AWARDS

Associate Professor Dr. Ozawa's Scientific Achievement

Prof. Takeaki Ozawa of Department of Molecular Structure received the Young Scientists Award from Minister of MEXT. The award title is "Development of the Methods for Analyzing Molecular Dynamics in Live Cells in the Fields of Chemistry and Biology." A current focus on biological research is to quantify and to image cellular processes in living cells and animals. To detect such cellular processes, many reporter proteins are now extensively being used. The most common reporters include fluorescent and bioluminescent proteins such as firefly luciferase, green fluorescent protein (GFP), and their variants with various spectral properties. Prof. Ozawa developed a novel design of the reporter proteins with general applicability for detecting the biological processes in living cells and animals. The principle is based on reconstitution of split reporter protein fragments by the use of 'protein splicing' technique. He showed the following attractive applications with the split reporter fragments. First, split reporter fragments, connected respectively with a pair of interacting proteins, worked as indicators for protein-protein interactions in live bacteria and mammalian cells. Second, the split GFP reporter provided a genetic method for identifying mitochondrial proteins from large-scale cDNA libraries. Finally, the split luciferase reporter enabled high-throughput sensing and noninvasive imaging of nuclear transport of proteins of interest in living animals. The basic concept of split reporter reconstitution by protein splicing will promise a wide variety of applications to study protein-protein interactions, protein localizations, intracellular protein dynamics, and protein activity in living cells and animals. Thus, the impact of Prof. Ozawa's work on methodological development for analyzing molecular dynamics in living cells is clearly significant.

Professor Emeritus Hirota's Scientific Achievements

Professor Emeritus Eizi Hirota received E. Bright Wilson Award in Spectroscopy by the American Chemical Society for his outstanding contributions to "high-resolution spectroscopy, in particular to the detection and the characterization of free radicals and ions that have led to deeper understanding of chemical reaction mechanisms." This award was founded 1997 to commemorate the significant establishments of E. B. Wilson, Jr. in physical chemistry, in particular, experimental and theoretical achievements in molecular spectroscopy, and it has been granted to an individual who makes outstanding accomplishments in fundamental or applied spectroscopy in chemistry.

Dr. Hirota had settled high-resolution spectroscopy of radicals and ions as the main subject to be explored since he joined IMS as a professor of Department of Molecular Structure at the occasion of the foundation of the Institute (1975). Free radicals and molecular ions are reactive intermediates that play significant roles in chemical reactions, so importance of decisive characterization *via* spectroscopic investigations had been well recognized even at the moment. Nevertheless, high-resolution spectroscopic studies of them were believed to be too demanding because of inherently low concentration of the species to be detected. Dr. Hirota and his co-workers overcame this difficulty by the development of highly sensitive detection methods, such as millimeter- and submillimeter-wave spectroscopy and infrared diode laser spectroscopy. During his carrier in IMS, Dr. Hirota achieved successful detection and precise structural determination of dozens of free radicals and ions, including prototypical organic free radicals (methyl, vinyl, allyl, methoxy, vinoxy, *etc.*) and those of fundamental importance in plasma and in space (SiH_3, H_2D^+, FHF^-, *etc.*). In addition, high-resolution spectroscopic detection was applied to monitor elementary chemical reactions with quantum-state resolved manner, and entirely new information was provided on photodissociation dynamics and oxidation mechanisms of several fundamental molecules. In these respects, Dr. Hirota's achievements have an enormous impact not only on molecular spectroscopy but also on varieties of related scientific fields, such as quantum chemistry, chemical reaction studies, plasma chemistry, atmospheric chemistry, and interstellar chemistry.

Professor Hama's Scientific Achievements

Prof. Hiroyuki Hama at Tohoku University, a former associate professor of the UVSOR facility (1990–2000), received the 2004 FEL (Free Electron Laser) Prize for his contribution to "Storage Ring Free Electron Lasers." He has performed fundamental and pioneering contributions in Storage Ring Free Electron Lasers (SRFELs). Thanks to his deep understanding of the FEL and to his achievements, he has promoted the use of SRFELs in a broad scientific community, from synchrotron radiation to nuclear physics. He Installed the first optical klystron with adjustable planar-to-helical field in 1996 on the UVSOR storage ring. This improvements produced short wavelength records for FELs in 1996. He also demonstrated the production of monochromatic gamma-rays by Compton Back-Scattering with a storage ring free electron laser.

Mr. Horigome's Technological Achievements

Mr. Toshio Horigome, the chief of the technical section of the UVSOR facility, received "The CSJ Award for Technical Achievement" in the spring of 2005. His contribution is "Experimental Apparatus Design and Fabrication for Molecular Photoscience."

The Chemical Society of Japan (CSJ) awards every year a person who has contributed to the development or improvement of experimental techniques in chemistry and chemical engineering. Mr. Toshio Horigome is recognized for his distinguished and long-standing achievements in high-precision and compact instrumentation for various types of experiments under ultra-high vacuum condition.

Associate Professor Taira Group's Scientific Achievements

Drs. J. Saikawa, Y. Sato, and T. Taira of Laser Research Center for Molecular Science received the Award from the Laser Society of Japan for the paper on "Short pulse generation in Yb:$Y_3ScAl_4O_{12}$ disordered ceramic laser" presented in the 324th Conference on "High-performance solid-state lasers and their applications." Recently, they have developed Nd^{3+} or Yb^{3+} doped mixed garnet materials $Y_3ScAl_4O_{12}$ ceramics, which are a solid solution of YAG and $Y_3Sc_2Al_3O_{12}$ (YSAG), by using sintering methods. They demonstrated that a passively mode-locked Yb^{3+}-doped YSAG ceramic laser provides the maximum average output power of 150 mW with a pulse duration of 500 fs and an average output power of 62 mW with a pulse duration of 280 fs at 1035.8 nm. These developments opened a new field of lasers and variety of applications.

Technical Associate Ishimura's Scientific Achievement

Mr. Kazuya Ishimura, Technical Associate of Department of Theoretical Molecular Science, received the Diamond Award for the presentation of an excellent poster titled "A New Parallel second-order Møller-Plesset algorithm" in the 7th Congress of WATOC (World Association of Theoretically Oriented Chemists), the most representative international congress in theoretical and computational chemistry, which was held in Cape town, South Africa, on January 16–21, 2005. He developed a new parallel algorithm of the canonical MP2 method with two-step parallelization and dynamic load-balancing, which is applicable to large molecular systems. The developed MP2 algorithm made it possible to perform reliable calculations of weak non-covalent interactions that play an important role in host-guest chemistry, molecular recognition, and self-assembly.

Research Associate Dr. Imura's Scientific Achievement

Dr. Kohei Imura, Research Associate of Department of Molecular Structure, received two awards this year. One is the Nano Optics Award in the 14th Annual Symposium of The Nano Optics Research Group (July 2005) and his title of paper was "Plasmon-Mode Imaging of Noble Metal Nanorods and Dispersion Relations." The other one is Young Scientist Award in the 2005 Annual Conference on Molecular Structure and Related Topics (September 2005, the largest conference in the field of physical chemistry in Japan) and his title of paper was "Plasmon-Mode Imaging and Two-Photon Induced Photoluminescence of Gold Nanorods and Nanoplates."

He succeeded in direct observation of the plasmon-mode wavefunctions of noble-metal metal nanorods and nanoplates based on near-field transmission imaging or near-field two-photon induced emission imaging, with a spatial resolution as high as ~50 nm. At the same time, the resonant frequencies of the plasmon modes of nanorods were determined from the near-field transmission spectra. From these measurements, the dispersion relations for the nanorod plasmons were obtained, and the results were discussed based upon electromagnetism. He also investigated spectra and polarization characteristics of the two-photon induced photoluminescence from nanorods and nanoplates and analyzed them in relation to the crystal structures and band structures. These results are important for fundamental understanding and application of optical properties of metal nanoparticles, and those of plasmon resonances in nanometric systems.

Dr. Tero's Scientific Achievement

Dr. Ryugo Tero, received the Young Scientist Award for the presentation of an Excellent Paper in the Annual Meeting of The Surface Science Society of Japan (November, 2004). The title of the paper was "Fabrication of avidin single molecular layer on silicon oxide surfaces and formation of tethered lipid bilayer membranes." He

fabricated single molecular layer of avidin on an atomically flat SiO_2 surface and characterized using atomic force microscopy (AFM) and infrared reflection absorption spectroscopy. He showed that each of avidin molecules adsorbs as a single molecule and retains the biotin-binding activity from the AFM topographs and function-recognizing images obtained by biotin-modified cantilever. He also succeeded in the depositing and observing tethered lipid bilayer membranes of a biotinylated phospholipid on the single molecular avidin layer. These observation and characterization was achieved due to the atomically flat surface and well-controlled surface modification with biological materials. These results are very important for the modification and characterization of biological materials on silicon surface, which is an attractive research field for the development of new devices, biosensors and screening methods.

Graduate Student Hino's Scientific Achievement

Miss Takami Hino, Graduate student of Department of Structural Molecular Science, School of Physical Sciences, the Graduate University for Advanced Studies received the Young Scientist Award for the Presentation of an Excellent Paper in the Annual Meeting of The Japan Society of Coordination Chemistry (2004 Autumn). Her title of paper was "Catalytic Oxidation of Alcohols Utilyzed by Acid-Base Equilibrium of Ruthenium-dioxolene-Amine Complexes." She constructed a new catalytic system composed of Ru-dioxolene-amino complexes and bases that catalyzes alcohols under very mild conditions such as electrolysis at 0 V. She also obtained the direct evidence that the oxidation of alcohols catalyzed by an Ru-dixoxolene-aniline complex proceeds *via* a radical mechanism. The outcome that she obtained will give fundamental information about designing of molecular catalysts aimed at electrochemical oxidation of alcohol in fuel cells.

Dr. Hiyama's Scientific Achievement

Research Associate Dr. Miyabi Hiyama of Department of Vacuum UV Photoscience has received the Society of Atomic Collision Research Award for Young Scientists 2005 for her contribution to "Molecular Inner-shell Excitation Mechanism revealed by the R-matrix/MQDT method," in the summer of 2005.

Dr. Hiramatsu's Scientific Achievements

Dr. Hirotsugu Hiramatsu, a JSPS fellow in Okazaki Institute for Integrative Bioscience who moved to Tohoku University on September, 2005, received the 2005 William F. Meggers award for his publication entitled "Development of Infrared Electroabsorption Spectroscopy and Its Application to Molecular Structural Studies." [*Applied Spectroscopy* **volume 58** number 4] This award is given to the authors of an outstanding paper appearing in *Applied Spectroscopy*. He developed a spectrometer that consists of dispersive IR spectrometer, low-noise MCT detector, AC coupled pre-amplifier, lock-in amplifier, and sample cell for electric field modulation, and realized an electroabsorption (Stark) spectroscopy in mid-IR region on liquid sample at room temperature. This equipment enabled him to detect of an absorbance change as small as 6×10^{-8} generated by electric field modulation. Accordingly, he succeeded in observing an electric field-dependent change of equilibrium between rotational isomers of 1,2-dichloroethane, and also in determining the permanent dipole moment of *N*-methylacetamide for each oligomer, besides finding electric field responses of some molecules. These studies provided a new method of investigating structural chemistry of liquid molecules, and demonstrated a potential of this fundamental spectroscopic approach.

Research Associate Dr. Yamada's Achievement

Research Associate Dr. Yoichi M. A. Yamada of Research Center for Molecular-scale Nanoscience received the Pharmaceutical Society of Japan Award for Young Scientists 2005 for his contribution to "Development of New Solid-Phase Catalysts and Their Applications to Synthetic Organic Reactions."

This award is given to encourage young researchers in all the field of pharmaceutical sciences (Age up to 38). Dr. Yamada developed highly active and reusable polymeric catalysts produced by self-assembly process of non-cross-linked amphiphilic polymeric ligands with inorganic species. Thus, PWAA prepared from $H_3PW_{12}O_{40}$ and poly[(*N*-isopropylacrylamide)-*co*-(acrylamide with ammonium salt)] is suitable for oxidation of alcohols, amines, and sulfides in aqueous hydrogen peroxide. PdAS produced by self-organization of $(NH_4)_2PdCl_4$ and poly[(*N*-isopropylacrylamide)$_{10}$-*co*-diphenylphosphinostyrene] is an excellent recyclable catalyst for Suzuki-Miyaura

reaction in water, water-organic solvents, and organic solvents. PdAS has been commercially supplied from Tokyo Kasei Kogyo (TCI) since 2003. PdAS-V assembled from $(NH_4)_2PdCl_4$ and poly[(*N*-isopropylacrylamide)$_5$-*co*-diphenylphosphinostyrene] provides recycling system of itself for Mizorogi-Heck reaction. TiSS made from Ti(O-*i*-Pr)$_4$ and poly(styryl-linked binaphtholate-*co*-styrene) promotes an enantioselective carbonyl-ene reaction as a recyclable catalyst.

Professor Suzuki's Scientific Achievement

Professor Toshinori Suzuki, Chief Scientist of Chemical Dynamics Laboratory, RIKEN (Institute of Physical and Chemical Research), a former associate professor of Department of Electronic Structure, IMS, received the JSPS (Japan Society for the Promotion of Science) Prize in 2004 for his contribution to "Imaging of Chemical Reactions using Molecular Beam Scattering Method." This prize was founded in order to raise the level of scientific research in Japan to the world's highest standard and is given to young researchers who have rich creativity and superlative research ability.

He accomplished the visualization of motions of reacting molecules. Integrating the techniques of molecular beams, ultrafast laser spectroscopy and imaging, he realized for the first time the real-time tracking of rotational, vibrational and electronic states of reacting molecules and the imaging of three-dimensional product scattering distributions. He contributed to the elucidation of the quantum dynamics of chemical reactions. His method is expected to develop into versatile techniques applicable to investigations on the nano-scale reaction fields around solvated molecules and also on the vital phenomena.

Dr. Tahara's Scientific Achievements

It is a great delight to report that the former associate professor of Department of Vacuum UV Photoscience, Dr. Tahei Tahara (1995–2001; currently, Chief Scientist of RIKEN) earned the IBM Japan Science Prize in 2004 for his contribution to "Development of Novel Time-Resolved Spectroscopy and its Application to Dynamics of Condensed-Phase Molecules."

He has been working as a frontier scientist in the research field of molecular photochemistry in condensed phase, by introducing various kinds of time-resolved spectroscopic techniques, based on his original ideas. He has made enormous efforts for research and development on novel experimental methods. Picosecond two-dimensional coherent anti-Stokes Raman scattering spectroscopy, femtosecond impulsive Raman spectroscopy, femtosecond UV-pump/visible-probe photoabsorption spectroscopy can be listed as his known examples. His continuous effort towards utilizing ultrafast molecular spectroscopy has led to successful observation of the excited state vibrational coherence. All his recent results shed light upon dynamics and structures of short-lived species that play an important role in the elementary process of chemical reactions.