Special Research Projects

IMS has special research projects supported by national funds. Six projects in progress are:

(a) The Ministry of Education, Culture, Sports, Science and Technology
HPCI Strategic Program "The Strategic Program for Innovation Research (SPIRE)"
Field 2 "New Materials and Energy Creation"
"Construction of Innovative High Performance Computing Infrastructure (HPCI)"
(b) Extreme Photonics
(c) MEXT Nanotechnology Platform Program
Platform of Molecule and Material Synthesis
(d) Inter-University Network for Efficient Utilization of Research Equipments
(e) Consortium for Photon Science and Technology (C-PhoST)

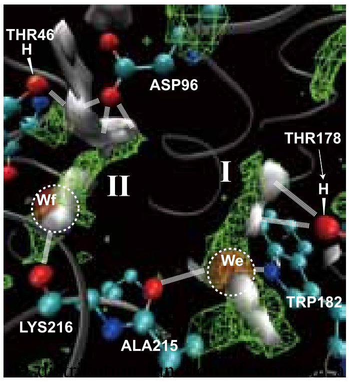
These five projects are being carried out with close collaboration between research divisions and facilities. Collaborations from outside also make important contributions. Research fellows join these projects.

(a) The Ministry of Education, Culture, Sports, Science and Technology HPCI Strategic Program "The Strategic Program for Innovation Research (SPIRE)" Field 2 "New Materials and Energy Creation" "Construction of Innovative High Performance Computing Infrastructure (HPCI)"

HPCI strategy programs "SPIRE" aims to promote scientific research using "K-computer" at RIKEN Advanced Institute for Computational Science. In the strategic filed 2 of SPIRE, the Institute for Solid State Physics (ISSP) of the University of Tokyo, Institute for Molecular Science (IMS), and Institute for Material Research (IMR) of Tohoku University were selected as strategic organizations. The project started in September 2010 for "Computational Material Science: Turning the Headwaters of Basic Science into a Torrent of Innovations in Functional Materials and Energy Conversion" as a strategic target. To promote the activities of the strategic organizations, a new community "Computational Materials Science Initiative (CMSI)" consisting of research fields of condensed matter physics, molecular science and materials science was launched.

Theoretical and Computational Chemistry Initiative (TCCI) at IMS completed the activities of the 2013 fiscal year: (1) TCCI continued to contribute on making "Road-Map for Computational Science" to clarify the requests for post-K computers, such as computing speed, memory size, and other specifications, (2)TCCI organized the fourth TCCI workshop, the third symposium for communicating with experimental chemists, and the other one for industry–academic partnership, (3)TCCI also sponsored the seventeenth summer school of Molecular Simulations, two TCCI winter colleges (molecular simulations, and quantum chemistry), and one workshop for massively parallel programming, (4)Research Center for Computational Science (RCCS) continued to provide a part of its computing resources to the SPIRE project as one of the actvities of TCCI, and (5)TCCI and RCCS started to promote several software developed in "Next Generation Integrated Nanoscience Simulation Software Development" project, which had been completed by the end of FY 2011.

In the following years, TCCI is going to pursue the activities above and promote the research using K-computer and the computational molecular science field.



protein computed with the MC-MOZ method.

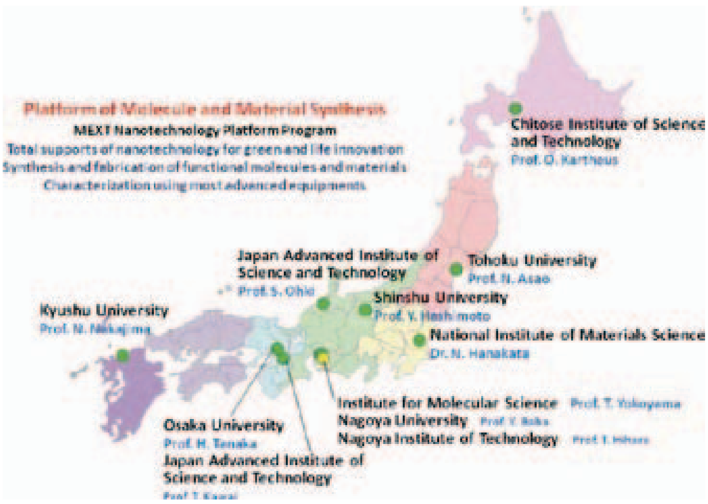
(b) Extreme Photonics

Institute for Molecular Science has a long-standing tradition of promoting spectroscopy and dynamics of molecules and molecular assemblies. Accordingly, photo-molecular science is one of the major disciplines in molecular science. This field is not confined in the traditional spectroscopy, but makes solid basis for other disciplines including nanoscience and bioscience, *etc*. Therefore, continuing developments in spectroscopy and microscopy are vital to enhance our abilities to elucidate more complex systems in time and spatial domains. In order to achieve full developments of photo-molecular science, we need to pursue three branches in developing: (1) new light source, (2) new spatio-temporally resolved spectroscopy, and (3) new methods to control atomic and molecular dynamics. Since 2005, we have started the program of "Extreme Photonics" in collaboration with the RIKEN institute. Currently 6 groups in IMS are involved in this program, and the specific research titles are as follows:

(1) Development of new light sources	
TAIRA, Takunori	Micro Solid-State Photonics
FUJI, Takao	Coherent Synthesis of Femtosecond Pulses over the UV-IR Range
KATOH, Masahiro	Coherent Synchrotron Radiation
(2) Development of new spatio-temporally resolved spectroscopy	
OKAMOTO, Hiromi	Development of Extreme Time-Resolved Near-Field Spectroscopy
(3) Development of new methods to control atomic and molecular dynamics	
OHMORI, Kenji	Development of Attosecond Coherent Control and Its Applications
OHSHIMA, Yasuhiro	Quantum-State Manipulation of Molecular Motions by Intense Coherent Laser Pulses

(c) MEXT Nanotechnology Platform Program Platform of Molecule and Material Synthesis

Since July 2012, Nanotechnology Platform Program supported by Ministry of Education, Culture, Sports, Science and Technology has been conducted in order to promote public usage of various nanotechnology facilities. This program will continue until March 2022 and consists of three platforms of nanostructure analysis, nanoprocessing, and molecule and material synthesis, together with the management center of the platforms. Each platform constitutes of about ten organizations all over Japan. IMS conducts a representative core organization of the Molecule and Material Synthesis Platform. All the organizations in this platform are shown in Figure. In this platform, to promote green and life innovation researches using nanotechnology related techniques not only for universities and government institutes but also for private companies, we will open various kinds of our facilities with total supports including molecular synthesis, materials fabrications, characterization, data analysis and scientific discussion. We will encourage applications not only to each element, but to combined usage of several supporting elements for biotechnology and green chemistry. In IMS, the number of accepted proposals amounted 123 (103 non-proprietary and 20 proprietary proposals, excluding applications from IMS) and the total number of days used for the supports is 2488 (2379 days for non-proprietary proposals and 109 days for proprietary ones).



List of Supports in IMS (FY2013)

Supporting Element		Responsible Persons		Charging Persons
Platform Management		T. Yokoyama, Y. Kaneko, M. Inoue		Y. Funaki, Y. Toyama, M. Yokota, K. Nakane
Organization Management in IMS		T. Yokoyama		
UVSOR Synchrotron Radiation	Scanning Transmission X-Ray Microscopy	M. Katoh	N. Kosugi	T. Ohigashi, Y. Inagaki
	X-Ray Magnetic Circular Dichroism		T. Yokoyama	Y. Takagi, M. Uozumi, Y. Uemura
Microstructure Fabrication		M. Katoh	M. Suzui, M. Aoyama	N. Takada, T. Kondou
Electron Microscopy	300kV Transmission Electron Microscopy	Y. Ohshima		T. Ueda
	Field Emission Scanning Electron Microscopy			S. Nakao
	Focus Ion Beam Processing			
Molecular Properties	Electron Spectroscopy for Chemical Analysis	Y. Ohshima	N. Kosugi	M. Sakai
	Electron Spin Resonance		T. Nakamura	M. Fujiwara
	Superconducting Quantum Interference Device			
	Microscopic Raman Spectroscopy		H. Yamamoto	M. Uruichi
	Fourier Transform Far Infrared Spectroscopy			
High Field NMR	920 MHz NMR Solutions & Solids	Y. Ohshima	K. Kato, K. Nishimura	T. Yamaguchi M. Nakano
	800 MHz Solutions, Cryostat Probe		K. Kato	T. Yamaguchi
	600 MHz Solids		K. Nishimura	
Functional Molecular Synthesis and Molecular Device Fabrication	Organic Thin Film Solar Cells	T. Yokoyama	M. Hiramoto	T. Kaji
	Organic Field Effect Transistors		H. Yamamoto	M. Suda, M. Uruichi
	Molecular Catalysts		M. Tada	S. Muratsugu
	Functional Organic Synthesis		H. Sakurai	S. Higashibayashi
	Large Scale Quantum Mechanical Calculations		M. Ehara	R. Fukuda
	Magnetic Thin Films		T. Yokoyama	Y. Takagi, M. Uozumi, Y. Uemura

(d) Inter-University Network for Efficient Utilization of Research Equipments

It is highly important to improve the supporting environment for research and education in the field of science and engineering. Nowadays, advanced research instruments are indispensable for conducting research and education in high standard. To install such sophisticated instruments, significant amount of budgets is necessary. In 2007, for constructing a national-wide network to provide the easy access to high-level equipments to researchers and students in universities all over Japan, the 5 year project “Functioning of Inter-University Network for Efficient Utilization of Chemical Research Equipments,” was launched. The network maintains an internet machine-time reservation and charging system by the help of equipment managers and accounting sections in each university. 73 national universities all over Japan have been participating to the network. They are grouped into 12 regions and in each region the regional committee discusses and determines the operation of regional network system with the hub university chairing. There is no barrier for every user to access to any universities beyond his/her regional group. From 2009, the registered equipments are open to the researchers and students of every public and private universities. Since 2010, the project name has been changed as “Inter-University Network for Efficient Utilization of Research Equipments,” still keeping the original strategy and stable functioning. In June 2014, the number of user registrants amounts to more than 9000 in 147 universities/institutions covering more than 2300 laboratories in Japan. Usage of the network reaches to a few thousands per month since April 2010, and keeps growing in numbers.

(e) Consortium for Photon Science and Technology (C-PhoST)

In order to establish strong bases in the research and education in optical science, a new 10-year program "Photon Frontier Network" has been started in 2008 by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). Consortium for Photon Science and Technology (C-PhoST) is the one of two research consortia of Photon Frontier Network. It is composed of 4 Core Organizations headed by Principal Investigators (written in parentheses): Osaka University (R. Kodama), JAEA (A. Sugiyama), Kyoto University (S. Noda) and Institute for Molecular Science (K. Ohmori). The major strength of this Consortium is the collaboration between the specialists in three fields: High power lasers, semiconductor lasers, and coherent control. Emphasis is placed in the education to foster young researchers capable of taking leaderships in scientific projects through participation to the forefront researches taking place at C-PhoST and also participation to international collaboration activities.

Okazaki Conference

The 73rd Okazaki Conference
Coherent and Incoherent Wave Packet Dynamics
(October 30–November 2, 2013)

Organizers: M. Shapiro (*Univ. British Columbia*), K. Ohmori (*IMS*), Y. Ohshima (*IMS*)

The topics discussed at the Coherent and Incoherent Wave Packet Dynamics colloquium are at a forefront of a number of rapidly expanding interdisciplinary areas of research, spanning atomic, molecular, and optical physics, condensed-matter physics, chemical physics, physical chemistry, quantum optics, and quantum information, with the number of groups interested in applying coherent control to such diverse areas of research increasing rapidly from year to year. Of particular interest will be the implementations of recent technological breakthroughs in molecular and laser science, which offer new ways of creating and manipulating molecular processes using quantum effects.

The main objectives of the workshop are: 1) To discuss strategies of making progress in subfields which have so far resisted the application of coherent control. 2) To advance innovative future technologies, and in particular the development of new optical tools to exercise control on the nanoscale. 3) To discuss ways of enhancing the interactions between theoreticians and experimentalists that are absolutely crucial for making progress in such an interdisciplinary field. 4) To lay the foundation for a strong and vibrant hub of activity in coherent control across the Pacific, which will facilitate the exchange of UBC and Japanese scientists and students and the organization of joint workshops and conferences. 5) To make the public more aware of the tremendous potentials of coherent control, and UBC's leadership in this field.

As for the public event, the participants enjoyed an excursion to Asuke village, which is a historical village that used to be a hub of salt trading along "Sanshu Highway" in Edo era. They also enjoyed Samurai performance played by a volunteer group in Okazaki. These events helped participants to develop their personal friendships.

Listed below is the list of invited speakers.

Prof. Ilya Averbukh (Weizmann Institute of Science)
Prof. Thomas Baumert (University of Kassel)
Prof. Jianshu Cao (Massachusetts Institute of Technology)
Prof. Akihito Ishizaki (Institute for Molecular Science)
Prof. Ronnie Kosloff (The Hebrew University of Jerusalem)
Prof. Roman Krems (The University of British Columbia)
Prof. Robert J. Levis (Temple University)
Prof. Valery Milner (The University of British Columbia)
Prof. Takamasa Momose (The University of British Columbia)
Prof. Kazutaka Nakamura (Tokyo Institute of Technology)
Prof. Ed Narevicius (Weizmann Institute of Science)
Prof. Keith Nelson (Massachusetts Institute of Technology)
Prof. Yasuhiro Ohshima (Institute for Molecular Science)
Prof. Hiromi Okamoto (Institute for Molecular Science)
Dr. Leonardo Pachon (University of Toronto)
Dr. Benjamin Sussman (National Research Council, Canada)
Prof. Matthias Weidemuller (University of Heidelberg)

The colloquium yielded a coherent control network across a variety of disciplines raging from atomic physics to biosciences. It has also laid the foundation for a strong and vibrant hub of activity in coherent control across the Pacific between UBC and Japanese scientists, and has made the public more aware of the tremendous potentials of coherent control and UBC's leadership in this field.

The invited speakers gave excellent lectures on the frontiers of a variety of disciplines ranging from AMO physics, nano-sciences, condensed matter physics, and biosciences from a viewpoint of quantum coherence. There was a good balance between experimentalists and theoreticians. Such arrangement of speakers activated interdisciplinary discussion among all the participants to discuss each subject for its new perspective and concept, and to further promote coherent control network across those various disciplines.

Examples of innovative approaches or creative ways of knowing that were developed or expanded through this Colloquium are as follows.

1) New schemes of optical control and observation of molecular rotation, strong-laser induced molecular dissociation and ionization, high bit-rate information processing with molecular vibration, formation of ultracold molecules, and ultracold molecular collisions.
2) Exploring many-body physics with ultracold Rydberg gases and ultracold molecules in an optical lattice.
3) Optical control of collective motion in condensed phases such as plasmon, coherent phonons, and photo-induced phase transitions in bulk solids and nano-materials.
4) Exploring the role of coherence in biological systems such as photosynthesis and circadian rhythm.

The colloquium generated a new research model in which coherent control, which has originally been developed for isolated small molecules, is now being applied to many-body systems ranging from strongly correlated ensembles of ultracold atoms and molecules to biological systems such as photosynthesis. Such active control offers a new possibility for better understanding of those complicated many-body phenomena than that obtained by passive observation.

The colloquium has demonstrated a possibility of new collaborations of two different disciplines such as ultracold physics and ultrafast coherent control, quantum optics and photosynthesis, and quantum information processing and molecular science. It has also promoted collaborations in each discipline among top researchers of Canada, USA, Europe, Israel, and Japan.

Although we initially planned to simulate the exchange of idea and concepts between participants belonging to different research fields, the varieties and diversities of the topics discussed in the colloquia were far more extended than we expected. Some representative examples, exhibiting the present state-of-the-art status of coherent control, includes: Creation of a uni-directionally rotating molecular ensemble with its internal energy reaching to hundred times of thermal ensembles, bimolecular reaction with finely tuned collisional energy ranging from a few tens of K to mK, and spatio-temporal tracking of excitation-energy transfer from a single ultracold Rydberg atom to surrounding ground-state atoms. Still, the discussions were not simply scattered into each specific problems, but always linked to a common concept, *i.e.*, coherent/incoherent nature of the systems under discussions. It was impressive to observe unexpectedly intensive exchange of thoughts between the researchers with different disciplines.

At the beginning, we had always to spend some times to clarify the difference in meaning of the same words or terms among the people with different research backgrounds, before we were able to find out the bottom line of the discussions we shared in the colloquia. After managing this little bit time-consuming process, it became possible to extract the similarity in the underlying physics and the uniqueness of each system, from apparently different two phenomena observed in separated fields, *e.g.*, energy transfer in ultracold atoms and bio-systems. It was also of much appreciation to find out plenty of possibilities of state-of-the-art new technology developed in some research field transferable to a far remote scientific area, for instance, ultrafast laser technology to be implemented in ultracold atomic physics and coherent control of molecular degrees of freedom into quantum information processing.

This article was reprinted from Wall Colloquia Abroad Report, Peter Wall Institute for Advanced Studies, The University of British Columbia.

Joint Studies Programs

As one of the important functions of an inter-university research institute, IMS facilitates joint studies programs for which funds are available to cover the costs of research expenses as well as the travel and accommodation expenses of individuals. Proposals from domestic scientists are reviewed and selected by an interuniversity committee.

(1) Special Projects

A. Development of Polarized Quantum Beam Sources and their Applications to Molecular Science

KATOH, Masahiro *(IMS)*
KOBAYASHI, Kensei (*Yokohama Natl. Univ.*)
YAMAMOTO, Naoto (*Nagoya Univ.*)
AKITSU, Takashiro (*Tokyo Univ. Sci.*)
OHGAKI, Hideaki (*Kyoto Univ.*)
KURIKI, Masao (*Hiroshima Univ.*)
TOYOKAWA, Hiroyuki (*AIST*)
KIMURA, Shin-ichi *(Osaka Univ.)*

By using particle accelerator technologies, polarized quantum beams of various kinds can be produced, which can be powerful tools for molecular science. In this joint study program, we have been developing techniques to produce polarized quantum beams and exploring their applications. The major part of the researches has been carried out in the UVSOR facility.

We have succeeded in producing intense circular polarized UV and VUV radiation by using polarization-variable undulators and free electron lasers. We successfully demonstrated that they could be a powerful tool for the investigations on the photon induced chirality on the bio-molecules.[1,2] Towards higher intensity polarized photon beams, we developed a new undulator system called optical klystron and installed it in the ring (Figure 1). The ordinary undulator radiation is useful for experiments that requires wide tunability of the wavelength from UV to VUV but does not require very high intensity. Some experiments on the base metal complexes utilizing these polarized lights have started by the Tokyo Univ. Sci. team. We have successfully demonstrated the generation of coherent VUV radiation by using the undulator and an external laser, based on Coherent Harmonic Generation (CHG) technique. The CHG radiation is also polarization variable and has much higher peak intensity than the ordinary undulator radiation. A combined use of the CHG radiation and coherent terahertz radiation, which is generated simultaneously, is under preparation.

We successfully demonstrated the generation of polarized gamma-rays by using a technique called Laser Compton Scattering (LCS) in collaboration with AIST. Laser photons are injected to the electron beam and are scattered off, and they are converted to gamma-rays via inverse Compton scattering process. The polarity of the gamma-rays can be changed by changing that of the laser photons. We have successfully demonstrated that these gamma-ray photons can be used for the photon-induced positron annihilation lifetime spectroscopy.[3] The possible applications utilizing their polarization are being explored.

In Nagoya University, a polarized electron source has been developed based on an electron gun technology using the GaAs photocathode. The spin polarization higher than 90% has been demonstrated.[4] In collaboration with the Nagoya University team, we have been developing a spin polarized electron source at UVSOR. Some experiments on the chirality of the bio-molecules has been started. An inverse photoelectron spectroscopy system is being developed in collaboration with Osaka University team.

Based on the results on this joint study program, several research projects have started, based on other grants, such as Astrobiology program of CNSI, NINS, Grant-in-Aid for Scientific Research, and so on.

Figure 1. Twin Polarization-variable Undulator System at UVSOR-III.

References

1) J. Takahashi, H. Shinojima, M. Seyama, Y. Ueno, T. Kaneko, K. Kobayashi, H. Mita, M. Adachi, M. Hosaka and M. Katoh, *Int. J. Mol. Sci.* **10**, 3044–3064 (2009).
2) H. Nishino, M. Hosaka, M. Katoh and Y. Inoue, *Chemistry* **19**, 13929–13936 (2013).
3) Y. Taira, H. Toyokawa, R. Kuroda, N. Yamamoto, M. Adachi, S. Tanaka and M. Katoh, *Rev. Sci. Instrum.* **84**, 053305 (2013).
4) N. Yamamoto, X. G. Jin, A. Mano, T. Ujihara, Y. Takeda, S. Okumi, T. Nakanishi, T. Yasue, T. Koshikawa, T. Ohshima, T. Saka and H. Horinaka, *J. Phys.: Conf. Ser.* **298**, 012017 (2011).

B. Development of a Power Delivery IC for Wavelength Selective Organic Solar Cells

MIYAMOTO, Jun-ichi (*Chubu Univ.*)
HIRAMOTO, Masahiro (*IMS*)
KAJI, Toshihiko (*IMS*)
SATO, Motoyasu (*Chubu Univ.*)
ITOH, Hibiki (*Chubu Univ.*)
KATO, Akira (*Chubu Univ.*)

The present project aims at new solar cell system symbiotic with plants. The system uses mainly green-yellow wavelength region, unnecessary for the photosynthesis. One of the research elements is a development of a photocurrent extraction system with a small loss from circuit network connecting the vast number of cells. The system is realized by the Integrated Circuits, based on a new concept, named as a Power Delivery IC (PDIC).

The PDIC block diagram is shown in Figure 1. The voltage drop of the transfer-gate depends on the current flow. But it can be designed to be smaller by enlarging the transistor width. It means that the power of each solar cell can be taken out with little loss in comparison with a conventional one. The transfer-gate goes OFF, when the generated voltage of a cell drops below the reference voltage, preventing the power loss toward the non-active cell. The PDIC also notifies the locations of non-active cells outside, by outputting the memory data. Since the non-active cells are easily detected, they can be replaced in order to sustain whole system performance.

The PDIC was designed, and was fabricated with the 0.18μm CMOS process. The PDIC timing chart is shown in Figure 2, obtained by the actual chip evaluation. Note that the circuits consume the DC power only during the period of activating comparators (MONEN = high.). It is easy to make the PDIC power consumption negligibly small, since the climate changing speed is very slow as an order of second, or even millisecond.

Dye Sensitized Solar Cells (DSSC) are connected to the 4 stage PDIC for power generation system. Figure 3 depicts AC and DC characteristics of the output, PWSUM (power summation). It is shown that in case of 4 active cells, the PWSUM drivability increases and the power is accumulated by PDIC. Actually, because of the performance variation among cells, the total drivability did not exactly equal to 4 times of one cell active case.

The PDIC concept has been successfully verified by evaluating the actual chip. The device concept can be applied not only to DSSC, but also to organic solar cells. In other words, the PDIC, the combination IC of analog & digital circuits and power transistors, enables to accumulate low-density energy source, widely spread over in nature, effectively.

This work is supported by VLSI Design and Education Center, the University of Tokyo in collaboration with Synopsys, Inc., and Cadence Design Systems, Inc.

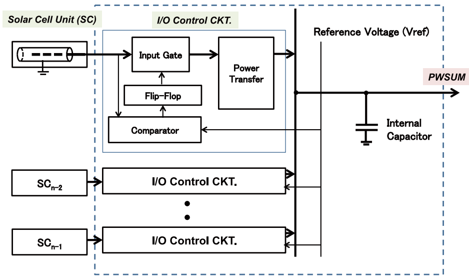


Figure 1. Block Diagram of PDIC. The interface with each Solar Cell is not a conventional blocking diode but a CMOS transfer-gate. The comparator detects whether a cell is active or not, by comparing the generated voltage by a Solar Cell with the reference voltage. The information is stored in the memory, which controls the gate of transfer-gates. The electric power obtained by each active cell is accumulated on the internal capacitor.

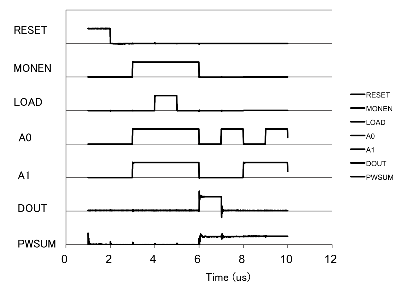
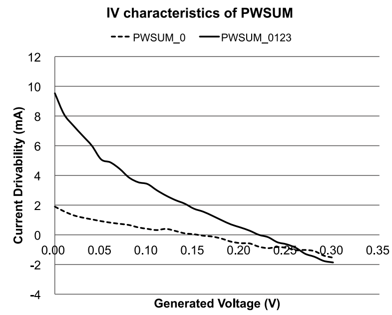


Figure 2. PDIC Timing Chart. At first, the RESET turns all the transfer-gates OFF. Then, the MONEN (Monitor Enable) makes comparator active, and the status of a Solar Cell is loaded in the memory at the LOAD timing. In the Figure, because only one cell is active, DOUT goes high only when the address of the SC, (A0, A1) equals to (0, 0). The accumulated power appears on the PWSUM (Power Summation).

(A)



(B)

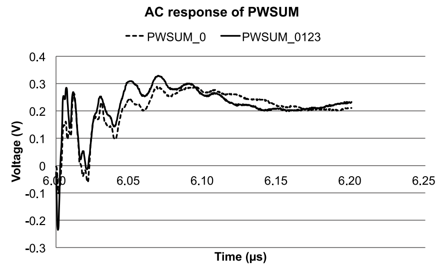


Figure 3. DC (a) and AC (b) Characteristics of PDIC connected to DSSC in both cases of 4 active cells (PWSUM_0123) and just one active cell (PWSUM_0). The PWSUM waveforms correspond to those in Figure 2 between 6 μs and 6.2 μs.

(2) Research Symposia

(From Oct. 2013 to Sep. 2014)

Dates	Theme	Chair
Oct. 3– 4, 2013	Photo-Controllable Electronic Phases in Molecular Conductors	**YAMAMOTO, Hiroshi**
Oct. 25–26, 2013	Future Materials Initiative from π-System Figuration with Multi-Discipline Integration	**ISOBE, Hiroyuki** **SAKURAI, Hidehiro**
Nov. 18–19, 2013	Developing New Ideas Based on the History of Rhodopsin Studies	**IMAMOTO, Yasushi** **FURUTANI, Yuji**
Nov. 25–27, 2013	IMS Asian International Symposium Korea-Japan Seminars on Biomolecular Sciences—Experiments and Simulations	**KATO, Koichi**
Dec. 18–19, 2013	Survey and Perspective of Material Science by Advanced ESR Studies	**OTA, Hitoshi** **NAKAMURA, Toshikazu**
Mar. 12–13, 2014	Structure and Function of Metal Clusters and Coordination Polymers	**NORO, Shin-ichiro** **MURAHASHI, Tetsuro**
Sep. 27, 2014	Molecular Science in the Cell Nucleus	**URISU, Tsuneo** **FURUTANI, Yuji** **SAITO, Shinji**
Jun. 15, 2014	Preparation Meeting for 54th Young Researchers Society for Molecular Science, 2014 Summer School	**FUKUDA, Masahiro** **FURUTANI, Yuji**
Jul. 21–23, 2014	12th ESR Summer School	**TANAKA, Ayaka** **NAKAMURA, Toshikazu**

(3) Numbers of Joint Studies Programs

Categories		Oct. 2013–Mar. 2014		Apr. 2014–Sep. 2014		Total		
		Regular	NanoPlat	Regular	NanoPlat	Regular	NanoPlat	Sum
Special Projects		0		1		1		1
Research Symposia		6		1		7		7
Research Symposia for Young Researchers		0		2		2		2
Cooperative Research		32	24	30	32	62	56	118
Use of Facility	Instrument Center	17	43	14	54	31	97	128
	Equipment Development Center	4	4	3	9	7	13	20
Use of UVSOR Facility		70	30	67	22	137	52	189
Use of Facility Program of the Computer Center						185*		185*

* from April 2013 to March 2014

Collaboration Programs

(a) International Inter-Institutional Collaboration Symposia

Several international symposia and workshops in molecular science are held in IMS and in Japan. Some workshops are organized with our MOU partners for international collaboration in the MOU partner's country as well as in Japan:

Program	Coordinator	Date	Place
Okazaki Conference "Coherent and Incoherent Wave Packet Dynamics"	OHMORI, Kenji (IMS) OHSHIMA, Yasuhiro (IMS) SHAPIRO, Moshe (Univ. British Columbia, Canada)	2013.10.30–11.2	IMS
Workshop at German Science Days in Kyoto "Use of Accelerator-Based Photon Sources: Present State and Perspectives"	RÜHL, Eckart (Freie Univ. Berlin, Germany) KOSUGI, Nobuhiro (IMS)	2013.10.26	Kyoto University
ESR Workshop at Institute for Molecular Science —Toward International Cooperation—	NAKAMURA, Toshikazu (IMS)	2013.10.28–29	IMS
Joint IMS-KU (Kasetsart Univ. Thailand) Workshop "Joint IMS-KU Workshop on Molecular Sciences towards Green Sustainability"	HANNONGBUA, Supa (KU, Thailand) EHARA, Masahiro (IMS)	2014.1.5–1.6	Kasetsart University, Bangkok, Thailand
IMS Asian International Symposium "6th Japan-Korea Seminars on Biomolecular Science—Experiments and Simulations"	AONO, Shigetoshi (IMS) JEONG, Hawoong (KAIST, Korea) KATO, Koichi (IMS) KUWAJIMA, Kunihiro (SOKENDAI) LEE, Jooyoung (KIAS, Korea)	2013.11.25–11.27	IMS
SOKENDAI Asian Winter School "Innovations and Challenges in Molecular Science: From Basics to Cutting-Edge Researches"	MASAOKA, Shigeyuki (IMS) YANAI, Takeshi (IMS) SAKURAI, Hidehiro (IMS)	2013.12.10–12.13	IMS
EXODASS Mini Symposium	SAKURAI, Hidehiro (IMS)	2013.12.11	IMS
IMS Asian CORE (with ICCAS, KAIST, IAMS) "Asian CORE Winter School on Frontiers of Molecular, Photo- and Material Sciences"	UOZUMI, Yasuhiro (IMS) CHEN, Kuei-Hsien (IAMS) TAKAHASHI, Kaito (IAMS)	2014.2.24–2.26	Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei, Taiwan
Meeting with MOU Partner "CU (Chulalongkorn Univ., Thailand)-IMS Faculty Exchange Meeting"	SAKURAI, Hidehiro (IMS)	2014.2.25	IMS
Meeting with MOU Partner "NTU (Nanyang Technological Univ., Singapore)-IMS Faculty Exchange Meeting"	SAKURAI, Hidehiro (IMS)	2014.3.3	IMS

(b) IMS International Internship Programs and SOKENDAI International Lecture & Training Courses

Category	Number of People	
	Overseas	Domestic
IMS International Internship Program (EXODASS program incl.)	33*	–
SOKENDAI Asian Winter School (2013.12.10–2013.12.13)	29	14

* from Sep. 2013 to Aug. 2014

(c) IMS International Collaboration

Category	Number of People
International Joint Research Programs	59
International Use of Facilities Programs	34

* from Sep. 2013 to Aug. 2014

(d) MOU Partnership Institutions

IMS has concluded academic exchange and agreements with overseas institutions.

The agreements encourage

- Exchange of researchers
- Internship of students
- Joint research symposia

Institution	Period	Accept	Send
The Korean Chemical Society, Physical Chemistry Division [Korea]	2010.11–2014.11	11	0
Institute of Atomic and Molecular Sciences (IAMS) [Taiwan]	2011. 2–2017. 2	0	18
Institute of Chemistry Chinese Academy of Science (ICCAS) [China]	2008. 9–2018. 9	1	0
Korea Advanced Institute of Science and Technology (KAIST) [Korea]	2012. 9–2016. 9	0	0
École Nationale Supérieure de Chimie de Paris (ENSCP) [France]	2009.10–2014.10 2014.10–2019.10	10	1
Indian Association for the Cultivation of Science (IACS) [India]	2013. 3–2017. 3	4	1
Freie Universität Berlin (FUB) [Germany]	2013. 6–2016. 6	7	1

* from Sep. 2013 to Aug. 2014

Academic Exchange Agreement with Overseas Universities/Institutes (SOKENDAI) as follows ;

Institution	Period	Accept	Send
Chulalongkorn University, Faculty of Science [Thailand]	2010.4–2015.10	16	4
Kasetsart University, Faculty of Science [Thailand]	2011.3–2016.3	3	0
Mahidol University, Faculty of Science [Thailand]	2014.3–2019.3	3	1
Nanyang Technological University, College of Science [Singapore]	2014.3–2019.3	1	1
University of Malaya, Faculty of Science [Malaysia]	2014.3–2019.3	10	1

* from Sep. 2013 to Aug. 2014