junji TANAKA

Organic Chemistry, Life Science, Medicine/Agrochemical

## Division of Applied Molecular Chemistry Cluster Chemistry

Chikushi Campus

**Synthesis of new organometallic clusters, which are effective as homogeneous catalysts to synthesize various useful organic molecules and polymers with fine structures.**

**Intelligent Catalyst System**  
An efficient reduction of carboxamides is offered by the ruthenium-cluster catalyst with polymethylhydrosiloxane (PMHS).

**Nanoparticle ON Nanofiber**  
Highly Efficient and reusable catalysts with no leaching of the metals

**On the surface**  
Environmentally benign catalyst system  
Reusable and environmentally friendly iron catalyst

To develop really environmentally benign synthetic system by using non-toxic and recyclable element

Professor Hideo NAGASHIMA  
Assistant Professor Atsushi TAHARA

Organic Chemistry, Organometallic Chemistry, Environmentally Friendly Catalysis

## Division of Integrated Materials Design of Nano-systems

Chikushi Campus

**Blue phase liquid crystals with hierarchical structures**

Liquid crystal molecule (2 nm)  
Nematic LC  
Blue phase LC  
Chiral dopant

Self-organization  
Double twist cylinder (75 nm)  
Unit lattice model of blue phase (300 nm)  
Confocal laser scan micrograph

Professor Hirotosugu KIKUCHI  
Associate Professor Yasushi OKUMURA

Soft Matter Science (Liquid Crystal, Polymer), Self-organization, Next-generation LCD

## Division of Integrated Materials Nanostructured Integrated Materials

Chikushi Campus

**Innovation via Atomic Engineering of Inorganic Nanomaterials**

Nanostructure Chemistry  
Single crystalline nanowires  
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

Professor Takeshi YANAGIDA  
Associate Professor Kazuki NAGASHIMA  
Research Assoc. Prof. Tsunaki TAKAHASHI  
Research Assist. Prof. Takuro HOSOMI  
Research Associate Zhang Guozhu

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)

Material Science, Nanoscale Science, Green/Life Innovation Devices

Division of Integrated Materials  
**Heterogeneous Integrated Materials** Chikushi Campus

**Materials Chemistry based on Organic Synthesis**

Associate Professor Ken ALBRECHT

Solution-Processable OLEDs (Dendrimer materials)

Microporous Crystalline Fibers

Single-Molecule Diodes

Photoluminescence/Sensor

Organic Chemistry, Materials Chemistry, Organic semiconductor

Division of Advanced Device Materials  
**Photonic Materials** Chikushi Campus

**Photonic Materials**

Associate Professor Katsuhiko FUJITA

Organic Field-Effect Transistor

Organic Photovoltaic Cell

High-Performance Organic Semiconductor

Organic Light Emitting Diode

New Device Preparation Technique

Organic Materials Chemistry, Organic Electronics, Organic Device

Division of Advanced Device Materials  
**Energy Storage Materials** Chikushi Campus

**Energy Storage Materials**

Professor Shigeto OKADA

Assistant Professor Atsushi INOISHI

Cathode candidates for next generation proposed by Okada Lab.

$\text{Li}_2\text{CoPO}_4\text{F}$ : JP3624205 (2004. 12. 10)

$\text{LiCoPO}_4$ : JP3523397 (2004. 2. 20)

$\text{FePO}_4$ : JP3126007 (2000. 11. 2)

$\text{Na}_2\text{FeF}_6$ : JP2008-243646A

$\text{Li}_2\text{FeSiO}_4$ : JP2007-335325A

Electrochemistry, Material Science, Secondary Battery

Division of Advanced Device Materials  
**Nano Scale Evaluation** Chikushi Campus

**Polymer photonic devices**

Professor Shiyoshi YOKOYAMA

Assistant Professor Kazuhiro YAMAMOTO

Research Assist. Prof. Qui Feng

Research Associate Hong Jianxun

Associate Professor Yoshiaki TAKAHASHI

Assistant Professor Akihiko TAKADA

Dendrimer

Polymer photonics

EO polymer

Nanoscale polymer devices

Polymer Chemistry, Nanotechnology, Optoelectronics

Division of Advanced Device Materials  
**Carbon Materials Science** Chikushi Campus

**Carbon Materials Science**

Professor Seong-Ho YOON

Associate Professor Jin MIYAWAKI

Assistant Professor Koji NAKABAYASHI

Production of High-functional Carbon Materials Based on New Structural Unit Model

Development of High-performance Carbon Materials from Low Rank Resources

High-strength carbon fiber prepared from naphtha-cracked oil

Material Science, Functional Carbon Materials, Energy & Environment

Division of Advanced Device Materials  
**Microprocess Control** Chikushi Campus

**Microprocess Control**

Professor Junichiro HAYASHI

Assistant Professor Shinji KUDO

Assistant Professor Shusaku ASANO

Chemical Reaction Engineering in Carbon Resource Conversion

Biomass

Wastes

Pyrolysis Gasification

Energy/Chemical Platform

Chemical reaction engineering, Chemical energy conversion, Carbonaceous resource conversion

**International Collaborative and Interdisciplinary Laboratory**

Division of Soft Materials  
**Soft Materials Chemistry** Ito Campus

**Soft Materials Chemistry**

Professor Masaru TANAKA

Associate Professor Takahisa ANADA

Research Assoc. Prof. Shingo KOBAYASHI

Assistant Professor Daiki MURAKAMI

Research Assist. Prof. Fumihiko ARATSU

Design of Highly Functionalized Bio-Compatible Materials based on Hydration Structure Control at Bio-Interfaces.

Polymer synthesis

Interface analysis

Cell culture

"Intermediate Water" Concept

Biomaterial, Bio-compatibility, Hydrated water

Division of Soft Materials  
**Nano-bio Device** Ito Campus

Professor Kaoru TAMADA

Assistant Professor Sou RYUZAKI

Division of Soft Materials  
**Mechanobio-materials** Ito Campus

Professor Satoru KIDOAKI

Assistant Professor Kuboki Thasaneeya

Division of Soft Materials  
**Soft Interface Chemistry** Ito Campus

Professor Atsushi TAKAHARA

Assistant Professor Yoshifumi AMAMOTO

**Evaluation Center of Materials Properties and Function**

Center Director Mitsuru SHINDO

The center is engaged in the management and operation of large equipment for shared use, with an intensive allocation of technical staff with advanced expertise. This allows the implementation of advanced analysis of molecules and materials, as well as related education and instructions. The center also carries out diverse activities pertaining to the environmental and safety management of the institute.

Division of Soft Materials  
**Evaluation Office of Materials Properties and Function** Chikushi Campus

**Evaluation Office of Materials Properties and Function**

Chief Associate Professor Yoshiaki TAKAHASHI

Assistant Professor Akihiko TAKADA

Physical Properties of Polymeric Materials

Biopolymers

Polysaccharide

Protein

DNA

Synthetic Polymers

From nano scale (Molecular Structure)

Relationship between Hierarchical Structure and physical properties of polymers

Controlling methods.

to meso scale (Hierarchical Structure)

Polymer network

Crystalline

Immiscible blends

Polymer Science, Soft Matter Physics, Environment-conscious polymers

**Office of Research Support**

The Evaluation Office of Materials Properties and Function also offers consultations on research related to advanced analyses to external researchers. The main activities of the Office of Research Support are related to environmental and safety management of the institute as well as analysis support for internal and external researchers and students.

■The main equipment

NMR, Solid state NMR, Single-crystal X-ray structure analysis, XRD, SAXS, TEM, MASS, ESR

Chief Assistant Professor Junji TANAKA

Technical staff Mitsutaka UMEDU, Keiko IDETA, Satoko GONDO, Taisuke MATSUMOTO, Takeshi TANAKA

