University of Connecticut
Institute of Materials Science

IMS Associates Program Newsletter

Vol. 11, No. 1 January 2007

Weiss selected 2006 Fellow of PMSE Division of the American Chemical Society

Robert Weiss, of the Polymer Program and IMS, has been selected by the American Chemical Society Division of Polymeric Materials: Science and Engineering (PMSE) as one of five in a new class of Fellows for 2006. Quoting from the PSME web site:

"Dr. Robert Weiss is a Board of Trustees Distinguished Professor of Chemical Engineering at the University of Connecticut. He received his B.S. from Northwestern and Ph.D. from the University of Massachusetts, Amherst. His work on the use of ionomers to compatibilize blends, and more generally on the effect of ionomeric groups on miscibility, is outstanding and has opened up much new ground in this field. This could also be said about other areas in which he has contributed, such as the effects of shear on miscibility. Dr. Weiss's research has not only been of high quality, but the number of his publications and patents also attest to the extensive range of his interests. He also has shown the ability to find the key, critical experiment, particularly in terms of finding an answer to a particular question. This latter feature is one of the main reasons that his efforts have been so highly valued in the industrial research community. His widespread service record includes leadership roles in the PMSE and the Society of Plastics Engineers where he has served as editor of *Polymer Engineering and Science* for many years. In 2003 Bob was selected as a University of Connecticut Board of Trustees Distinguished Professor, the highest honor that the University bestows on faculty who have demonstrated excellence in teaching, research and service."

Complete details can be found at:
http://membership.acs.org/P/PMSE/awards/fellows/2006fellows.html

American Physical Society names Dobrynin as Fellow

from the UConn Advance, Cindy Weiss - December 11, 2006

Andrey Dobrynin, an associate professor of physics and member of the Polymer Program at IMS, has been named a fellow of the American Physical Society. The APS, the main society of physical scientists, limits fellowships to one half of one percent of its members. Dobrynin was elected "for his contributions to the theory of charged polymers." He has studied charged polymers for the past 10 years. The best known example of a charged polymer is a DNA molecule. Charged polymers are widely used in industry. For example, they are used in proton exchange membranes for fuel cells. Similarly, many biomaterial applications, such as implantable glucose sensors, rely on the unique properties of ion selective membranes made of charged polymers. These polymers are also used in new generations of electronic materials for nanoelectronic devices.

"It is particularly nice that Andrey was awarded this early in his career. It speaks to the quality of his work in the polymer

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field," says William Stwalley, Board of Trustees Distinguished Professor of Physics and department head.

To view the complete article see:
http://advance.uconn.edu/2006/061211/06121108.htm

More information about Dobrynin's research can be found on his web page: http://www.ims.uconn.edu/~avd/

Budnick and Shumway Named AAAS Fellows

from the UConn Advance, Cindy Weiss - December 11, 2006

Two faculty members in the College of Liberal Arts and Sciences have been elected fellows of the American Association for the Advancement of Science (AAAS). Sandra Shumway, professor-in-residence in the Department of Marine Sciences, and Joseph Budnick, professor emeritus, research professor in physics and member of IMS, join the list of 14 faculty and emeritus faculty members at UConn who are AAAS fellows.

Shumway, who came to UConn five years ago, conducts research on shellfish and harmful algal blooms, known popularly as "red tides." She was cited by AAAS for her work in using flow cytometry to learn more about how molluscs feed, and for documenting the impacts of toxic algae on marine life.

Joseph Budnick, who retired three years ago but returned to UConn as a research professor in physics, joined UConn in 1974 as head of the physics department, setting up an extensive nuclear magnetic resonance laboratory here. He studies the basic science of the properties of superconductive and magnetic materials. He was cited by the AAAS for his contributions to condensed matter physics and materials science as a scientist, educator, and administrator.

His present research interest is magnetism and superconductivity. With Barrett Wells, associate professor of physics, and colleagues at the Paul-Scherrer Institute in Switzerland, he is studying the role of electronic phase separation in high temperature, superconducting materials. An eventual outcome of this basic research could be a more complete understanding of the mechanism to produce high temperature superconductivity. That could lead to the more efficient transmission of electricity.

To view the complete article see:
http://advance.uconn.edu/2006/061211/06121106.htm

Adjunct Engineering Professor Named to Italian Government Post

from the UConn Advance, Michael Kirk - July 24, 2006

Luigi "Gino" Nicolais, an adjunct professor with UConn's polymer program since the 1980's, has been named Minister of Innovation and Technologies in the new government that took office following the defeat of former Prime Minister Silvio Berlusconi's ruling party in Italy's national elections.

Anthony DiBenedetto, an emeritus professor of chemical engineering and former vice president for academic affairs at UConn, has known and worked with Nicolais since the 1960's. He recently served as president of a commission overseeing an academic partnership with industry that was administered by Nicolais and sponsored by the Italian state of Campania and the European Union. "In my opinion, it was one of the most innovative and intelligently designed programs of its type in the world," says DiBenedetto. "He is a man of unusual talent - a scientist with a worldwide reputation, an outstanding administrator, and a charismatic individual."

Over the past 30 years, DiBenedetto and Nicolais have collaborated regularly in joint research projects; student exchanges between UConn and the University of Naples, where Nicolais was a faculty member; and as visiting professors at their respective universities.

To view the complete article see:
http://advance.uconn.edu/2006/060724/06072404.htm

Update on Nanotechnology in Connecticut

In the 2006 session, the State General Assembly provided the Office of Workforce Competitiveness with $500,000 to begin addressing the Nanotechnology Advisory Council's recommendations for promoting nanotechnology in the State. As part of the approach, curricula for addressing nanotechnology at all levels of higher education in the state were to be defined. A very active curriculum committee involving UCONN, Yale and most other institutions in the state is working on some common approaches to introducing nanotechnology. Additional areas to be investigated are aspects of SBIR programs focusing on nano-related companies, National Nanotechnology Initiative (NNI) funds, and a major study on approaches to implement a Connecticut Center for Nanoscale Sciences and Development to advance joint university/industrial research and education involving nanoscale materials/systems. All these efforts are required to provide the 2007 session of the Legislature with recommendations on how the State should proceed to implement activities to promote forward momentum in the State on a nanotechnology effort.

As part of the overall nano-related efforts, a UCONN Nanotechnology Steering Committee has been formed. Committee members are Harris Marcus/IMS, Chair, Mehdi Anwar/SOE, Robert Birge/CLAS, Robert Magnusson/SOE, Fotios Papadimitrakopoulos/IMS and Boris Sinkovic/CLAS.

For further information contact:
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Mid-Length Projects (MLP) Program

The Institute of Materials Science (IMS) announces the creation of a new program that addresses 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 most of UConn and other institutions) last for some number of years. Industry often has exploratory projects of intermediate length between these extremes, projects that 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 those required for the project of interest.

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.

UConn Biodiesel Consortium

The UConn Biodiesel Consortium is a team of students and professors from IMS, Chemistry, Chemical Engineering, Plant Science, Marine Science, Economics, and Business. Our mission is to advance UConn's biodiesel research initiative for the greater good of the environment, and to help our nation gain energy independence. For more information see http://biodiesel.engr.uconn.edu/home/index.php or contact Richard Parnas (Richard.Parnas@uconn.edu).

FIRST Lego Teams Visit IMS

On November 6 over 20 middle school students from Andover and Mystic visited IMS to learn more about nanotechnology. Professors Papadimitrakopoulos and Huey presented some of the basics of nanotechnology to the students who then toured the AFM; optoelectronic; and separation and analysis labs of IMS.

The students were members of two FIRST Lego Teams. FIRST stands for For Inspiration and Recognition of Science and Technology and was founded over 15 years ago by inventor Dean Kaman of insulin pump and Segway fame. FIRST consists of an international series of competitions in robotics with a flair, similar to high school athletic events with music, cheerleaders, etc. The goal of FIRST is to create the same interest most young students have in sports and entertainment into excitement and interest in science and technology. There are various levels of complexity in FIRST competitions. More details can be found at: http://www.usfirst.org

The FIRST Lego League (FLL) is for middle school students. Each year the FLL focuses on some aspect of science or technology. This year the focus of the FIRST Lego Leagues is nanotechnology. Teams are tasked to simulate various nano concepts such as individual atom manipulation, self assembly, AFM etc. through the use of Legos. See http://www.firstlegoleague.org/default.aspx?pid=23720 for more details.

A good time was enjoyed by all, culminating with ice cream from the UConn Dairy Bar.

Focus on Research

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 Fotios Papadimitrakopoulos, Professor of Chemistry, and Associate Director, Institute of Materials Science (IMS). Dr. Papadimitrakopoulos received his B.S. with honors in chemistry from the National University of Athens. He obtained his M.S. and Ph.D. in Polymer Science and Engineering from the University of Massachusetts. Upon

graduation Dr. Papadimitrakopoulos conducted post-doctoral studies at the AT&T Bell laboratories for two years. Papadimitrakopoulos joined the University of Connecticut as an Assistant Professor and member of IMS and the Polymer Program in 1994. Dr. Papadimitrakopoulos has also been a visiting professor at Carnegie Mellon University and an adjunct advisor for the International Center for Young Scientists in Japan. Dr. Papadimitrakopoulos has authored or co-authored over 100 peer-reviewed journal publications, holds or co-holds 8 patents, with 7 additional filed, and has presented numerous conference papers and invited talks.

The research effort of the Papadimitrakopoulos' group includes a wide range of materials and devices in nano-bio-systems. Their expertise is focused on supramolecular assembly of man-made artificial nanostructures and their unique interactions with biological entities (such as proteins, DNA and biocompatible polymers). These endeavors span into the following areas:

1) **Single Wall Carbon Nanotubes (SWNTs)**: The metallic (met-) vs. semiconducting (sem-) nature of single wall carbon nanotubes (SWNTs) has attracted considerable attention from the scientific community. Their group was the first to report the use of wet chemistry to separate and/or enrich fractions of SWNTs according to type (or otherwise termed "metallicity") and diameter. Aside from the immense technological importance of enhancing the structural purity and homogeneity of SWNTs, obtaining well-fractionated samples could also enable them to better characterize and model the effects of diameter and chirality. The group continues to advance this separation methodology and obtain a better description of the physicochemical properties of solution-dispersed SWNTs. Separated SWNTs are poised to enhance considerably the properties of nanostructured devices. Building on their initial finding of self-assembled SWNT forest arrays, a number of enzymatic electrochemical biosensors have been developed in collaboration with Prof. Rusling's group. More recently, they demonstrated SWNT forest-based electrochemical immunoassays with sensitivity exceeding that of traditional ELISA. Patterning of these SWNTs forest arrays at the nanometer level is currently used to produce nanosized needles that could electrochemically interface with living bacteria and cells, without disturbing their normal physiology (in collaboration with Professors Marcus, Rusling, Noll and Huey).

2) **Semiconductor Nanocrystals (NCs):** Over the past ten years, their group has investigated two classes of semiconductor NCs: (a) Si-based quantum dots (QDs) for the fabrication of high refractive index (as high as 3.4) transparent nanocomposites, and (b) CdSe-based II-VI QDs and quantum rods for a number of optoelectronic and bio-marker related applications. More recently, their group has been developing selective faceting methodologies for CdSe NCs, which are vitally needed in order to selectively control their interactions with a variety of biomolecules.

3) **DNA-assisted solid freeform fabrication manufacture of photonic crystals:** The ability of DNA oligomers to selective bind and recognize their complementary stands is currently used for the fabrication and immobilization of 2-dimensional photonic crystals of monodispersed colloidal microspheres. In collaboration with Prof. Marcus, their groups have demonstrated selective insertion or defects at predetermined positions of these 2-D photonics crystals.

4) **Totally implantable wireless glucose sensors:** Real time monitoring of various metabolic analytes that control function and physiology of the human body is crucially needed for a variety of applications and especially for diabetic patients in everyday life. Their group, in collaboration with the groups of Professors Burgess and Jain, has been developing wireless, totally implantable glucosensors that exhibit significant size reduction, increased bio-acceptability and suppression of inflammation. Significant effort is exerted to identify the various failure mechanisms and improve upon both *in-vitro* and *in-vivo* device stability.

Many of Papadimitrakopoulos' publications can be found at http://www.ims.uconn.edu/~papadim/PUBLICATIONS.html. Selected publications include:

1. X. Yu; B. Munge; V. Patel; G. Jensen; A. Bhirde; J. D. Gong; S. N. Kim; J. Gillespie; J. S. Gutkind; **F. Papadimitrakopoulos**; J. F. Rusling, "Carbon Nanotube Amplification Strategies for Highly Sensitive Immunodetection of Cancer Biomarkers", *J. Am. Chem. Soc.*, **2006**, *128*, 11199-11205.
2. S. Kim; B. Yang; S. Hou; J. Lee; **F. Papadimitrakopoulos**; "DNA-Assisted 2D Photonic Crystal Fabrication", *Adv. Funct. Mat.* **2006**, *16*(12), 1590-1598.
3. R. Li; Z. Luo; **F. Papadimitrakopoulos**; "Redox-Assisted Asymmetric Ostwald Ripening of CdSe Dots to Rods", *Journal of the American Chemical Society*, **2006**, *128*, 6280-6281.
4. M. K. Mathai, K. Higginson, E. Shin, **F. Papadimitrakopoulos** "Correlating Physical and Chemical Degradation in the Performance of Aluminum *tris* (8-hydroxyquinoline), (Alq_3)-based OLEDs" *J. Macrom. Sci. Part A—Pure and Appl. Chem.* **2004**, *A41*(12), 1425-1435.

For more information please contact Dr. Papadimitrakopoulos (papadim@mail.ims.uconn.edu).

New Faculty

Dr. Rainer Hebert joined the faculty of the University of Connecticut in August 2006 as an Assistant Professor in Materials Science and Engineering. He received his Diploma in Physics from the University of the Saarland, Saarbrücken, Germany in 1997 and his Ph.D. from the Department of Materials Science and Engineering, University of Wisconsin-Madison, in 2003. From 2003 to 2005 Dr. Hebert worked as a post-doctoral research associate at the Institute of Nanotechnology at the Research Center in Karlsruhe, Germany, before returning to the Department of Materials Science and Engineering at the University of Wisconsin-Madison as a research associate in the summer of 2005. His work is mainly focused on the synthesis and microstructure control of amorphous and nanostructured alloys and composites.

Dr. Puxian Gao will be the MSE Program's newest member starting January 2007 as an assistant professor in the CMBE department. Most recently he was a Postdoctoral Fellow in the School of Materials Science and Engineering at the Georgia Institute of Technology. He received his Ph.D. from the School of Materials Science and Engineering, Georgia Institute of Technology, GA (2005), a Masters of Engineering in Materials Science and Engineering, Beijing University of Aeronautics & Astronautics, China (2000) and a Bachelor of Science in Mechanical Engineering, Xiangtan University, China (1997). His research interests include syntheses, characterization and catalyzed growth mechanisms of 1-dimensional nanomaterials; biomedical applications (biosensor and bioactuator) of 1-D nanomaterials; and biofluidics.

Members Corner

In each newsletter we present short descriptions of one or two of our member companies. In this issue we focus on **Phonon Corporation**. We thank Jim Jacobs of Phonon for this contribution.

Phonon's products are custom designed surface acoustic wave (SAW) devices & subsystems, which are specialty microcircuits for high performance analog signal processing, including filters, delay lines, and correlators. SAW technology is faster than digital integrated circuit technology, and provides the small size weight and power required by modern airborne, space and portable systems.

The devices manufactured at Phonon use acoustic waves on the surface of special solid-state materials to achieve their unique signal processing capabilities. SAW devices basically consist of an input transducer to convert electrical signals to tiny acoustic waves, which then travel through the solid propagation medium to the output transducer where they are reconverted to electrical signals. The device designer has great flexibility in configuring the transducers and medium, and therein lies the ability to realize a wide range of signal processing functions.

Phonon's 15,000 sq. ft. facility is located in Simsbury, CT. More information can be found at:
http://www.phonon. com/

Department Seminars

Spring seminar schedules have not been finalized at this time. A preliminary schedule for the Materials Science and Engineering Department can be found at:
http://www.engr.uconn.edu/cmbe/page.php?id=seminar&pid=seminars

This information will be updated as additional seminars are added. The schedule for the Polymer Program spring semester seminars was not available when this newsletter was written but when published will be found on the Polymer Program web site.
http://www.ims.uconn.edu/poly/component/option,com_wrapper/wrap,Seminars/Itemid,91/

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

Upcoming Events

The IMS Associates Program Annual Meeting will be held in the spring of 2007. We are also planning two short courses. Failure of Materials will combine two of our previous courses, Plastics Failure and Failure of Metals and Ceramics. Drs. McEvily and Ezrin will jointly present the course. A short course about conductive polymers is also in development and will be presented by Dr. Greg Sotzing. It is anticipated that all three events will take place in the May/ June 2007 time frame. Watch your mail for details. Associates Program member companies will receive one reduced price registration to each short course. We welcome your suggestions for future short courses.

Spring Semester Starts

Spring semester classes start January 16, 2007. Some courses that may be of interest include the following.

CHEM-384	Polymer Characterization II	L. Zhu and A. Asandei
CHEG-352	Polymer Properties	F. Papadimitrakopoulos
CHEG-367	Rheology	R. Weiss
CHEM-353	Chemical Kinetics	C. Sung
BME 271	Biomaterials	M. Wei
MMAT-309	Transport Phenomena in Materials	H. Brody
MMAT-320	Physical Ceramics	T. Kattamis
MMAT-323	Transmission Electron Microscopy	M. Aindow
MMAT-298	Nanomaterials	B. Huey
MMAT-311	Mechanical Properties of Materials	R. Hebert
MMAT 276	Thermal/Mechanical Processing of Materials	L. Shaw

Some courses require pre-approval of the instructor. Course descriptions can be obtained online:
http://catalog.grad.uconn.edu (for courses >300 level)
http://catalog.uconn.edu (for courses <300 level)

Recent Patents and Licenses by IMS Faculty Members

Patents:

Jain, F., Papadimitrakopoulos, F.
Full Color Display Structures Using Pseudomorphic Cladded Quantum Dot Nanophosphor Thin Films
6,992,317

Weiss, R., Erkey, C., Shenoy, S., Cohen, D.
Conductive Elastomeric Foams and Method of Manufacture Thereof
7,029,722

Mather, P., Kim, B., Ge, Q., Liu, C.
Nonionic Telechelic Polymers Incorporating Polyhedral Oligosilsesquixane (POSS) and Uses Thereof
7,067,606

Licenses:

Sotzing, G.
Area - Conductive Polymers
Companies - Sekisui Chemical Co. Ltd. and Triton Systems

DiBenedetto, A.
Area - Bioactive Fibroin Gel
Company - Eurocoating SpA

IMS Associates Program

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

Recent Associates Program Staff Presentations

"Unexpected and Unusual Failures of Polymeric Materials" Myer Ezrin and Gary Lavigne, Second International Conference on Engineering Failure Analysis, September 12-15, 2006, Toronto, Canada.

"The Role of Analytical and Physical Methods in Plastics Failure Analysis" Myer Ezrin, Gary Lavigne, Mark Dudley, Laura Pinatti and Fiona Leek, to be presented at Society of Plastics Engineers Annual Technical Conference, May 6-10, 2007, Cincinnati, Ohio.

"Auger Electron Microscopy: When Skimming the Surface is a Good Thing!" Daniel Goberman and Edward Kurz, 2006 Eastern Analytical Symposium and Exhibit, November 13-16, 2006, Somerset, New Jersey.

Sample Preparation

In many projects that the Associates Program deals with, such as 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 make efforts not to contaminate these surfaces during sample preparation, collection and shipment. **Shipment in common plastic bags should be avoided**! Common plastic bags typically contain significant amounts of additives used to prevent the plastics from adhering to themselves and other materials. These additives will migrate to the sample during shipment and at best 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. Typical price is about $200 per thousand depending on the exact size. Be sure to specify non-contaminating/ non-plasticized material.