

International Symposium on “Multifunctional Nanoscale Materials for the 21st Century”, March 2009

The Center for Nanoscale Materials hosted this March 6-7, 2009 event at Argonne National Laboratory. It was co-organized by Elena Rozhkova (CNM), Dr. Abhijit Sarkar (Michigan Molecular Institute), and Dr. Hirotaka Sugawara (Director, Japan Society for Promotion of Science, Washington DC).

This symposium focused on the research advances and information exchange among Japan and U.S. researchers and was specifically targeted to benefit young researchers and scientists in their early careers. The 2-day symposium featured leading researchers from Japan, the United States and Europe. The symposium was sponsored by the Japan Society for the Promotion of Science-USA Alumni Association. All CNM and Argonne employees were welcome to attend with no conference fees. The JSPS-USA AA is a group of scientists who have received awards from JSPS and who currently live and work in U.S., including Elena Rozhkova, a member of the Symposium Organizing Committee. Rozhkova, an Assistant Scientist in the CNM Nanobio Interfaces Group, received a JSPS award to work for two years at the Institute of Multidisciplinary Research for Advanced Materials, Tohoku University. The interdisciplinary symposium included keynote and plenary talks, as well as invited and selected contributed papers encompassing all fields of multifunctional nanoscale materials. Major topical areas included:

- Energy systems
- Advanced materials for electronics and photonics
- Life science and biotechnology
- Composite materials
- Sustainability of water

The meeting convened with a welcome from Dr. Hirotaka Sugawara (Director of the JSPS Washington office) and Mami Oyama (Director of International Program Department, JSPS, Tokyo, Japan). Eric Isaacs (Argonne), the keynote speaker, then presented a talk on “Nanomaterials for Energy” in which he outlined important research challenges to finding renewable energy sources and developing next-generation technologies based on advances of nanoscale materials. In his talk “Supramolecular Materials for Functional Tasks” Katsuhiko Ariga (World Premier International (WPI) Research Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS), Japan) focused on design, synthesis, and fabrication of organic materials and organic/inorganic hybrids with nanosized structural features based on bottom-up approaches from unit molecular structures. For example, a novel hierarchical nanostructure based on layer-by-layer (LbL) assembly and mesoporous technology, a so-called “mesoporous nanocompartment film”, was reported. The nano-compartment films exhibit *stimuli-free* auto-modulated material release, unlike previous examples, due to the special morphology of silica capsules.



Christine Luscombe (Dept. Chemistry, University of Washington) reported development of novel and reliable cost-efficient methods for the polymerization of semiconducting polymers which uses readily available and inexpensive reagents compared to existing polymerization methods for use in light-weight, flexible, disposable organic light-emitting diodes, and thin-film transistors. A key application currently attracting a lot of interest for semiconducting polymers is for organic photovoltaic devices (OPVs).



Stephen Streiffer, Interim Director of the CNM, provided an overview of CNM facilities for the synthesis, processing, characterization, and modeling of the next generations of nanoscale materials and devices. He described some of the initial work that has been performed on the hard x-ray nanoprobe beamline and outlined some other ways in which synchrotron x-rays can be used for studying nanomaterials. In his stimulating talk “How Will the Information Technology Revolution Be Extended?” Sam Bader, ANL Distinguished Fellow and CNM Chief Scientist, emphasized that the nanoscience community has a unique opportunity to join together to meet the grand challenge of developing of new molecules and atoms scale devices to store, process, and communicate information. These new approaches include spintronics, plasmonics, and molecular electronics. The possibility to communicate information via spin currents or subwavelength pulses of light, instead of traditional electrical charge currents, opens new vistas for research.



A session on Nanophotonics included a plenary talk titled “Nanophotonics: Exchanging the Dressed Photons” by Prof. Ohtsu (University of Tokyo). He believes that in conventional optical science and technology, light and matter have been discussed separately and the flow of optical energy in a photonic system has been unidirectional from a light source to a photodetector. By contrast, in nanophotonics, light and matter have to be regarded as coupled to each other, and the energy flow between nanometric particles is bidirectional. He emphasized that for the development of nanophotonics, far-reaching physical insights into the local electromagnetic interaction in the nanometric subsystem composed of electrons and photons is required. State-of-the-art advances in nanophotonic devices fabrication and design were overviewed by Tadashi Kawazoe (University of Tokyo), Takashi Yatsui (University of Tokyo), Jayan Thomas (University of Arizona), Makoto Naruse (National Institute of Information and Communications Technology, Tokyo), Arup Neogi (University of North Texas) and others.



Biomaterials sessions resulted in lengthy informal discussions after a plenary talk by Samuel Stupp (Northwestern University) on “Hierarchical Self-Assembly of Materials”. A grand challenge in materials chemistry is finding self-assembly pathways to create highly functional systems with structures spanning many length scales using building blocks such as small molecules, polymers, ions, and nanoscale particles. Both biological and electronic functions are of great interest given their relevance to medicine and energy. In his lecture Prof. Stupp reviewed self-assembly pathways developed in his laboratory for supramolecular materials using designed molecules. One of their self-assembly pathways generates diverse bioactive nanostructures that can be used to regenerate organs and tissues and also in cancer therapies. A second system self-assembles polymers and small molecules into macroscopic constructs that can self-repair and store nanostructures. Also shown was the formation of highly efficient photoconductors in which self-assembly can synergistically couple to the formation of inorganic lattices to generate interesting electronic properties.

Another stimulating talk on “Development of Bioinspired Molecular Machines” was given by Kazushi Kinbara (Tohoku University). His group has developed molecular machines involving power-conversion mechanisms by interlocking the motions of photochromic molecules and ferrocene. The results will make possible the construction of extended interlocked systems that allow remote manipulation of molecular events. Yasuko Osakada’s (Osaka University) talk on

“Charge Transfer in DNA Nanoscaled Assemblies” attracted attention because of its relevance to the development of DNA nanoelectronics and biosensors. Applications of composite nanomaterials containing multiple chemical and biological moieties that perform different functions applicable for life sciences and medicine were reported by Dr. Edward Van Keuren (Georgetown University), Elena Rozhkova (CNM), Karol Gryczynski (University of North Texas), Dr. Haim Grebel (NJIT, Newark), D.-H. Kim (MSD), and Ilya Ulasov (University of Chicago).

The poster session created an atmosphere of excited and extensive discussions between the presenters and the audience, young investigators and eminent scientists, and scientists from various fields of nanoscale materials research. The cohort of young researchers included CNM postdoctoral fellows, graduate students and early career CNM users from the University of Chicago and Illinois Institute of Technology. Tours of the CNM and APS attracted over 40 meeting participants. In summary, this Symposium enhanced international scientific cooperation between researchers from academia, research institutes, and industry. The CNM was pleased to host these 80 scientists from the United States, Japan and Europe, ranging from world-renowned professors to students.



Multifunctional Nanoscale Materials for the 21st Century (MNM21)

Agenda

March 6, 2009 (Friday). Venue: APS Conference Center, Argonne National Laboratory

No.	Time	Speaker	Presentation
Continental Breakfast (Posters should be in their place before 8.45 am)		8:00-9:00 am	
Opening Session		Opening Remarks	
Chair Dr. Abhijit Sarkar		Dr. Hiroataka Sugawara, Dir., JSPS Washington DC Office <hr/> Ms. Mami Oyama, Dir., International Program, JSPS Tokyo	
Session I: Materials	1	9:15-9:45 am	KEYNOTE SPEAKER Dr. Eric Isaacs
Chair Dr. Stephen K. Streiffer		Nanomaterials for Energy	
	2	9:45-10:10 am	Dr. Katsuhiko Ariga
	3	10:10-10:35 am	Prof. Christine Luscombe
Coffee Break		10:35-10:50 am	
Session II: Materials		4	10:50-11:20 am
Chair Prof. Christine Luscombe		Dr. Stephen K. Streiffer	
	5	11:20-11:40 am	Dr. Koichi Akahane
	6	11:40-12:00 pm	Prof. Samuel D. Bader
Lunch & Poster Session		12:00-2:00 pm	
ANL Tour (Capacity 20 persons)		1:00-2:00 pm	
Session III: Nanophotonics		7	2:00-2:20 pm
Chair Prof. Motoichi Ohtsu		Dr. Youichi Sakakibara	
	8	2:20-2:40 pm	Prof. Arup Neogi
	9	2:40-3:00 pm	Dr. Kiyoshi Kobayashi
Coffee Break & Poster Session (Cont.)		3:00-3:45 pm	
Session IV: Bio		10	3:45-4:05 pm
Chair Prof. Haem Grebel		Prof. Ed Van Keuren	
	11	4:05-4:25 pm	Prof. Karol Gryczynski
	12	4:25-4:45 pm	Dr. Elena Rozhkova
ANL Tour (Capacity 20 persons)		5:00-6:00 pm	
US-JSPS Alumni Association Annual General meeting		5:00-7:00 pm	
Conference Banquet		7:00-9:00 pm	
Banquet Keynote Speaker		8:00-8:15 pm	
		KEYNOTE SPEECH: Mr. Yoshiharu Kato, Deputy Consul General, Japanese consulate office, Chicago	

March 7, 2009 (Saturday). Venue: APS Conference Center, Argonne National Laboratory

	No.	Time	Speaker	Presentation
Continental Breakfast		8:30-9:00 am		
Session V: Nanophotonics Chair Prof. Arup Neogi	13	9:00-9:30 am	PLENARY SPEAKER Prof. Motoichi Ohtsu	Nanophotonics: Exchanging the Dressed Photons
	14	9:30-9:50 am	Prof. Takashi Yatsui	Nanophotonic Fabrication and Operation
	15	9:50-10:10 am	Prof. Tadashi Kawazoe	Essences of an Optical Near Field and its Applications to Nanophotonic Devices and Fabrications
Coffee Break		10:10-10:25 am		
Session VI: General Chair Prof. Kazushi Kinbara	16	10:25-10:55 am	Prof. Samuel I. Stupp	Hierarchical Self-Assembly of Materials
	17	10:55-11:15 am	Prof. Jayan Thomas	NIMP: A New Nanoimprinting Technique for Nanophotonic Device Fabrication
	18	11:15-11:35 am	Prof. Petar Dvornic	Dendritic Polymers-Based "Soft" Nanotechnology
	19	11:35-11:55 am	Prof. T. Onodera	Recent Progress in Hybridized Nanoparticles and Their Ordered Structure for Optical Devices
Lunch		11:55-1:00 pm		
Session VII: Bio Chair Prof. Petar Dvornic	20	1:00-1:25 pm	Prof. Kazushi Kinbara	Development of Bioinspired Molecular Machines
	21	1:25-1:45 pm	Prof. Haim Grebel	Nano-Structured Materials for Electro-Optics and Biological Applications
	22	1:45-2:00 pm	Ms Yasuko Osakada	Charge Transfer in DNA and Photosensitized Oxidative DNA Damage
	23	2:00-2:20 pm	Prof. Arkadii Krokhin	Statistical Correlations Electron Localization in DNA Molecules
Coffee Break		2:20-2:35 pm		
Session VIII: General Chair Prof. Takashi Yatsui	24	2:35-2:55 pm	Dr. Makoto Naruse	System Architecture for Nanophotonics
	25	2:55-3:15 pm	Dr. Abhijit Sarkar	Carbon Nanotubes-Polymer Nanocomposites for Photonics Applications
	26	3:15-3:35 pm	Dr. Shinobu Ohya	III-V-Based Ferromagnetic Semiconductor and Magnetic Heterostructures
	27	3:35-3:55 pm	Dr. Hiroaki Matsui	Functionalities and Prospects of Oxide Quantum Wells Controlled at the Nano-Scale
Closing Remarks		3:55-4:00 pm	Prof. Arup Neogi, Chairman, JSPS US Alumni Association	