Lih-Juann Chen

Professor of Department of Material Science and Engineering, National Tsing Hua University, Hsinchu, Taiwan, Republic of China

Staying Period: July 31 and August 1, 2006
Host: H. Kurata (Institute for Chemical Research)

Recent development of nanotechnology makes it possible to shrink the size of components in devices to nanometer scale so as to increase the density of integration. As the structure or morphology of materials scale down to nanometer, transmission electron microscopy plays an important role in analyzing nanostructure. Prof. Chen is one of famous researchers in the field of nanostructure analysis using transmission electron microscope. By taking the chance that Prof. Chen came to Japan to attend the Asia-Pacific Conference on Semiconducting Silicides in Kyoto, we invited him to our laboratory to discuss common interests on nanostructure analysis.

Prof. Chen gave us a lecture in the Uji Campus entitled "In-situ ultrahigh vacuum transmission electron microscope investigations of nanostructures on silicon". He began his lecture by emphasizing the importance of the synthesis of nanomaterials related to the development of new devices and the necessity of their characterization based on the electron microscopy technique. He presented the recent works on in-situ observation of growth process of nanomaterials, especially metal silicide nanorods and gold fine particles on silicon substrate, by using an ultrahigh vacuum transmission electron microscope. He showed the growth mechanism of nanorods depending on the annealing temperature and the diffusion process of gold nanoparticles, which were recorded on beautiful video images. Such the direct observation of dynamical phenomena occurring at nanometer area is an important technique in modern electron microscope. The time resolution of his experiment is about 30 milliseconds, which is limited by the brightness of electron gun and the performance of imaging detector. Currently the improvement of time resolution is a hot issue in this field. Actually Prof. Sakabe's group collaborating with Prof. Isoda in Institute for Chemical Research started the development of new electron gun using a laser to improve the time resolution to nanosecond order. Prof. Chen's lecture impressed that in-situ observation of dynamical process is very important in nanoscience and the improvement of time resolution will promise to open a new scientific field.

King-Fu Lin

Professor of Department of Material Science and Engineering and Institute of Polymer Science and Engineering, National Taiwan University, Taipei, Taiwan, Republic of China

Staying Period: July 2 and August 2, 2006
Host: S. Isoda (Institute for Chemical Research)

During the past two decades, titania (TiO_2) nanocrystals have attracted vast attention owing to their versatile applications, such as solar cells and photocatalysts. Various forms of TiO_2 nanostructures have been reported, including spheres, wires, tubes, and rods by the synthetic routes and their associated preparation methods such as sol-gel processes, template methods, and hydrothermal treatments. However, it is still awaited for new materials in applications on the photocatalysts and organic solar cells with high efficiency.

Prof. Lin gave us a lecture in the Uji Campus entitled "Fabrication of the organic/inorganic hybrid nanostructures via self assembly of amphiphilic light emitting molecules" and presented that his group proposed another template to prepare nano-hollow rods of TiO_2 by using π-conjugated oligomers of phenylenevinylene (OPV) which showing supramolecular structures. He has synthesized a specifically designed amphiphilic PEO17-OPV3 molecule with a rigid OPV segment linking with a soft PEO segment through a sulfonate group that twists the molecule in between hydrophilic and hydrophobic segments. In particular, his group succeeded to form a cylinder shape suprastructure with a core-shell skin in the nano-hollow rods. During and after the lecture, we agreed to start a collaboration to understand the formation process and electrical properties of the nano-hollow. In this conjunction, Prof. Lin sent a graduate student to Institute for Chemical Research for one month to work with young researchers in Prof. Isoda's group. This collaboration contributed also to stimulate graduate students in Institute for Chemical Research in exchanging mutual scientific knowledge and understanding national traits. As a result of the promptly started collaboration, two papers have been submitted for publication.

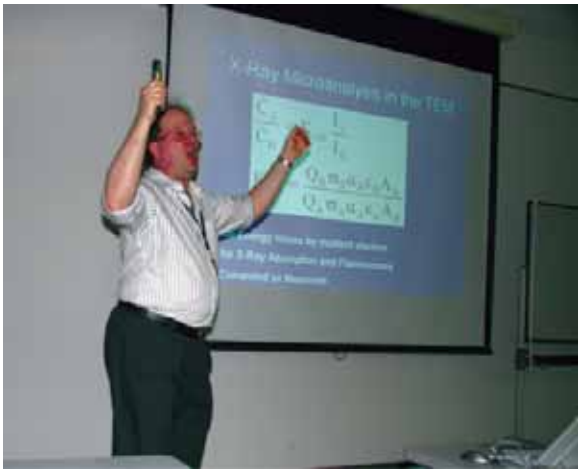
Raynald Gauvin

Professor of Department of Mining, Metals & Materials Engineering, McGill University, Canada

Staying Period: August 23, 2006
Host: S. Isoda (Institute for Chemical Research)

In resonance with the development of nanoscience and nanotechnology, local state analysis becomes very crucial, where the locality means atomic scale ultimately. X-ray microanalysis and electron energy-loss spectroscopy are significant methods and complimentary techniques in local state analysis in atomic scale, because X-ray analysis is advantageous in heavy elements detection, but electron energy-loss in light elements. The Institute for Chemical Research has an active group in electron energy-loss spectroscopy and Prof. Gauvin is a well-known specialist in X-ray microanalysis. By taking the chance that Prof. Gauvin came to Japan to attend the 15-th International Microscopy Congress in Sapporo, he was invited to come to discuss common interests of both sides on local state analysis.

Prof. Gauvin gave a lecture in the Uji Campus entitled "X-Ray Microanalysis in the Electron Microscope". Since he serves now as the president of Microbeam Analysis Society of America, the lecture was started with the overview of X-ray microanalysis, followed by his recent achievements on simulation with the CASINO package and applications for the cases of composite materials in transmission electron microscope and scanning transmission electron microscope as well as back-scattering analysis. Especially, practical analytical technique and its physical background to separate multiple peaks located closely are attractive issues for the young researchers attended. In the final part of the lecture, Prof. Gauvin emphasized strongly that a new type of field emission gun with high brightness and good coherency is essential so as to improve X-ray microanalysis in the case of no-reference measurement in future. This is just the same direction what Prof. H. Kurata in Institute for Chemical Research intends in electron energy-loss spectroscopy. Actually Prof. Kurata is developing a novel field-emission gun (nano-tip gun) under the support of MEXT, which is a promising electron source not only for electron energy-loss spectroscopy but also for X-ray microanalysis. Accordingly Prof. Gauvin's visit provides us an opportunity for future collaboration.



Prof. Michael L. Klein

Professor, Laboratory for Research on the Structure of Matter University of Pennsylvania

Staying Period: June 16, 2006
Host: M. Nakahara (Inst. Chem. Res.)

Nano- to micro-scale systems are most challenging subjects of the theoretical/computational studies at present. It needs to be established how to describe the structure and dynamics of a nano- to micro-scale system. In his talk, Professor Klein gave a lecture in Uji campus with the title "Nothing amuses more harmlessly than computation …" He introduced the current status of the coarse-grained methodology and showed representative applications to self-organizing systems. The coarse-grained methodology can describe a much more variety of physical systems than the atomistic simulation, and provides a picture for complex systems consisting of solvent (water and ion), lipid, and protein. The connection to atomistic description was discussed in connection with experimental probing. Professor Klein is a senior researcher with enthusiasm of education, and the lecture was deliberately prepared. He accepted any questions from students and post-docs, and provided a nice atmosphere of training for question-and-answer in English.

Prof. Jose Luis Garcia Ruano

Professor of Organic Chemistry, Universidad Autónoma de Madrid, Spain

Staying Period: August 28, 2006
Host: T. Kawabata (Inst. Chem. Res.)

Prof. Ruano's current activity is mainly focused on the use of the sulfinyl group as a chiral inductor in nucleophilic additions and aldol reactions on C=X bonds (X=O, N), as well as the use of unsaturated sulfoxides in cycloadditions (mainly Diels-Alder and 1,3-dipolar reactions) and conjugated additions. In this seminar, diastereoselective C-C bond formation with benzyl lithium species has been described. Chiral benzyl anions were formed by deprotonation with strong bases such as LDA under the influence of a remote chiral sufoxide group. The resulting chiral benzyl anions were trapped by aldehydes and ketones to give products in high diastereoselectivity. The reactions of the chiral anions with N-arylimines produced a mixture of syn- and anti-adduct. The syn/anti ratio depended on the electronic nature of the aromatic ring. Although the anionic benzyl carbon is assumed to be sp^2-hybridized, it is assumed to be chiral due to the chelation with a lithium cation. Mechanism involving a six-membered transition state consisting of C=C-S-O-Li-C (anion) was proposed for the stereoselective addition of the anionic species to electrophiles.

Prof. Ernst Schaumann

Professor of Technical University of Clausthal, Germany

Staying Period: August 29-31, 2006
Host: Prof. Norihiro Tokitoh (Inst. Chem. Res.)

Organoheteroatom chemistry is one of the attractive research areas. In particular, there has been much interest in organosilicon chemistry from the viewpoints of fundamental chemistry, organic synthesis, material science, etc. Professor E. Schaumann is one of the specialists in organoheteroatom chemistry, in particular, organosilicon, sulfur, and phosphorus chemistries, and he edited the famous handbook for synthetic organic chemists, "Science of Synthesis". He was invited as a plenary lecturer of the 22nd international symposium, ISOCS-22 (International Symposium on the Organic Chemistry of Sulfur), held in Omiya during the period of 20-25 August, 2006. After this symposium, he visited ICR and gave us a lecture in Uji campus entitled "Silicon Migration as a Useful Tool in Organic Synthesis" on August 30. The lecture covered the most recent studies on organosilicon chemistry directed toward organic synthesis. In addition, he made discussions with many professors of Institute for Chemical Research and gave fruitful suggestions during his stay.

Prof. Francesco A. Devillanova

Professor of Departimento di Chimica Inorganica ed Analitica,
Univerdita' degli Studi di Cagliari, Italy

Staying Period: October 3-5, 2006
Host: Prof. Norihiro Tokitoh (Inst. Chem. Res.)

Professor F. A. Devillanova is known to be one of the specialists in the organoheteroatom chemistry, in particular, that concerning chalcogens and halogens. At Uji campus, he gave us a lecture entitled "The nature of the chemical bond in linear three-body systems: from I^{3-} to mixed chalcogen/halogen and trichalcogen moieties." on October 4. The lecture covered the most recent studies on theoretical and structural chemistry on hyper-coordinated compounds of chalcogens and halogens, which were very fascinating results for the audience from the viewpoints of fundamental chemistry, organic synthesis, material science, etc. In addition, he made discussions with many professors of Institute for Chemical Research and gave fruitful suggestions during his stay. He and his wife enjoyed sight seeing around Uji and dinner with us during their free time. After his stay in Uji and Kyoto, he was invited as a plenary lecturer of the 18th Symposium on Fundamental Organic Chemistry, held in Fukuoka in October 7-9.

Prof. Shengming Ma

Research Professor of Chemistry, Shanghai Institute of Organic Chemistry, Chiana

Staying Period: November 9, 2006
Host: T. Kawabata (Inst. Chem. Res.)

The simplest cumulated diene is 1,2-propadiene, $CH_2=C=CH_2$, also known as allene. The central carbon in such compounds is sp-hybridized, and the double bond array is linear as a result. Since the π-bonds of allenes are orthogonal, the planes defined by the end carbon substituents are also orthogonal. A consequence of this configuration is that allenes having two different substituents on each of the terminal carbon atoms are chiral. Prof. Ma described some aspects of stereo- and regiochemistry of electrophilic addition of allenes. Especially stereochemistry of hydroxyiodonation of sulfoxide–substituted allenes was shown in detail. Stereochemical course of the reactions was investigated by the introduction of optically active sulfoxide. If the source of the hydroxyl group of the producing hydroxy iodates is sulfoxide-oxygen, the stereochemistry of the sulfoxide chiral center should be inversion. On the other hand, it should be retention if the source of hydroxyl-oxygen is water in the reaction medium. The experimental results indicated that the stereochemistry at the sulfoxide chiral center is inversion. This clearly showed that the origin of oxygen of the hydroxyl group is internal sulfoxide.

Prof. Peter G. Schultz

the Scripps Professor of Chemistry, the Scripps Research Institute, USA

Staying Period: November 16, 2006
Host: N. Esaki (Inst. Chem. Res.)

Professor Schultz is one of world leaders in the field of Chemical Biology. He has opened the ways to combine the tools and principles of chemistry with the molecules and processes of living cells to synthesize new molecules and molecular assemblies with novel physical, chemical and biological functions, and by studying the structure and function of the resulting molecules, he has shown new insights to gain into the mechanisms of complex biological and chemical systems. Professor Schultz gave us a lecture in the main campus entitled "New Opportunities at the Interface of Chemistry and Biology" and showed how we can expand genetic code. He and his group have developed a methodology that allows one to genetically encode novel amino acids, beyond the common twenty, in prokaryotic and eukaryotic organisms. They have shown that this methodology can be used to efficiently incorporate a large number of amino acids into proteins in *E. coli* and yeast with fidelity and efficiency rivaling that of the common amino acids. Professor Schultz presented also new results in the field of functional genomics using "rationally designed" chemical libraries together with phenotypic and pathway based screens to identify and characterize small molecules with novel biological activities: kinase-directed molecular scaffolds, including substituted purines, pyrimidines, quinazolines, pyrazines, pyrrolopyrimidine, pyrazolopyrimidine, phthalazines, pyridazines, and quinoxalines. The libraties have been successfully used to screen for molecules that control stem cell fate and self-renewal (embryonic and adult), as well as molecules that induce dedifferentation of lineage committed cells. Many exciting new data based on new ideas have been presented in the lecture.