University of Connecticut
Institute of Materials Science

IMS Associates Program Newsletter

Vol. #13, No. #1 January 2009

Kasi Wins NSF Early Career Award

(From the UConn Advance, Cindy Weiss, August 25, 2008, see http://www.advance.uconn.edu/2008/080825/08082507.htm for the complete article.)

A polymer and materials chemist who started her faculty career at UConn two years ago has won a National Science Foundation early career development award.

Rajeswari Kasi, assistant professor of chemistry in the College of Liberal Arts and Sciences *and member of the Institute of Materials Science (ed.),* won the five-year, $475,000 award for research into new polymer-based organic and hybrid materials that can be tailored for a particular function.

Her work focuses on materials that respond to physical or chemical stimuli – heat, light, electrical or magnetic fields, for example.

She looks for a fundamental understanding of the materials and applications for them, such as encapsulating a drug in a polymer that responds to a magnetic field so that it can be used in an MRI scan to find cancer.

The award she won, Faculty Early Career Development (CAREER), is the NSF's most prestigious award in support of the career development of promising teacher-scholars who integrate research and education.

Kasi's research group includes five Ph.D. students, three of whom will receive support from the grant.

Kasi received her Ph.D. from the University of Massachusetts in 2004 and her master's degree from the Indian Institute of Technology in Madras in 1998. She is a member of the interdisciplinary Polymer Program at UConn.

Collaborative Research Teams Funded

(From the UConn Advance, Elizabeth Omara-Otunnu, December 8, 2008 see http://advance.uconn.edu/2008/081208/08120806.htm for the complete article.)

New grants intended to promote collaboration between researchers at Storrs and the Health Center have recently been awarded to 11 research teams.

The year-long grants – known as UCHC/Storrs and Regional Campus Incentive Grants, or UCIG – are approximately $50,000 each. They were jointly funded from the research budgets at Storrs and the Health Center, using money derived from indirect costs on extramural grants.

Applications for UCIG funding were peer reviewed by a committee comprising four

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Inside this issue:

UConn Hosts First Materials Camp

(From eMaginations, University of Connecticut, School of Engineering. See http://www.engr.uconn.edu/SoE/materialscampf08.php for the complete article.)

Mark Vecchiarelli, president of Yankee Casting, speaks with high school students about materials science.

Faculty and students from the department of Chemical, Materials & Biomolecular Engineering and the University's Institute of Materials Science (IMS), along with industrial partners, hosted nearly 40 students and four teachers on Monday, October 20 for UConn's first Materials Camp. The students hailed from the University High School for Science and Engineering, a Hartford magnet school.

According to Dr. Rainer Hebert, the camp was organized under the auspices of ASM International, a professional organization of materials engineers and scientists. The organization has offered Materials Camps since 2002 as an avenue for high-school students to gain exposure to materials science activities and careers. Members of the ASM International Hartford chapter sponsored the event. Dr. Hebert said UConn's IMS decided to host and sponsor the Materials Camp because the Institute houses an impressive selection of cutting-edge equipment and resources for demonstrations, an enthusiastic population of undergraduate and graduate students, and a desire to "attract bright and curious students to our program."

During the half-day camp, the Hartford students visited seven learning stations, each equipped with a particular theme. The stations covered a range of representative materials science demonstrations involving nanotechnology, materials identification, high-temperature materials, casting, microstructures, energy and brazing. The groups enjoyed 30-minute explanations and demonstrations at each station, where "instructors" included not only UConn materials science faculty and students but also industry representatives, along with individuals from the Center for Research on Interface Structures and Phenomena (CRISP) program comprising researchers from Yale University and Southern Connecticut State University.

The day culminated with a panel discussion hosted by materials science and engineering senior Salay Stannard, Dr. Hebert and industry representatives Joe Kubinski and Mark Vecchiarelli, president of Yankee Casting. Dr. Hebert expressed gratitude to Mr. Arnie Grot of the ASM Hartford chapter for his assistance, and to the student volunteers whose efforts and excitement made the event a success.

Trillionth Floor Please

(From the Hartford Courant, William Weir, September 9, 2008. For the complete article see http://www.courant.com/ search under author Weir. Note the Courant now charges to access many of its published articles.)

An elevator that leads into space might sound farfetched, but scientists have been seriously considering it for years — and work at the University of Connecticut could end up being a key part of it actually happening.

UConn chemistry professor *and IMS member(ed.)* Fotios Papadimitrakopoulos believes he and his team of researchers have found a way to harness the potential of nanotubes — an extremely strong material made from carbon molecules. Their work was recently published in the journal Nature Nanotechnology. Sang-Yong Ju, a doctoral candidate in polymer science, is the lead author.

If the West Hartford resident is right about the potential of their work, it could lead to practical applications for everything from new drug delivery systems to better tennis rackets.

And, yes, a space elevator. It's an idea that's been around for more than a century, but never seriously considered until recent breakthroughs in nanotube technology.

It's pretty much what it sounds like. The most commonly touted vision of the space elevator involves a paper-thin ribbon made from carbon nanotubes that brings carrier cars thousands of miles into orbit. The ribbon would be tethered to the Earth's surface, while a counterweight at the other end — a space station, perhaps — would float in orbit.

Huey Lands Large Microscopy Development Award

(From eMaginations, University of Connecticut, School of Engineering, see http://www.engr.uconn.edu/SoE/hueyawardmicroscopy.php for the complete article.)

Dr. Bryan Huey, assistant professor of Chemical, Materials & Biomolecular Engineering, *and member of IMS (ed.)* has received a $311,000 award from the National Science Foundation that will support his efforts to enhance the speed with which nano-scale surface properties can be mapped. The award, made under NSF's Instrumentation for Materials Research (IMR) program, is two years in duration.

Dr. Huey will apply the funding toward enhancing and refining a method of microscopy used by researchers across the globe, Scanning Probe Microscopy (SPM). With SPM, an image of the specimen surface is obtained by positioning a sharp probe in close proximity to a specimen and then progressively scanning the sample in a line-by-line manner. Probe-surface interactions are simultaneously recorded as a function of position through an integrated flexible cantilever, allowing mechanical forces, electric fields, magnetic fields, local thermal properties, etc., to be mapped in three dimensions. Dr. Huey notes that SPM has been an enabling tool for nanotechnology since its invention in the early 1980s, providing the capability to measure and manipulate materials down to atomic scale resolution. A persistent constraint of SPM, however, has been its relatively slow speed, averaging four minutes per image or worse with little improvement over the past 25 years.

To address this limitation, Dr. Huey and his team have invented High Speed Scanning Property Mapping (HSSPM), a novel method that allows full-frame image acquisition in less than 1/10th of a second with resolution equal to that of conventional systems, for certain configurations. A new method of enhancing contrast (patent pending) was central to the development of the HSSPM technique. This over 1000-fold improvement has significant implications in terms of increased throughput and efficiency, large area imaging, and especially the ability to quantify dynamic effects with previously inaccessible spatial and temporal resolution.

Besides involving his own post-docs, graduate, and undergraduate research students in this project, Dr. Huey will make the HSSPM technology available to faculty and students across campus, as well as industrial research partners, through the Institute of Materials Science. The technique can also be easily transferred to other academic and industrial institutions because it is compatible with both legacy and next generation SPM systems. "The biggest question right now," he said, "is just how much faster can we go? Our equipment - not any fundamental speed limit - is what is slowing us down at this point. This grant, and hopefully further support, will help us to answer that question."

Footage of HSSPM images in motion can be viewed at http://www.engr.uconn.edu/SoE/hueyawardmicroscopy-popup.php. This short movie depicts 244 consecutive HSSPM images of a 4000nm x 4000nm area combined into a movie depicting in situ ferroelectric memory switching. The movie first presents nucleation-dominated switching in the positive direction (white to black contrast, for example a binary '1'), followed by backswitching in the negative direction (black to white, writing a binary '0'). This film is courtesy of R. Ramesh, UC Berkeley. HSPFM measurements were performed by N. Polomoff, Huey AFMLabs, UConn.

Employment Web Page

The Institute of Materials Science has a web page to help match students with potential employers. The IMS Employment Center can be accessed from the IMS home page http://www.ims.uconn.edu/ and clicking on Outreach. The site consists of two sections: 1) postings of open positions from industry/academia; and 2) postings of student resumes. Both graduate and undergraduate students can participate.

We post announcements of open positions from industry/academia for full-time or part-time employment as they are received. Please forward any open position announcements you wish to post to Shari Masinda (smasinda@ims.uconn.edu).

We have a few positions on the website now, but with your help we can build this database of information, which will benefit both students and employers.

Focus on Research-Rainer Hebert

In each issue of this newsletter we profile one of the active research areas at IMS. In this issue we focus on the research being led by Rainer Hebert, Assistant Professor of Chemical, Materials and Biomolecular Engineering.

Rainer Hebert received a Diploma degree in physics from the University of the Saarland in Saarbrücken, Germany in 1997 and a Ph.D. in Materials Science and Engineering from the University of Wisconsin-Madison in 2003. Following a 2-year stint as a post-doctoral researcher at the Institute of Nanotechnology of the Research Center Karlsruhe, Germany (formerly Nuclear Research Center Karlsruhe) he returned to UW-Madison before joining the University of Connecticut in the fall 2006. Among Dr. Hebert's interest are metallic glasses and metallic multilayers.

Metallic Glasses

Metallic materials and their phase transformation behavior under conditions of sustained external forcing represent a main research area in Rainer's group. Metallic glasses have been used since the 1970s for soft-magnetic applications. Since the 1990s research efforts have shifted toward structural applications. Little is known about the effect of deformation, in particular elastic deformation, on the amorphous atomic arrangement and the stability of the amorphous phase. Amorphous alloys are suction-cast with a laboratory arc-melter into cylindrical shapes. Differential scanning calorimetry (DSC) and thermomechanical analysis (TMA) are the main analysis tools to detect changes in the amorphous alloys following cyclic elastic deformation. The group focuses on a relatively novel measurement mode, modulated DSC and TMA, to separate irreversible from reversible effects. Experimental results of DSC and TMA measurements are interpreted with the free volume theory, annihilation models for structural defects, and the theory of thermal expansion. In addition to studying cyclic elastic deformation, the group has started to examine surface sliding effects on the phase stability of Cu-based glasses. Traditionally, the main interest in phase stability of amorphous alloys has been directed on thermally induced crystallization. Rainer's group continues this long-standing research theme and currently investigates the crystallization behavior in shear bands of metallic glasses.

Metallic Multilayers

A second research theme in Rainer's group centers on severe plastic deformation processing of metallic multilayers. Using a continued cold-rolling and folding process, similar to ancient Japanese sword making, metallic sheets containing hundreds to thousands of very thin layers can be created with a thickness of hundreds of micrometers to millimeters. These multilayer materials have recently been used commercially as reactive foils for localized soldering and welding applications. Experiments with thin film multilayers have furthermore demonstrated that film strength can increase dramatically by decreasing individual layer thickness to the nanometer level offering the prospective of ultra-high strength metallic sheet materials.

The research efforts in Rainer's group are directed to improve the understanding that is necessary to manufacture multilayers obtained from the repeated rolling and folding technique. The group uses continuum mechanics models to predict the microstructure evolution, for example, necking of individual layers under different processing conditions. Microstructural analyses based on optical, scanning electron, and transmission electron microscopy are linked to the mechanical properties that are measured with tensile testing and nanoindentation measurements. The research thus extends the traditional cladding and roll-bonding techniques to formulate novel approaches for the synthesis of bulk nanolaminate materials.

For more information Dr. Hebert can be contacted at rhebert@mail.ims.uconn.edu.

Two New Members – ASML and Metabolix

Since the last newsletter two companies, Metabolix and ASML, have joined the IMS Associates Program.

Metabolix, founded in 1992 and headquartered in Cambridge, MA, is an innovation-driven bioscience company providing sustainable solutions for the world's needs for plastics, fuels and chemicals. The Company is taking a systems approach, from gene to end product, integrating sophisticated biotechnology with advanced industrial practice. Metabolix is now developing and commercializing Mirel™ bioplastics, a sustainable and biodegradable alternative to petroleum-based plastics. Metabolix is also developing a proprietary platform technology for co-producing plastics, biofuels and chemical products in biomass energy crops such as switchgrass.

ASML is the world's leading provider of lithography systems for the semiconductor industry, manufacturing complex machines that are critical to the production of integrated circuits or microchips. Headquartered in Veldhoven, the Netherlands, *(with facilities worldwide including Wilton, CT, ed.)* ASML designs, develops, integrates, markets and services these advanced systems, which continue to help their customers - the major chipmakers - reduce the size and increase the functionality of microchips, and consumer electronic equipment.

Nanotechnology 'clean room' opens at IMS

(From the UConn Advance, Colin Poitras, October 27, 2008 see http://advance.uconn.edu/2008/081027/08102702.htm for the complete article.)

The University dramatically expanded its nanotechnology research capabilities this past October, with the opening of a 1,000-square-foot 'clean room' that will allow scientists to fabricate cutting-edge devices for use in defense, industry, and medicine.

Gov. M. Jodi Rell, President Michael J. Hogan, and a host of other elected officials and University representatives acknowledged the opening with a ribbon-cutting ceremony Oct. 20 at the Institute of Materials Science (IMS) in the Edward V. Gant Science Complex.

The Nanobionics Fabrication Facility – as the dust-free 'clean room' is formally known – supplements state-of-the-art research technology worth more than $20 million that is currently available at the IMS, including high-power electron microscopes, atomic force microscopes, and advanced spectrometers. Hogan called the $2 million facility a "significant milestone" in UConn's continuing program to build new interdisciplinary scientific initiatives. "This new nanobionics clean room is one part of UConn's comprehensive nanotechnology infrastructure that we think is second to none in Connecticut," Hogan said. "The possibilities of nanotechnology are innumerable, with the potential to revolutionize every facet of applied science and modern technology – from high-tech manufacturing to military devices to fuel cells to new methods of health care."

The University has invested more than $7 million of its own funds in support of nanotechnology research facilities and faculty as part of its revised academic plan. Nearly 80 faculty members from UConn's College of Liberal Arts and Sciences and the Schools of Engineering, Medicine, Dental Medicine, Pharmacy, and Agriculture are now actively engaged in nanotechnology research. Together they have received more than $25 million in research grants over the past three years.

The clean room is expected to advance UConn research into a nanosized implantable glucose sensor for diabetics. It will also help Robert Birge, holder of the Harold S. Schwenk Sr. Distinguished Chair in Chemistry, in his quest to develop an artificial retina.

Legislators and other dignitaries join University President Michael Hogan, center, and Gov. M. Jodi Rell, fifth from right, for a ribbon-cutting at the nanobionics 'clean room' on Oct. 20. From left are Prof. Harris Marcus, Mary Ann Hanley, former U.S. Rep. Rob Simmons, State Rep. Denise Merrill, State Sens. Donald E. Williams Jr., Gary LeBeau, and Eileen Daily, Vinod Makhijani, and Higher Education Commissioner Michael Meotti. *Photo by Gerald Ling*

Nejat Olgac, the head of UConn's Advanced Laboratory for Automation, will use the room to help with the ongoing development of a nanoscopic device that can transfer genetic material into cells with greater accuracy and effectiveness – a potential boon for nanomedicine. In addition, nanotechnology is expected to have a major impact on next-generation energy concepts, such as state-of-the-art solar and fuel cells.

The nanobionics fabrication facility was made possible in part through a U.S. Army Center grant, in conjunction with pooled resources and equipment from the University's nanobionics-associated faculty and IMS. In addition, UConn 2000 funding supported the necessary infrastructure improvements to make the clean room, said Professor Fotios Papadimitrakopoulos, director of the Nanobionics Fabrication Facility and associate director of IMS.

Biofuels Research Nets Nearly $600K in State Funding

(From eMaginations, University of Connecticut, School of Engineering, see http://www.engr.uconn.edu/biofuelgrant.php for the complete article.)

Dr. Richard Parnas, an associate professor in the Department of Chemical, Materials & Biomolecular Engineering, and two colleagues at the University of Connecticut, have been awarded $598,000 from the State to expand their clean energy research program involving biofuels. Dr. Parnas, who directs the University's Biofuel Consortium and is also a member of the Polymer Program within the Institute of Materials Science, is joined by professor emeritus James Stuart of chemistry and Christopher Perkins, an academic assistant with the Center for Environmental Science & Engineering.

According to Dr. Parnas, the funding will support three interrelated and complementary tasks: development of an ASTM testing facility at the UConn campus; process monitoring at the production plant; and real-time, in-line process monitoring.

He explained that the testing facility "will provide Connecticut producers, distributors, and sellers ASTM testing services at a greatly reduced price in order to encourage additional biodiesel development in Connecticut." According to Dr. Parnas, the high cost of testing - which can run as much as $1,000 a day - is an impediment to small startup

companies. By offering ASTM testing at a much-reduced cost, the facility will help to foster more biodiesel start-ups across Connecticut. He expects the testing facility to come online in March 2009 with the capability of testing samples on six core ASTM tests; in the fall, the facility will offer all 18 ASTM biodiesel quality tests.

The Biofuel Consortium comprises students and professors associated with the departments and programs of chemistry, chemical engineering, plant science, marine science, natural resources, economics, and business who share a common interest in stimulating a biofuels industry within Connecticut. Within the Biofuel Consortium laboratory, researchers currently convert waste cooking oil collected from UConn dining facilities into clean-running fuel for on-campus buses. The research team is also investigating the use of other feedstocks, including biomass and even algae. The consortium aims to help UConn reshape its environmental identity, develop environmental curricula and laboratory experiences for graduate and undergraduate students, and foster novel research targeting improved biofuel feedstocks and processing methodologies.

Collaborative Research (continued from Page 1)

researchers from Storrs and four from the Health Center. The group was co-chaired by Suman Singha, interim vice president for research and graduate education at Storrs, and Marc Lalande, associate dean for research, planning, and coordination at the Health Center.

The committee received 45 proposals and made 11 awards. Criteria for evaluating the proposals included the potential to attract extramural funding after the current funding expires, the interdisciplinary nature of the project, and the project's capacity to support the University's application for a Clinical and Translational Science Award – a National Institutes of Health program intended to speed up the translation of scientific research into practical applications in the medical field.

Among the award winning proposals was:

Phase Transformations to Control Morphology and Cell Behavior in Polymer Scaffolds for Tissue Engineering
Jon Goldberg, Reconstructive Sciences, Health Center (PI)
Robert Weiss, Chemical, Materials & Biomolecular Engineering, School of Engineering (Co-PI) *both members of the Institute of Materials Science (ed.).*

Spring Semester Starts

Spring semester classes start January 20, 2009. Some courses that may be of interest include:

MSE 5309	Transport Phenomena in Materials Science & Engineering	Rossetti,G
MSE 5311	Mechanical Properties of Materials	Hebert,R
MSE 5317	Electronics and Magnetic Properties of Materials	Ramprasad,R
MSE 5323	Transmission Electron Microscopy	Aindow,M
CHEG 5352	Polymer Properties	Papadimitrakopoulos, F.
CHEM 5384	Polymer Characterization II	Sotzing, G.
CHEG 5367	Polymer Rheology	Shaw, M.T. & Weiss, R.A.
CHEM 5341	Advanced Organic Chemistry	Adamson, D.
CHEM 5345	Organic Structure Determination	Sotzing, G.
CHEM 5393	Advanced Physical Chemistry	Lin, Y.
MCB 5003	Biophysical Chemistry	Burkhard, P.

Some courses require pre-approval of the instructor.

Department Seminar Schedules

Seminar schedules were not finalized at the time of this writing. Seminar schedules will be available near the beginning of the semester and can be found on the department web sites (http://www.ims.uconn.edu/polymer/seminars.html) and http://www.cmbe.engr.uconn.edu/events.html).

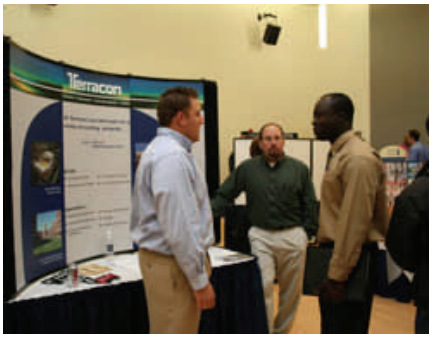
This information is updated as additional seminars are scheduled. Abstracts of seminars are usually available about a week in advance. We can put you in touch with the faculty member sponsoring the seminar to learn more about any seminar of interest. We also suggest you call before attending to be sure the seminar has not been canceled due to illness or weather.

Fall Engineering Career Fair

(From eMaginations, See http://www.engr.uconn.edu/fall2008careerfairevent.php for the complete article.)

The School of Engineering held its first all-school career fair over the course of two days, October 28 and 29, and two venues on the Storrs campus. The events attracted several hundred UConn engineering students, from sophomores through seniors and across all disciplines, who were interested in exploring summer and winter-break internships as well as full-time career opportunities.

The fair attracted between 40 and 50 employers each day, including numerous engineering consulting companies, construction firms, energy companies, manufacturers, computing giants, defense-industry leaders, pharmaceutical companies, as well as, state and federal employers. United Technologies Corporation, Pratt & Whitney, Sikorsky Aircraft, Alstom Power, Frito Lay, Microsoft, Praxair and the Connecticut Department of Transportation were among the organizations participating in the fair.



Both days culminated in receptions where recruiters and students could network and discuss opportunities in a relaxed atmosphere. Thirty to forty of the employer representatives attended the receptions.

The School will host a spring-semester career fair on February 24, 2009, from 10 a.m. to 3 p.m. Interested companies may contact Kimberly Duby at kaa@engr.uconn.edu for details.

IMS Associates Program

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We're on the Web!
www.ims.uconn.edu/associate/associates

Upcoming Events

The IMS Associates Program is planning two short courses for this summer; Nanomaterials and Gel Permeation Chromatography. The Associates Program Annual meeting will be held in May. Watch your mail for details concerning all three events.

Mid-Length Projects (MLP) Program

The Institute of Materials Science (IMS) is continuing a program that facilitates seed research/development projects of an intermediate length. This program is designed to encourage university/industry collaboration on projects that are too extensive for the existing Associates Program yet smaller than full-blown university research projects. Typical student/post-doc supporting research projects at IMS (and for most of UConn departments and other academic institutions) last for several years. Industry often requires exploratory projects of an intermediate length. These projects may require several months to a year of full time effort. Through the Mid-Length Projects (MLP) Program IMS will assist industry in matching the available resources of IMS to a company's needs.

For more information or to discuss specific projects please contact Ed Kurz (860-486-4186, ekurz@mail.ims.uconn.edu) or Harris Marcus (860-486-4623, hmarcus@mail.ims.uconn.edu)

Toxic and Bio-Contaminated Samples

IMS labs are not set up to handle toxic and bio-contaminated materials. We operate in a very open environment with multiple users and shared laboratory facilities. We can not accept toxic materials, materials that present biological hazards or similar materials such as drugs that require specialized handling. Such samples must be returned immediately. We can not dispose of such materials at UConn when they are created by external sources. Given the extensive paperwork required for shipping such material this can be expensive and time consuming.

Sample Preparation

In many Associates Program projects, such as those involving adhesion and coatings, surface analysis techniques are extremely important. The techniques used for such analysis, particularly GC/MS, Auger electron spectroscopy (AES) and X-ray photoelectron spectroscopy (XPS) are extremely sensitive to small amounts of material on the surface. It is important to protect these surfaces from contamination during sample preparation, collection and shipment. **Shipment in common plastic bags should be avoided!** These bags typically contain significant amounts of additives used to prevent the plastics from adhering to themselves and other materials. These additives migrate to the sample during shipment and make interpretation difficult and sometimes impossible. It is much better to ship such samples in common kitchen aluminum foil (not industrial aluminum foil which is often coated with an oil or other release agent). Samples can also be shipped in glass containers with aluminum foil over the opening under the cap. Alternatively special polyester bags that do not contain such additives can be purchased. One source of such bags is the Kapak Corporation (now Ampac) Typical price is about $200 per thousand depending on the exact size. Be sure to specify non-contaminating/non-plasticized material.