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

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YAMAMOTO, Naoto (*Nagoya Univ.*)
SODA, Kazuo (*Nagoya Univ.*)
AKITSU, Takashiro (*Tokyo Univ. Sci.*)
KIMURA, Shin-ichi *(IMS)*

By using particle accelerator technologies, polarized quantum beams of various kinds can be produced. At the UVSOR facility, circular polarized coherent synchrotron radiation ranging from visible to deep UV can be produced by using resonator free electron laser.[1)] We have demonstrated that such polarized radiation is a powerful tool for molecular science.[2,3)] In this joint study program, we are developing techniques to produce polarized quantum beams of various kinds and explore their applications.

It was successfully demonstrated at UVSOR to produce circular VUV light beam by using a technique called Coherent Harmonic Generation (CHG).[4)] Towards higher intensity, a new undulator system called optical klystron was developed and installed in the ring. The generation of CHG was already confirmed. The ordinary undulator radiation itself is also useful for experiments that requires wide tunability of the wavelength from UV to VUV but does not require very high intensity. Some experiments utilizing these polarized lights have started.

It was also successfully demonstrated at UVSOR to produce a polarized gamma-ray source by using a technique called Laser Compton Scattering (LCS). Laser photons are injected to the electron beam and are scattered off, and they are converted to gamma-rays via inverse Compton scattering process.[5)] The polarity of the gamma-rays can be changed by changing that of the laser photons. The possible applications are now being explored.

In Nagoya University, a polarized electron source has been developed based on an electron gun technology using GaAs photocathode. The spin polarization higher than 90% has been demonstrated.[6)] In collaboration with Nagoya University, a spin polarized electron source is now under commissioning at UVSOR. Some experiments on bio-molecular science and on inverse photoelectron spectroscopy are under preparation.

Figure 1. Spin polarized electron gun under commissioning at UVSOR.

References

1) M. Hosaka, S. Koda, M. Katoh, J. Yamazaki, K. Hayashi, Y. Takashima, T. Gejo and H. Hama, *Nucl. Instrum. Methods Phys. Res., Sect. A* **483**, 146–151 (2002).
2) 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).
3) T. Nakagawa, T. Yokoyama, M. Hosaka and M. Katoh, *Rev. Sci. Instrum.* **78**, 023907 (2007).
4) M. Labat, M. Hosaka, M. Shimada, M. Katoh and M. E. Couprie, *Phys. Rev. Lett.* **101**, 164803 (2008).
5) Y. Taira, M. Adachi, H. Zen, T. Tanikawa, M. Hosaka, Y. Takashima, N. Yamamoto, K. Soda and M. Katoh, *Nucl. Instrum. Methods Phys. Res., Sect. A* **637**, 5116–5119 (2011).
6) 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. Series* **298**, 012017 (2011).

B. Development of Wavelength Selective Organic Solar Cells

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

Silicon solar cell shades the vast area of lands eliminating the plants. The present project aims at new solar cell system symbiotic with plants, *i.e.*, agriculture (Figure 1). In this system, green-yellow wavelength region for which the photosynthesis of plants does not use is selected by the diffraction grating and focused to the array of several tens microns-wide stripe-type organic solar cells (OSC). Thus, total system has transparent characteristics for plants.

Three research elements are required to construct the present system. (1) Development of wavelength selective (green-yellow region) OSC. (2) Optimization of arrangement of solar cell devices having branch structure similar to the plants. (3) Development of the photocurrent extraction system with a small loss from circuit network connecting the vast number of cells. Research elements (1) and (3) relating to development of OSC and trial manufacture of circuit connecting many OSCs are studied by the present special project.

Trial manufacture of circuit connecting many OSCs is now in progress. Since each cell can generate only small photovoltage and output power is strongly dependent on the irradiated solar light conditions which are easily changed in the system structure (Figure 1), power loss is very large in the simply connected circuit. To overcome this problem, new type of circuit of theoretically zero loss, which utilizes flash memory, is now under designing based on the photovoltaic characteristics of OSC fabricated in IMS (Hiramoto G).

Next year, in order to utilize the green-yellow light, the system combining the micro diffraction grating array with stripe-type OSCs will be designed. On the other hand, OSC which selectively absorbs only green-yellow solar light will be developed.

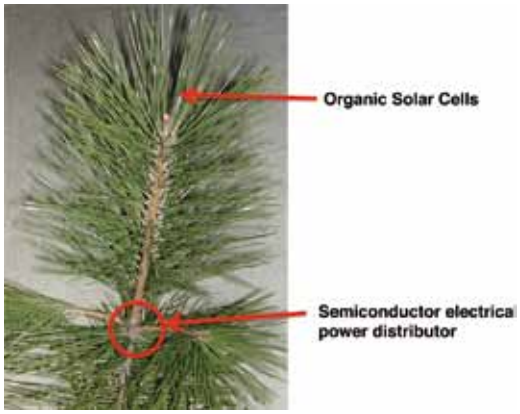

Figure 1. Concept of new plant-like organic solar cell system symbiotic with plants. A vast number of stripe-type organic solar cells only absorb green-yellow wavelength region was connected. Semiconductor power distributor extracts and a small photocurrent from each cell elements and accumulates the electricity. This system has transparent characteristics for the photosynthesis, namely, symbiotic with of natural plants and agriculture.

(2) Research Symposia

(From Oct. 2012 to Sep. 2013)

Dates	Theme	Chair
Oct. 11–12, 2012	Novel Light Generation and Materials Science —Development of Precise Measurement and Manipulation	**ASHIDA, Masaaki** **KATOH, Masahiro**
Nov. 24–26, 2012	Workshop of Quantum Dynamics and Quantum Walks	**SHIKANO, Yutaka** **SEGAWA, Etsuo**
Jan. 10–11, 2013	Prospects for Bio-Meterial Science	**KATO, Reizo** **FUJII, Hiroshi**
Jan. 17–19, 2013	The Present and the Future of Inorganic Chemistry: New Fields of Science Pioneered by Young Scientists	**KITAGAWA, Susumu** **MASAOKA, Shigeyuki**
Jan. 18–21, 2013	The 6-th Japan-China Joint Symposium on Functional Supramolecular Architectures	**MAEDA, Hiromitsu** **JIANG, Donglin**
Feb. 5– 6, 2013	The Frontiers and Perspective of Biological Coordination Chemistry	**AONO, Shigetoshi** **HAYASHI, Takashi** **ITOH, Shinobu**

Feb. 12–13, 2013	Advanced Laser Spectroscopy for Expanding Molecular Science	**OHSHIMA, Yasuhiro**
Mar. 13–14, 2013	Functions of Metal Complexes Derived from Novel Structural Changes	**MURAHASHI, Tetsuro**
Apr. 4– 6, 2013	Fundamentals and Applications of Laser Filaments	**TERASAKI, Akira** **WÖSTE, Ludger** **FUJI, Takao**
May. 25–26, 2013	Hierarchical Molecular Dynamics: From Ultrafast Spectroscopy to Single Molecule Measurements	**TAHARA, Tahei** **SAITO, Shinji**
Jun. 13–15, 2013	Japan-China Joint Coordination Chemistry Symposium for Young Scientists on Advanced Coordination Materials	**UENO, Takafumi** **MURAHASHI, Tetsuro**
Aug. 2– 4, 2013	IMS Workshop on Advanced Spectroscopy of Correlated Materials (ASCM 13)	**MIYAZAKI, Hidetoshi** **KIMURA, Shin-ichi**

(3) Numbers of Joint Studies Programs

Categories		Oct. 2012–Mar. 2013	Apr. 2013–Sep. 2013	Total
Special Projects		0	2	2
Research Symposia		8	4	12
Research Symposia for Young Researchers		0	1	1
Cooperative Research		72	32	104
Use of Facility	Instrument Center	47	14	61
	Equipment Development Center	9	4	13
Use of UVSOR Facility		80	71	151
Use of Facility Program of the Computer Center				190*

* from April 2012 to March 2013