

# ICR

Division of Synthetic Chemistry

Division of Materials Chemistry

Division of Biochemistry

Division of Environmental Chemistry

Division of Multidisciplinary Chemistry

Advanced Research Center for Beam Science

International Research Center for Elements Science

Bioinformatics Center

2014  
Institute for Chemical Research,  
Kyoto University

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# Preface



Director  
SATO, Naoki

The Institute for Chemical Research (ICR), launched in 1926 as the first research institute at Kyoto University, will celebrate its 88th anniversary in 2014, however, its factual roots date back to 1915 (Specialized Center for Chemical Research founded at Kyoto Imperial University, College of Science for the study of special medicinal substance, "Salvarsan," that is, arsphenamine, and so on). Our founding vision was to "Excel in the Investigation of Basic Principles of Chemistry and Their Applications." Since then, the ICR has continuously produced outstanding research achievements. Now, we have reached the current large-scale organization of five research divisions: Synthetic Chemistry, Materials Chemistry, Biochemistry, Environmental Chemistry, and Multidisciplinary Chemistry and three research centers: Advanced Research Center for Beam Science, International Research Center for Elements Science (IRCELS), and Bioinformatics Center. Currently, about 120 faculty members, 210 graduate students and 60 researchers are engaged in research activities in 31 laboratories in total supervised by full-time professors. Furthermore, we have 5 laboratories supervised by visiting professors and also an endowed laboratory.

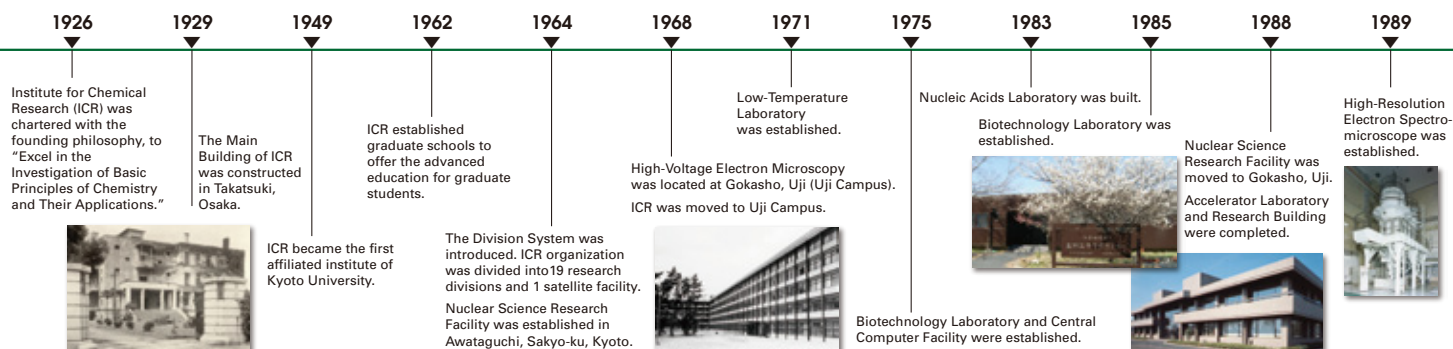
The research in the ICR encompasses the fields of chemistry, physics, biology, and informatics. The chemical studies core covers fields including physical chemistry, inorganic chemistry, organic chemistry, materials chemistry, and biochemistry. The graduate schools to which our laboratories belong as cooperative ones accepting graduate students cover diverse fields of science, engineering, agriculture, pharmaceutical sciences, medicine, informatics, and human/environmental studies. These laboratories are spearheading leading-edge research, and yielding outstanding results in their own and/or correlated research areas. The legacy of our founding philosophy above continues to the present day and describes the essence of our research activities. With this vision in mind, we have entrusted our scientists to choose and pursue research topics at the forefront of advanced chemistry with bottom-up paradigms. Whether or not the human race maintains sustained growth is a key issue of this century.

Moreover, we must facilitate the recovery and reconstruction of Japan with bearing in mind the Great East Japan Earthquake three years ago and a variety of difficult challenges it faces. Hence, the ICR encourages its members to be actively involved in research projects with bottom-up approach in mind, and to value the development of unique interdisciplinary research projects, in order to create new knowledge as well as to contribute to the future of our society in materials-related fields. Actually, one of our major issues in hand are creation and development of bio-inspired smart materials from the view point of not only academic interests but also a policy aimed at fabricating a sustainable society, as they will fulfill highly efficient respective functions enabling reduction of the effects on the environment and so on.

Besides, the ICR is currently collaborating with domestic/overseas universities and research organizations (with about 64 official international collaboration agreements) and is functioning as a Joint Usage/Research Center proclaiming the Frontier/Interdisciplinary Research Core for Deepening Investigation and Promoting Cooperation in Chemistry-Oriented Fields supported by MEXT (2010-2016); its activity received high commendation on the interim assessment last year. In addition, the ICR, IRCELS in particular, is making a significant contribution to the MEXT Project of Integrated Research on Chemical Synthesis (2010-2016) as one of the key members of core research institutions from four Japanese national universities. Further, we also fully strive to foster and secure of young researchers through these activities as well as the graduate education mentioned above. For instance, last year we restarted an in-house annual grant system named "ICR Grant for Encouraging Promoting Integrated Research." The strong collaboration basis so far constructed in-house and also with ensures the ICR serves as the core of global research propellers in chemistry-oriented fields. Finally, we would appreciate your continued encouragement and support.

## History

For about 90 years of its history, ICR has continued the challenge to uncover the basis of chemistry and answer the frontier quests.





# Our Mission

The founding philosophy of the Institute for Chemical Research is to “Excel in the Investigation of Basic Principles of Chemistry and Their Applications.” Research is grounded on the core values of freedom, independence, and harmony. As a key part of Kyoto University, the institute is committed to contributing to the harmonious development of the global community by solving fundamental chemical issues.

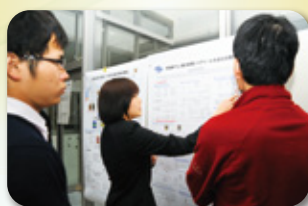
## 1. Research

We regard chemistry as a broad area of the natural sciences, and strive for balanced development: the platform of basic research into the true nature of matter serves as a foothold for more applied studies that strive to be flexible and responsive to the challenges of our global society.



## 2. Education

Through research in an integrated environment of world-class laboratories, we aim to train and develop talented people with broad experience and a high level of problem solving skills, capable of providing leadership towards the harmonious development of the global community.



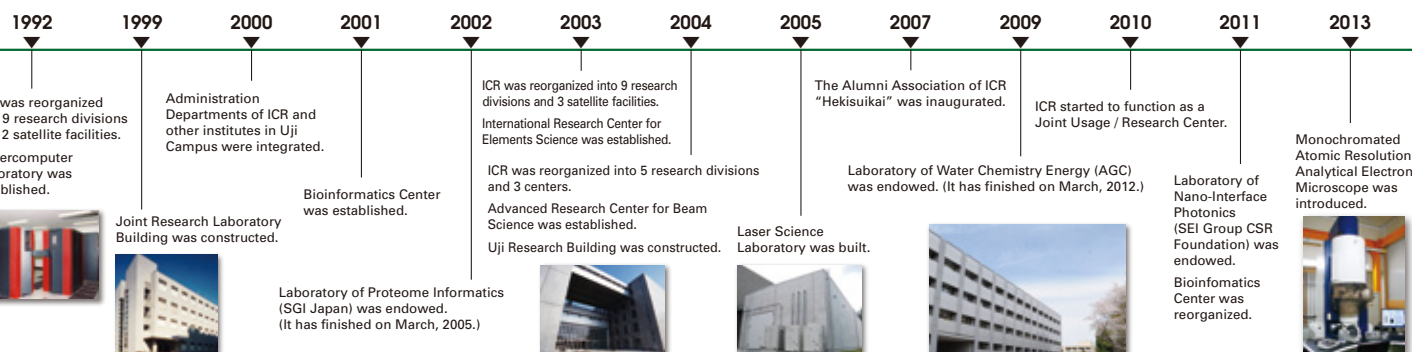
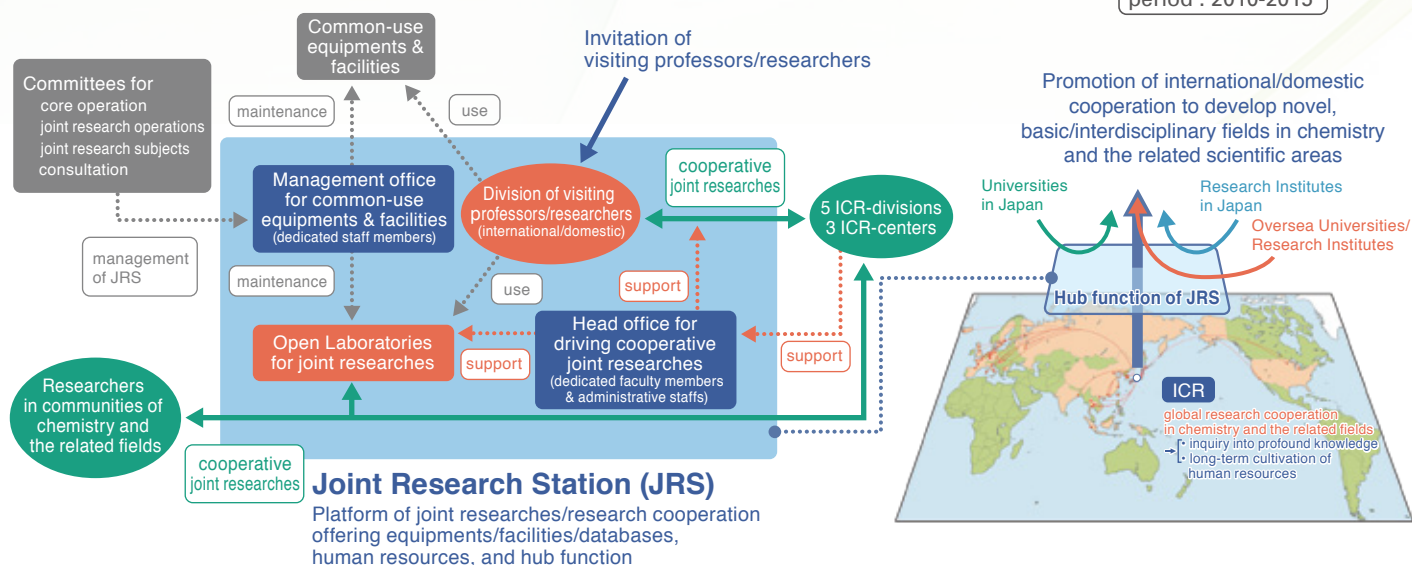
## 3. Relationship with Society

As researchers and educators of chemistry, we endeavor to deepen our exchanges with local communities and the Japanese society. We envision contributing to solving global problems through active scientific exchange with international researchers and institutions. Lastly, we commit to our accountability to society through internal review and information disclosure.



## Frontier/Interdisciplinary Research Core in ICR for Deepening Investigation and Promoting Cooperation in Chemistry-Oriented Fields

period : 2010-2015



## Division of Synthetic Chemistry

Research is conducted for the creation of "Novel Materials" for clarification of their structures, functions, and properties irrespective of disciplines of organic and inorganic chemistry.

Original research is conducted in individual laboratories across scientific disciplines toward the creation of novel materials beyond common concepts. Clarification of the structure and intrinsic properties of novel materials have impact in many scientific fields including material science, synthetic organic and inorganic chemistry.

### Organoelement Chemistry

**S** Prof. TOKITOH, Norihiro (D.Sc.)  
 Assoc. Prof. SASAMORI, Takahiro (D.Sc.)  
 Assist. Prof. MIZUHATA, Yoshiyuki (D.Sc.)  
 Assist. Prof. AGOU, Tomohiro (D.Sc.)  
 Techn. Staff HIRANO, Toshiko



### Structural Organic Chemistry

**E** Prof. MURATA, Yasujiro (D.Eng.)  
 Assoc. Prof. WAKAMIYA, Atsushi (D.Eng.)  
 Assist. Prof. MURATA, Michihisa (D.Eng.)



### Synthetic Organic Chemistry

**P** Prof. KAWABATA, Takeo (D.Pharm.Sc.)  
 Assoc. Prof. FURUTA, Takumi (D.Pharm.Sc.)  
 Assist. Prof. YOSHIMURA, Tomoyuki (D.Pharm.Sc.)  
 Techn. Staff FUJIHASHI, Akiko



### Advanced Inorganic Synthesis

**S** Prof. TERANISHI, Toshiharu (D.Eng.)  
 Assist. Prof. SAKAMOTO, Masanori (D.Eng.)  
 Assist. Prof. SATO, Ryota (D.Sc.)



## Division of Materials Chemistry

Creation of new functional materials for next generation by hybridization, conjugation, and integration of different materials and by nano-miniaturization.

The aim of this research area is to develop a controlled synthetic method for nano-sized macromolecules. Novel precision fabrication of polymeric materials are also investigated. This area also emphasizes the creation and development of new functional materials by controlling electronic, photonic, and spin states through hybridization of organic-inorganic materials, creation of novel surfaces with high-density polymer brushes, development of nano-fabrication of artificial multi-layers, and the utilization of size- and quantum effects.

### Chemistry of Polymer Materials

**E** Prof. TSUJII, Yoshinobu (D.Eng.)  
 Assoc. Prof. OHNO, Kohji (D.Eng.)  
 Assist. Prof. SAKAKIBARA, Keita (D.Agr.)  
 PS Assist. Prof. ISHIGE, Ryohei (D.Eng.)  
 PS: Program Specific



### Polymer Controlled Synthesis

**E** Prof. YAMAGO, Shigeru (D.Sc.)  
 Assoc. Prof. TOSAKA, Masatoshi (D.Eng.)  
 Assist. Prof. KAYAHARA, Eiichi (D.Eng.)  
 PS Assoc. Prof. NAKAMURA, Yasuyuki (D.Sc.)  
 PS: Program Specific

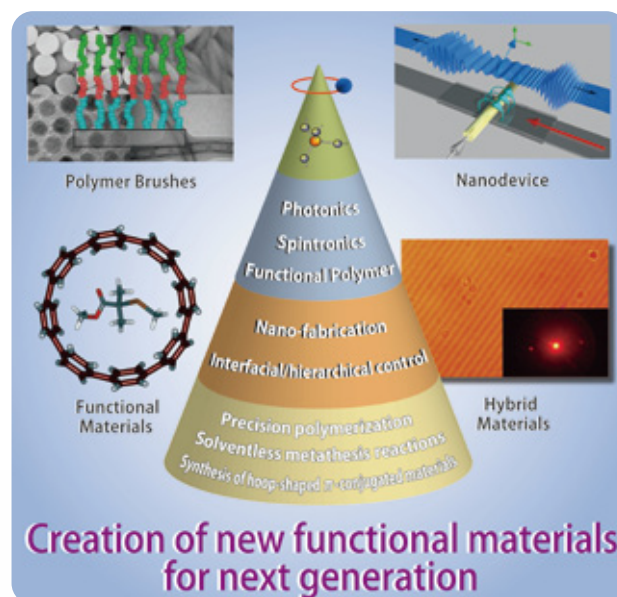
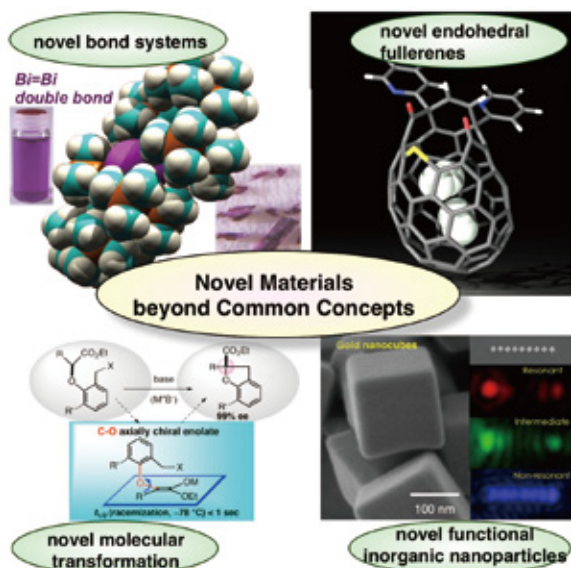


### Inorganic Photonics Materials

**E** Assoc. Prof. TOKUDA, Yomei (D.Eng.)  
 Assist. Prof. MASAI, Hirokazu (D.Eng.)

### Nanospintronics

**S** Prof. ONO, Teruo (D.Sc.)  
 Assist. Prof. MORIYAMA, Takahiro (Ph.D.)  
 Assist. Prof. KIM, Kab-Jin (Ph.D.)  
 Techn. Staff KUSUDA, Toshiyuki



Our Goal Is to Create Novel Fields of Research by Integrating the Wisdom in Our Various Research Fields.



ICR at Kyoto University Continues Its Challenge to Reveal Novel Findings for the Human Society.





## Bioscience

### Division of Biochemistry

Biology meets chemistry; this division elucidates the mechanisms behind intra/inter-cellular recognition, stimuli response, and biomolecular synthesis in living organisms, leading to the development of pioneering novel materials.

The goals of this division are (i) Design and creation of bioactive peptides/proteins controlling cellular and gene functions, (ii) Chemical understanding of the reaction mechanisms and physiological significance of biocatalysts, (iii) Unveiling the framework of regulatory network between genetic programs and environmental stimulus responses in higher plants, and (iv) Discovery of new bioactive organic molecules and their new use.

#### Biofunctional Design-Chemistry

**P** Prof. **FUTAKI, Shiroh** (D Pharm Sc)  
 Assist Prof. **IMANISHI, Miki** (D Pharm Sc)  
 Assist Prof. **TAKEUCHI, Toshihide** (D Pharm Sc)



#### Chemistry of Molecular Biocatalysts

**A** Prof. **HIRATAKE, Jun** (D Agr)  
 Assist Prof. **WATANABE, Bunta** (D Agr)



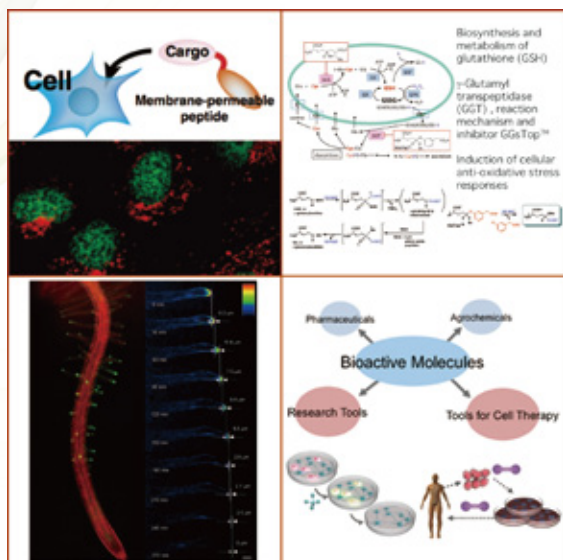
#### Molecular Biology

**S** Prof. **AOYAMA, Takashi** (D Sc)  
 Assoc Prof. **TSUGE, Tomohiko** (D Sc)  
 Assist Prof. **KATO, Mariko** (D Agr)  
 Techn Staff **YASUDA, Keiko**



#### Chemical Biology

**M** Prof. **UESUGI, Motonari** (D Pharm Sc)  
 Assoc Prof. **OHKANDA, Junko** (D Eng)  
 Assist Prof. **WATANABE, Mizuki** (D Pharm Sc)  
 PS Senior Lect. **PERRON, Amelie** (Ph D)  
 PS: Program Specific



## Environment

### Division of Environmental Chemistry

This research group aims to contribute to the development of a sustainable society through fundamental studies such as fabrication and characterization of environmentally-friendly organic devices, biogeochemistry in the hydrosphere, and biotechnology with useful enzymes and microorganisms.

The main research subjects are as follows: (1) Design and fabrication of novel organic LEDs and organic solar-cells. Clarification of relationship between structure and performance of the devices by solid-state NMR. (2) Biogeochemistry of trace elements in the hydrosphere, ion recognition. (3) Study of chemical roles of minute water and molecular complex involved in a functionalized polymer and a solution using vibrational spectroscopy. (4) Physiology of extremophilic microorganisms and their applications to production of useful compounds and bioremediations. Biochemistry of trace elements.

#### Molecular Materials Chemistry

**E** Prof. **KAJI, Hironori** (D Eng)  
 Assoc Prof. **GOTO, Atsushi** (D Eng)  
 Assist Prof. **FUKUSHIMA, Tatsuya** (D Eng)  
 Techn Staff **OHMINE, Kyoko**  
 Techn Staff **MAENO, Ayaka**



#### Hydrospheric Environment Analytical Chemistry

**S** Prof. **SOHRIN, Yoshiki** (D Sc)  
 Assoc Prof. **UMETANI, Shigeo** (D Sc)  
 Techn Staff **MINAMI, Tomoharu** (D Eng)



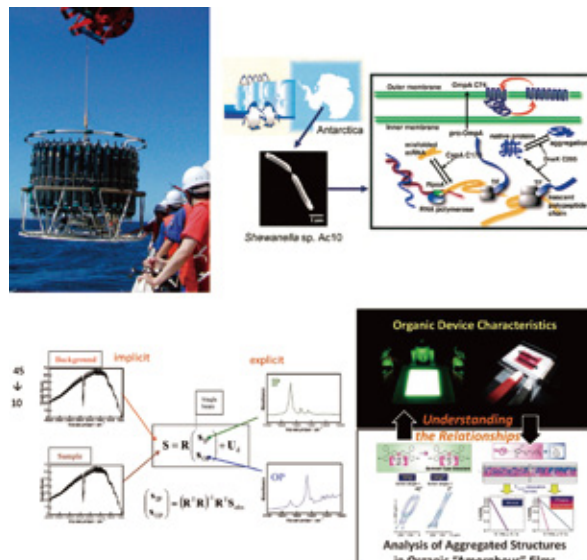
#### Solution and Interface Chemistry

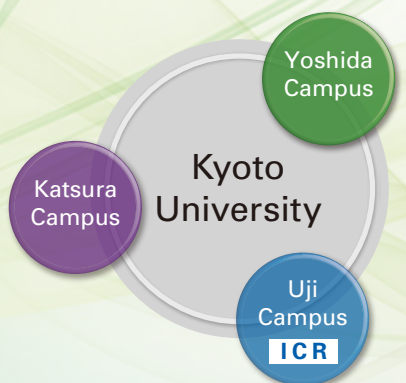
**S** Prof. **HASEGAWA, Takeshi** (D Sc)  
 Assist Prof. **WAKAI, Chihiro** (D Sc)  
 Assist Prof. **SHIMOAKA, Takafumi** (D Sc)



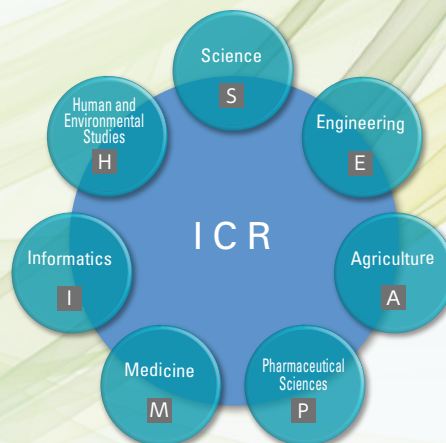
#### Molecular Microbial Science

**A** Prof. **KURIHARA, Tatsuo** (D Agr)  
 Assist Prof. **KAWAMOTO, Jun** (D Agr)





3 Campuses of Kyoto University



Education in the Graduate Schools

### Integration

## Division of Multidisciplinary Chemistry

Integrating viewpoints of science and engineering, we aim at developing basis in the interdisciplinary area between chemistry and physics. We carry out fundamental, exploratory research through cooperation with other divisions/centers in ICR to establish a novel aspect of the advanced materials science.

This division performs basic research that aims to achieve molecular understanding of various phenomena of natural/artificial materials, develop an interdisciplinary integration view of natural science based on chemistry, and establish a new aspect of material science. The research is being conducted with a multidisciplinary methodology through collaboration within this division as well as with the other divisions/centers in ICR.

#### Polymer Materials Science

**E** Prof. KANAYA, Toshiji (D Eng)  
 Assoc Prof. NISHIDA, Koji (D Eng)  
 Assist Prof. OGAWA, Hiroki (D Eng)



#### Molecular Rheology

**E** Prof. WATANABE, Hiroshi (D Sc)  
 Assoc Prof. MASUBUCHI, Yuichi (D Eng)  
 Assist Prof. MATSUMIYA, Yumi (D Eng)  
 Techn Staff OKADA, Shinichi



#### Molecular Aggregation Analysis

**S** Prof. SATO, Naoki (D Sc)  
 Assoc Prof. ASAMI, Koji (D Sc)  
 Assist Prof. YOSHIDA, Hiroyuki (D Sc)  
 Assist Prof. MURDEY, Richard (Ph D)



#### Interdisciplinary Chemistry for Innovation

**E** Prof. TOSHIMITSU, Akio (D Eng)



### Extreme Conditions

## Advanced Research Center for Beam Science

Our research is performed to develop new capabilities with combination of various beams, to develop new methods for space-time analysis with extreme resolution, to multidimensionally analyze of functional chemical materials oriented for application, and to establish the collaborative research system.

The Advanced Research Center aims to create advanced material science in nanoscale space/time by combining various beams (particle, laser, electron and X-ray beams) to understand and control nanospace/time phenomena from physical, chemical and biological aspects. The current topics include dynamics and handling of particle beams and improvement of their characteristics, physics of intense short pulse laser-matter interactions and its applications, high-resolution dynamical structure visualization of nano-materials, analysis of chemical reaction pathways, and dynamical analysis of vital phenomena based on molecular structures.

#### Particle Beam Science

**S** Assoc Prof. IWASHITA, Yoshihisa (D Sc)  
 Techn Staff TONGU, Hiromu

#### Laser Matter Interaction Science

**S** Prof. SAKABE, Shuji (D Eng)  
 Assoc Prof. HASHIDA, Masaki (D Eng)  
 Assist Prof. INOUE, Shunsuke (D Sc)



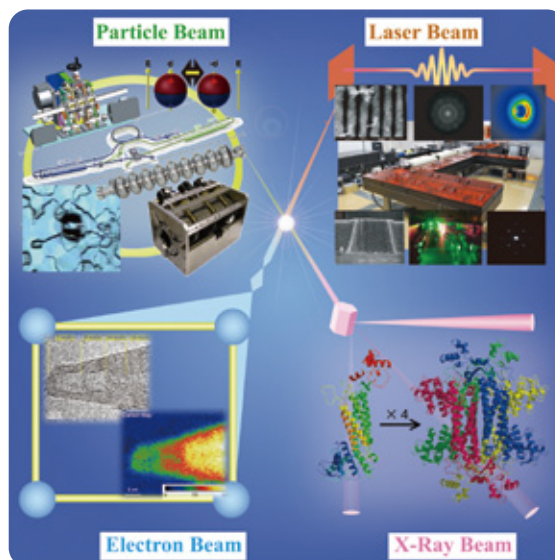
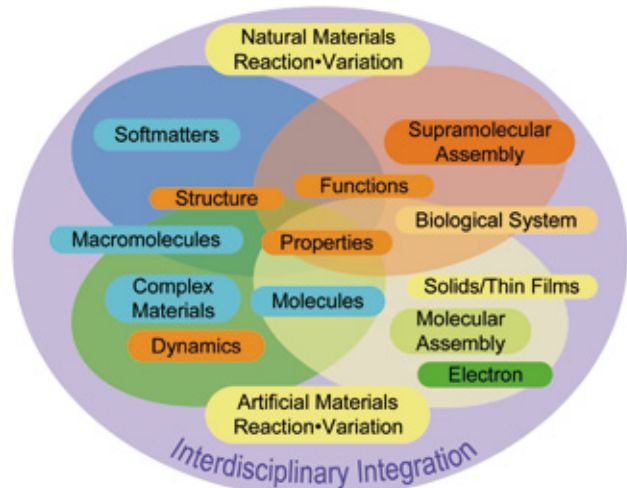
#### Electron Microscopy and Crystal Chemistry

**S** Prof. KURATA, Hiroki (D Sc)  
 Assist Prof. NEMOTO, Takashi (D Sc)  
 Assist Prof. HARUTA, Mitsutaka (D Sc)



#### Structural Molecular Biology

**H** Prof. HATA, Yasuo (D Sc)  
 Assoc Prof. ITO, Yoshiaki (D Sc)  
 Assist Prof. FUJII, Tomomi (D Sc)  
 Assist Prof. YAMAUCHI, Takae (D Agr)





## International Research Center for Elements Science

Our aim is to develop a guideline for the creation of novel elementary materials through uncovering the role of key elements which determine the functions of materials.

Our research interests are centered on the development of Elements Science for creation of new functional materials and innovative chemical transformations. We are trying to design and synthesize new inorganic and organic compounds and to seek for their new functionalities from the viewpoints of fundamental science and industrial applications.

### Organic Main Group Chemistry

**E** Prof. NAKAMURA, Masaharu (D.Sc.)  
 Assoc. Prof. TAKAYA, Hikaru (D.Eng.)  
 Assist. Prof. ISOZAKI, Katsuhiro (D.Eng.)  
 PS Assist. Prof. IWAMOTO, Takahiro (D.Eng.)  
 PS: Program Specific



### Advanced Solid State Chemistry

**S** Prof. SHIMAKAWA, Yuichi (D.Sc.)  
 Assist. Prof. KAN, Daisuke (D.Sc.)  
 Assist. Prof. SAITO, Takashi (D.Sc.)  
 PS Assist. Prof. ICHIKAWA, Noriya (D.Eng.)  
 PS: Program Specific



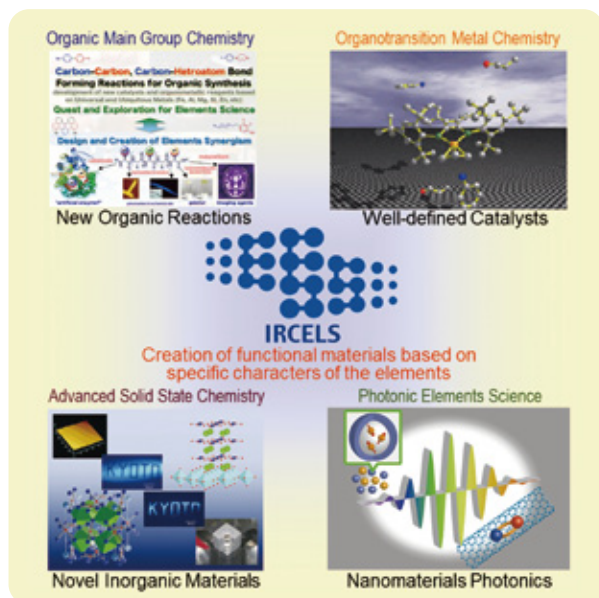
### Organotransition Metal Chemistry

**E** Prof. OZAWA, Fumiyouki (D.Eng.)  
 Assist. Prof. WAKIOKA, Masayuki (D.Eng.)  
 Assist. Prof. TAKEUCHI, Katsuhiko (D.Sc.)



### Photonic Elements Science

**S** Prof. KANEMITSU, Yoshihiko (D.Eng.)  
 Assoc. Prof. TAYAGAKI, Takeshi (D.Sc.)  
 Assist. Prof. IHARA, Toshiyuki (D.Sc.)



## Bioinformatics Center

Our laboratories promote research in bioinformatics and the development of the foundation for an integrated and extensive resource for the bioscience.

In order to understand and utilize the information encoded in the genome, a blueprint of life, it is necessary to develop both state-of-the-art informatics technologies and excellent human resources. The Bioinformatics Center is involved in basic research on the analysis of genomic and molecular information towards understanding design principles of the biological systems, applications of bioinformatics methods to pharmaceutical and medical sciences, development of databases for deciphering the genome, and bioinformatics education and training of young scientists.

### Chemical Life Science

**S** Prof. OGATA, Hiroyuki (D.Sc.)  
 Assoc. Prof. GOTO, Susumu (D.Eng.)



### Mathematical Bioinformatics

**I** Prof. AKUTSU, Tatsuya (D.Eng.)  
 Assist. Prof. HAYASHIDA, Morihiro (D.Inf.)  
 Assist. Prof. TAMURA, Takeyuki (D.Inf.)



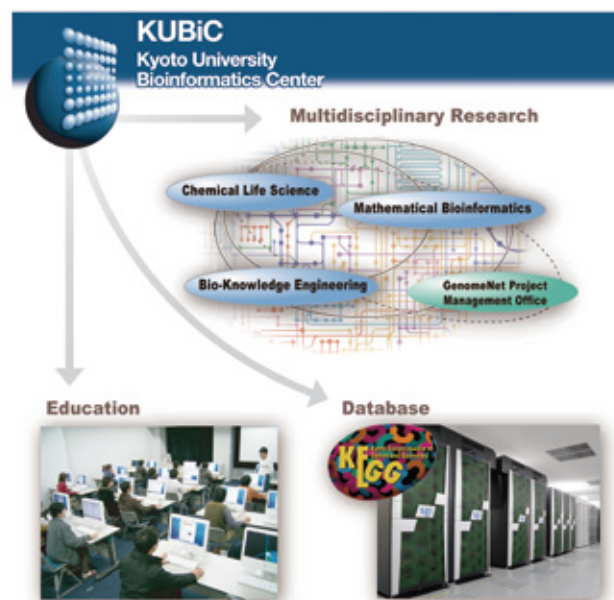
### Bio-knowledge Engineering

**D** Prof. MAMITSUKA, Hiroshi (D.Sc.)  
 Assist. Prof. KARASUYAMA, Masayuki (D.Eng.)  
 Assist. Prof. NGUYEN, Hao Canh (D.Eng.)



### GenomeNet Project Management Office

Prof. AKUTSU, Tatsuya (D.Eng.)



## Endowed Research Section

Division of Nano-Interface Photonics (SEI Group CSR Foundation) has been opened in April 2011, donated by Sumitomo Electric Industries Group CSR Foundation.

Our research aim is to open up new research field of nanomaterials science, by focusing on nano-interface as a platform to develop novel optical functionalities. We study optical properties of semiconductor nanomaterials, leading to new solar energy conversion technologies.

Program Specific  
 Assoc. Prof. YAMADA, Yasuhiro  
 Program Specific  
 Assist. Prof. OKANO, Makoto  
 Prof. (Supporting Faculty Member) KANEMITSU, Yoshihiko

## Hakubi Project to Foster and Support Young Researchers, Kyoto University

Algorithmic Graph Theory with Applications to Bioinformatics

Program Specific  
 Assoc. Prof. JANSSON, Jesper

## Visiting Professor from International Country

International Research Center for Elements Science,  
 Organic Main Group Chemistry

Prof. LI, Zhiping Professor, Renmin University of China, China, P. R.  
 March-May, 2014

## Visiting Professors

Division of Materials Chemistry, Chemistry of Polymer Materials

Prof. MATSUKAWA, Kimihiro Director, Electronic Materials Research Division, Osaka Municipal Technical Research Institute

Division of Environmental Chemistry, Molecular Microbial Science

Prof. KOBAYASHI, Toshihide Chief Scientist, Lipid Biology Laboratory, RIKEN

Advanced Research Center for Beam Science, Electron Microscopy and Crystal Chemistry

Prof. SUENAGA, Kazutomo Prime Senior Researcher, Nanotube Research Center, National Institute of Advanced Industrial Science and Technology

Bioinformatics Center, Bio-knowledge Engineering

Prof. MORISHITA, Shinichi Professor, Graduate School of Frontier Sciences, The University of Tokyo

Division of Synthetic Chemistry, Synthetic Organic Chemistry

Assoc. Prof. YOKOSHIMA, Satoshi Associate Professor, Graduate School of Pharmaceutical Sciences, Nagoya University

Division of Biochemistry, Chemistry of Molecular Biocatalysts

Assoc. Prof. MIZUTANI, Masaharu Associate Professor, Graduate School of Agricultural Science, Kobe University

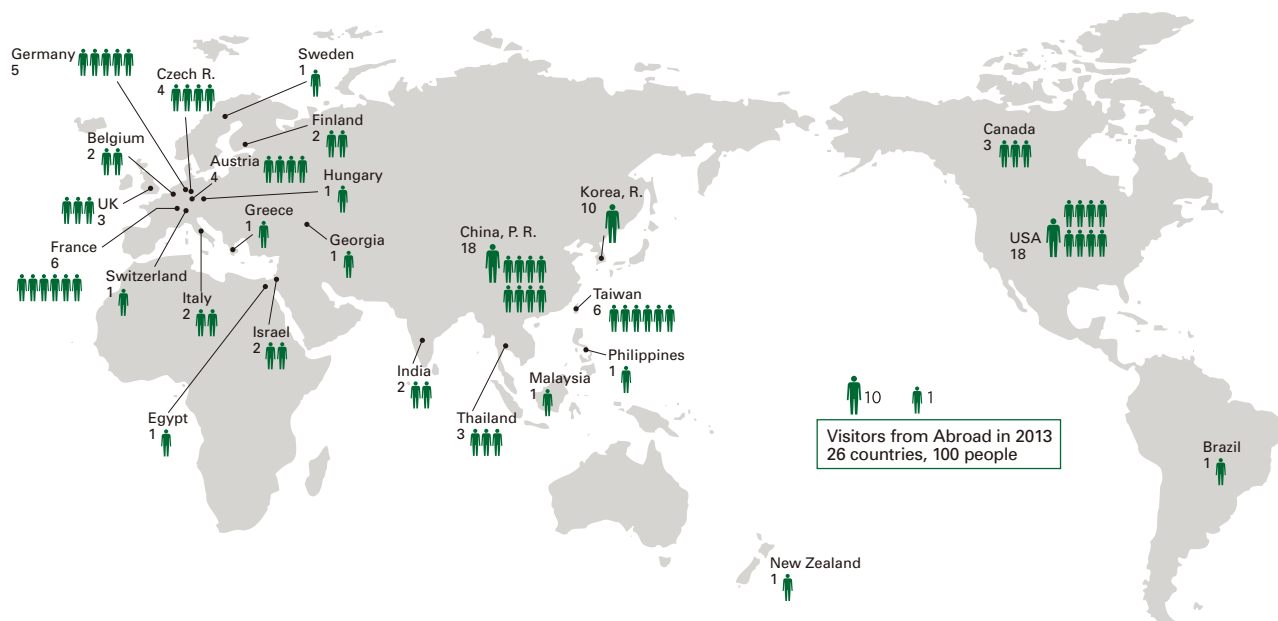
Division of Multidisciplinary Chemistry, Molecular Aggregation Analysis

Assoc. Prof. HAYASHI, Naoto Associate Professor, Graduate School of Science and Engineering for Research, University of Toyama

International Research Center for Elements Science, Organotransition Metal Chemistry

Assoc. Prof. HASHIMOTO, Hisako Associate Professor, Graduate School of Science, Tohoku University

# Visitors from Abroad in 2013



## Major Research Projects

As of May 2014

### Research and Education Funding

**Joint Usage / Research Center: Frontier/Interdisciplinary Research Core in ICR for Deepening Investigation and Promoting Cooperation in Chemistry-Oriented Fields**

Representative from ICR : SATO, Naoki / Term : 2010-2015

### MEXT Project of Integrated Research on Chemical Synthesis

Joint Project with CRC (Hokkaido Univ), RCMS (Nagoya Univ), IMCE (Kyushu Univ)

Representative from ICR : OZAWA, Fumiuyuki / Term : 2010-2015



### Life Science Database Integration Project

**Database Integration Coordination Program Integrated Database Linking Genomes to Phenotypes, Diseases and Drugs**

Research Leader : KANEHISA, Minoru (Specially Appointed Professor) / Term : 2014-2016

## Human Resource in ICR

### Faculty

Numbers in ( ) Represent Visiting Professors.

Professor	Associate Professor	Assistant Professor	Technical Staff	PS* Associate Professor	PS* Senior Lecturer	PS* Assistant Professor	PS* Researcher	Sub-total	Researcher**	Other Staff	Sub-total	Total
29	19	39	9	2	1	4	10	113	30	30	60	173
(4)	(4)							(8)				(8)

\* PS: Program Specific \*\* Including Researchers from Abroad As of July 1, 2014

### Researchers(PD) from Abroad

Country	Number	Country	Number	Country	Number	Country	Number	Total
Australia	1	Austria	1	China, P. R.	5	India	5	12
Korea, R.	1	Taiwan	3	Vietnam	2			18

As of May 1, 2014

### Research Students, Fellows and Associates

Research Student	Research Fellow	Postdoctoral Fellow of JSPS	Research Associate	Total
3	2	3	13	21

As of May 1, 2014

### Graduate Students

Numbers in ( ) Represent Students from Abroad.

	Science	Engineering	Agriculture	Pharmaceutical Sc.	Medicine	Informatics	Human & Environmental Studies	Total
Master's Course	41	58	13	11	1	3		127
	(1)	(3)	(1)	(1)	(1)	(3)		(10)
Doctoral Course	32	14	4	21	4	8		83
	(3)	(2)		(3)	(2)	(4)		(14)
Total	73	72	17	32	5	11	0	210
	(4)	(5)	(1)	(4)	(3)	(7)		(24)

As of May 1, 2014

### Graduate Students from Abroad

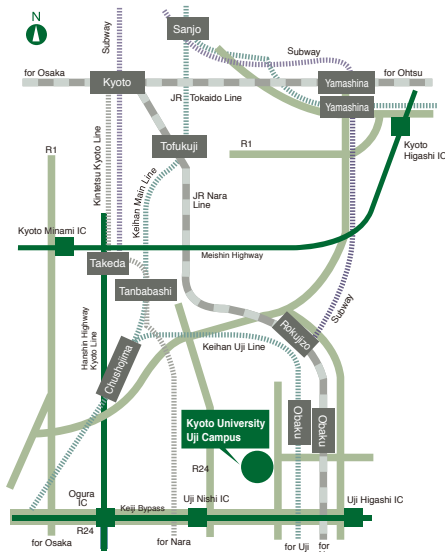
Country	Number	Country	Number	Country	Number	Country	Number	Total
Cambodia	1	China, P. R.	17	Congo, D. R.	1	Egypt	1	20
Korea, R.	2	Taiwan	1	Thailand	1			24

As of May 1, 2014



## Institute for Chemical Research, Kyoto University

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E-mail: koho@scl.kyoto-u.ac.jp



### Access

From Obaku Station on the JR Nara Line: 7 min by walk (from Kyoto Station to Obaku Station: 20 min)  
From Obaku Station on the Keihan Uji Line: 10 min by walk (from Sanjo Station to Obaku Station: 35 min)  
From Kyoto-Minami IC: 20 min by car  
From Uji-Higashi IC: 10 min by car / From Uji-Nishi IC: 10 min by car