



University of Connecticut Institute of Materials Science



IMS Associates Program Newsletter

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Sotzing and Zhu Win NSF Faculty Early Career Development (CAREER) Program

Two IMS faculty members have won the National Science Foundation's most prestigious award for new faculty members. The CAREER program recognizes and supports the early career-development activities of those teacher-scholars who are most likely to become the academic leaders of the 21st century. CAREER awardees are selected on the basis of creative, career-development plans that effectively integrate research and education within the context of the mission of their institution.

Gregory A. Sotzing, Assistant Professor of Chemistry and member of the IMS Polymer Program, has won an award of \$480,000 for a five-year program entitled "Novel Conjugated Macromolecules from Fused Heterocyclics and Oxidative Solid-state Crosslinking." The aim of this CAREER development plan is to prepare novel conductive polymers and conjugated macrocycles from fused five-membered heterocycles and to study the fundamentals behind a process that Sotzing has invented for nanolithographic patterning of conjugated polymers within insulating polymer matrices using electrochemical atomic force microscopy. The knowledge gained from this work will lead toward the development of molecular electronics and nanotechnology in addition to developments in the areas of sensor and flexible display technologies. Through the educational component of the CAREER, Sotzing will help to organize the first CT Science Olympiad that CT has seen for twenty years in the areas of biology, chemis-

try, and physics. This year, the Science Olympiad is primarily for high school students across the state and winners will advance to national competition. This event will be held at Putnam Science Academy on April 3, 2004. Any companies or individuals willing to be a part of this huge undertaking are encouraged to contact Professor Sotzing (sotzing@mail.ims.uconn.edu).

Lei Zhu, Assistant Professor of Chemical Engineering and member of the IMS Polymer Program, has won an award of \$430,000 for a five-year program entitled "Tailoring the Nanostructure and Morphology of Hydrogen-Bonded Supramolecular Liquid Crystals Using Immiscible Polymer Side Chains." The aim of this CAREER development plan is to achieve precise understanding of novel nanostructure and morphology in supramolecular columnar liquid crystals (LCs) with immiscible polymeric side chains, and to use these polymer side chains to manipulate spontaneous curvature in a microphase separated single LC column on nanometer scales. The knowledge gained on the formation mechanism of helical morphology induced by spontaneous curvature in hydrogen-bonded columnar LCs will both enrich our understanding in supramolecular self-assembly that mimics biomaterials and make additional contributions to the development of nanoscience and nanotechnology by their potential application in environment-responsive nanoactuators.

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New Faculty

In the summer of 2004 the Metallurgy and Materials Engineering Department welcomes one new faculty member, Bryan D. Huey, Assistant Professor. Dr. Huey received his BS in Materials Science from Stanford University and his MS and PhD from the University of Pennsylvania. His PhD work concentrated on the implementation of scanning surface potential microscopy using atomic force microscopy to measure, in-situ, the local voltage dependence of the electronic properties of varistors and other oxide grain boundaries at the nanoscale.

During his postdoctoral studies, at Oxford University; the EPFL Department of Physics in Switzerland; and the Ceramics division at NIST, he continued his research into various scanning probe techniques, including; the use of ultrasonic force microscopy to investigate nanometer-scale mechanical properties of nanocomposites, heterostructures and

ion beam damage; in vitro use of scanning probe microscopy to investigate fixed and living nerve cells; and theoretically and experimentally investigating distributed loading in piezoforce microscopy to enable truly quantitative measurements of ferroelectric thin films.

He has authored over 20 peer-reviewed publications and has numerous conference presentations and proceedings papers. He is the leading author of two book chapters; one in *Nanoscale Phenomena in Ferroelectric Thin Films*; and the other in *Scanning Probe Microscopy and Spectroscopy: Theory, Techniques, and Applications*, 2nd edition.

At the University of Connecticut, Dr. Huey plans to continue his work in developing and applying scanning probe techniques for nanoscale materials property measurements.

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 Mark Aindow, Associate Professor of Metallurgy and Materials Engineering.

Mark Aindow was educated at the University of Liverpool in England, receiving a BEng in Metallurgy and Materials Science in 1985 and a PhD in Materials Science and Engineering in 1988. After a brief spell as a temporary lecturer in Liverpool he spent two years in the USA as a Postdoctoral Fellow, first at Case Western Reserve University and then at Ohio State University. He was appointed to the faculty at The University of Birmingham, England in 1990 as a Lecturer and was promoted to Senior Lecturer in 1996. He returned to the USA in 1999 to join the faculty at the University of Connecticut as an Associate Professor.

Dr. Aindow's research involves the study of microstructural development in engineering materials using, primarily, electron microscopy techniques. He has published over 150 refereed papers on such topics in academic journals and conference proceedings and has presented invited talks on this work in North America, Europe and Asia. Dr. Aindow has led a comprehensive up-dating of the IMS Microscopy Laboratory facilities including the acquisition of a high-resolution field-emission gun scanning electron microscope and a digital automated high-resolution transmission electron microscope with imaging electron energy loss spectrometer and ultra-thin window energy-dispersive Xray spectrometer. These facilities are used in a wide range of IMS programs.

The emphasis of his current programs is on microstructural development in aerospace alloys. These include:

INTERFACIAL STRUCTURE AND PROCESSES IN LAMELLAR TITANIUM ALUMINIDE ALLOYS - The objective of this project is to develop a fundamental understanding of defect-mediated interfacial processes in lamellar TiAl-based alloys by using transmission electron microscopy to measure changes in the interfacial defect configurations as a function of thermomechanical history. (Funded by NSF)

ACCELERATED INSERTION OF MATERIALS: ROTOR COMPONENTS (with Martin Blackburn) - This project involves the development of quantitative measures for microstructural distributions in powder-processed components produced from the nickel-based superalloy IN100. This is part of a large multi-organization program led by Pratt & Whitney. (Funded by DARPA)

STRUCTURAL AMORPHOUS METALS (with Martin Blackburn) - This multi-investigator program led by Boeing has the aim of developing new high strength Al alloys from vitreous precursors. High-resolution and energy-filtered transmission electron microscopy are being used to elucidate the microstructural development in these new alloys. (Funded by DARPA)

Additional information and selected publications can be found at: <http://www.ims.uconn.edu/metal/Faculty/faculty.htm>.

Connecticut Nanotechnology Initiative

The Connecticut Nanotechnology Initiative (CNI) is now an incorporated entity of volunteers from industry, business and academia dedicated to establishing Connecticut as a global leader in nanotechnology. Nanotechnology is anticipated to be a transformative force in global industry, creating a \$1 trillion market for products and services in the U.S. and between 800,000 and two million new jobs by 2010. The organizers of CNI believe that Connecticut possesses all of the necessary building blocks to achieve nanotechnology leadership. The University of Connecticut and Yale University, for example, are home to world-class researchers in this field and each has spawned start-up companies engaged in nanotechnology. Many companies located here, such as Pfizer, United Technologies, Electric Boat, Praxair, Photronics and Gerber Scientific have recognized the need to access nanotechnology to remain as leaders in their fields and have been actively supportive of CNI's efforts. The State also possesses one of the most skilled and educated workforces in the country, affords ready access to sources of funding

and has a history and culture of innovation. And, the grass roots response to CNI's organizational efforts has been very enthusiastic and strong. The challenge perceived by CNI is how to take advantage of these assets and propel the State forward to success.

CNI believes that the path to success lies in continuing the Initiative's organizational efforts while sharpening its focus and strategy in order to present targeted items for action by CNI participants and supporters, both public and private. Toward that end, CNI hopes to conduct additional networking and outreach events to help build and sustain momentum and facilitate the gathering of information on how best to achieve a leadership position for the State in nanotechnology.

For more information on the Connecticut Nanotechnology Initiative please contact Dr. Harris Marcus (860-486-4623, hmarcus@mail.ims.uconn.edu) or see <http://www.ctnano.org/>.

Weiss Brings World Of Polymers To Life With Everyday Examples

As reported in the last IMS Associates Program Newsletter Robert Weiss, Professor of Chemical Engineering and Director of the Polymer Program, was named Board of Trustees Distinguished Professor, the highest academic title for a member of the UConn faculty. An excerpt from a recent *Advance* article featuring Dr. Weiss's research and educational activities follows. The complete article can be found at <http://www.advance.uconn.edu/03102010.htm>.

Professor Bob Weiss often introduces his students to the world of polymers with a memorable clip from the 1967 movie, *The Graduate*.

Dustin Hoffman, playing a graduate fresh out of college, is pulled aside at a pool party by a middle-aged friend of the family.

"I just want to say one word to you," the man says.

"Yes, sir," replies Hoffman.

"Just one word. Plastics."

For Weiss, the script might only have been improved with the word "polymers." But never mind; plastics are synthetic polymers, and *The Graduate* serves Weiss well.

It also gives a glimpse into the kind of approach he takes to teaching a subject of monumental proportion and complexity.

While polymers and their relationship to human beings are serious business, Weiss likes to convey that they can also be fun.

"In class I like to show my students a pull chain from a light fixture and tell them each little ball represents an atom," he says. "To make a polymer, the chain would have to be 90 feet long, and that's just one molecule. Then we start talking about the interactions between molecules."

More information regarding Dr. Weiss's research interest can be found at <http://www.ims.uconn.edu/polymer/faculty/weiss.htm>.

Associates Program Annual Meeting

The Associates Program annual meeting is tentatively scheduled for Wednesday May 26, 2004. Plans are still in development but one of the presentations will most likely deal with the recently completed member survey and our

plans for the future. Representatives from all member companies are encouraged to attend. Attendees learn of new developments, interact with other members, and have access to IMS faculty and staff. Watch your mail for details.

New Atomic Force Microscopes

Nanotechnology is one of the fastest growing areas of research in the scientific community. From bioscience to semiconductors, researchers require more powerful tools to explore this tiny world. The Atomic Force Microscope (AFM) has been the instrument of choice for three dimensional measurements at the nanometer scale.

IMS has ordered three new state-of-the-art Atomic Force Microscopes. Two of the instruments are the Molecular Force Probe 3D (MFP-3D) from Asylum Research. The MFP-3D, for use with an inverted optical microscope, is a sensitive and precise AFM with sensors in all three axes. The MFP-3D head is capable of numerous standard scanning

modes in fluid and air including: Q-controlled AC (with Phase), contact mode (with lateral force), force curves and force volumes. More details can be found at the Asylum Research web site at <http://www.asylumresearch.com>.

The third AFM will be equipped with hard vacuum compatibility tied to an IMS UPS (Ultraviolet Photoelectron Spectroscopy) system and will be supplied by Omicron Corp. (<http://www.omicron.de>)

The three AFMs are expected to be received and operational within six months.

New Pulsed Laser Deposition System

Pamir Alpay, Assistant Professor of Metallurgy and Materials Engineering, and Barry Wells, Assistant Professor of Physics, with additional support from the UConn Research Foundation have recently purchased and installed a pulsed laser deposition (PLD) system. The PLD system was purchased from PVD Systems Inc.

The PVD Products Nano PLD system is capable of depositing high quality films on substrates up to 2-inches in diameter. This unit features a rectangular box style chamber with a front mounted hinged door. This provides for quick and easy access for substrates and target changes. The chamber includes multiple user accessory ports for target and substrate viewing, a sputter or ion source, as well as spectroscopy. The substrate heater uses IR lamps that are

easily field replaceable. Substrates can be heated to 950°C when using silver paste. Temperature uniformity of $\pm 5^\circ\text{C}$ is achievable. The heater has a water-cooled shroud to minimize the radiation effects on the chamber walls. A complete, enclosed optical train is provided and the system is compatible with PVD Products' optional Intelligent Window. A large water-cooled plate protects the targets from the heater radiation. Either three 2-inch diameter targets or six 1-inch diameter target carousels are available along with programmable target rastering and indexing. The base pressure is below 1×10^{-6} Torr using a rear mounted 210-liter/sec turbo pump package. The system came with a laptop computer to operate all the Nano PLD functions as well as the excimer laser.

IMS Short Course

Dr. Ezrin, Director of the IMS Associates Program, will once again present the popular short course **Plastics Failure: Cause and Prevention**. The purpose of this course is to take some of the mystery out of why plastics fail by demonstrating the role of the major factors that determine if there will be failure or success: materials, design, processing and the effect of service conditions. The course bridges the gap between theoretical and basic aspects of polymers and the failures of plastics formulations in commercial and indus-

trial practice. Prevention is emphasized throughout the course. Case studies of wide-ranging types of failures of different materials and applications illustrate the underlying principles.

The exact dates will be finalized shortly. You will receive more detailed information in the spring. All Associates Program member companies will receive one reduced price registration.

Short Course Registrations

In the past a small number of people have registered for short courses through the Associates Program and not attended. The Associates Program must still pay in this situation. Please note that participant substitutions can be made

at any time and registration can usually be canceled at minimal cost until the day before the course. We understand that occasionally plans must change but request your assistance when such changes occur.

Members Corner

In each newsletter we present short descriptions of one or two of our member companies. In this issue we focus on Crompton Corporation. We thank Ron Rosenberg of Crompton for this contribution.

Crompton Corporation is a global producer and marketer of specialty chemicals and polymer products and equipment. The company has about 5,700 employees in research, manufacturing, sales and administrative facilities in every major market around the world. Annual sales are approximately \$2.2 billion.

Crompton Corporation was created in September 1999 with the merger of Crompton & Knowles Corporation and Witco Corporation.

The roots of Crompton stretch back over 100 years and include some of the most recognizable names in the chemical industry: Uniroyal Chemical, Witco and Davis-Standard.

Many business groups at Crompton have made broad

use of the Associates Program since 2000. Various microscopy studies have been performed on multiphase polymers. NMR has been applied to polymer additives, helping Crompton to plan future upgrading of its own NMR capabilities. MALDI-TOF spectroscopy and GPC chromatography with UV detection helped provide detailed structure of new polymers. UConn has also provided consulting advice in the design and use of heterogeneous catalysts.

In one case, UConn provided major assistance in overcoming severe chemical degradation that was occurring in isolated batches of a Crompton polymer product. IMS thermal desorption GC/MS analyses helped establish that the cause was unsuspected trace contamination in a raw material used widely by many polymer producers. The manufacturer of this raw material was completely unaware of this contamination or its downstream effect, but was able to correct the problem on being informed. Thus, this joint effort by UConn and Crompton benefited a broad segment of the polymer industry.

Nanotechnology in Connecticut Symposium

Over 200 people attended an all day symposium on Nanotechnology in Connecticut held at Jorgenson Auditorium, University of Connecticut, Storrs campus on Tuesday, October 16, 2003 from 8:30 a.m. to 7:00 p.m. Presentations included:

- James Murday, NRL, *"The National Nanotechnology Initiative"*
- Alain Kaloyeros, U. Albany, *"The New York State Nanotech Effort"*
- B. Hwang, Brookhaven, *"Nanoscience at Brookhaven National Laboratory"*
- Gualberto Ruano, Genomas, *"The Evolving Interface of Nanotechnology and Modern Genomic Analyses"*
- Steve Suib, UConn, *"Molecular Sieves"*
- Jack Solomon, Praxair, *"R&D Roadmap for Nanomaterials by Design: From Fundamentals to Function"*
- Mark Reed, Yale, *"Beyond the Brick Wall: Off-Road Map Technologies"*
- Leon Pintsov, Pitney Bowes, *"Nanotech in Industry"*
- Fotis Papadimitrakopoulos, UConn, *"Carbon Nanotubes*

for Biosensory Technologies"

- Hollis Kleinert, Protometrics, *"Proteomics For Everyday Use In Pharmaceutical R&D"*
- Mark Saltzman, Yale, *"Biomedical Applications of Nanotech"*
- Anne DeGroot, EpiVax, *"Design of Vaccines and Therapeutic Products through Immunoinformatics"*
- Mark Reed, Yale, *"What Nanotech Isn't, What Nanotech Is"*
- Carol Lynn Alpert & Joel Rosenberg, Boston Museum of Science, *"Connecting the Quantum Dots: Educational Outreach Activities of the Harvard-MIT-UCSB-Museum-of-Science Nanoscale Science and Engineering Center"*
- Robert Birge *"Nanotech for Students: How to Teach It and Guide Them to the Courses They Need to be Nano-ready!"*
- H. Rosvally, Westport, *"The New Connecticut Science Framework"*

This event was sponsored by the Connecticut Nanotech Initiative. See <http://www.ctnano.org/> for more information.

Department Seminars

Spring seminar schedules have not been finalized at this time. We will send the schedules to our members for the Metallurgy and Materials Engineering Department and the Polymer Program when finalized. This information, and the seminar schedules for most departments, will also be available on the World Wide Web. Ab-

stracts 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.

CONNSTEP Seminars

CONNSTEP (Connecticut State Technology Extension Program), in conjunction with the Connecticut Industrial Efficiency Partnership, is presenting a series of seminars offering ways to reduce use of electricity and gas, reduce waste, and improve manufacturing operations. Titles and abstracts are listed on page 7. For more information, please contact Judy Włodarczyk, CONNSTEP, 860-644-9718 or

jwlodarc@connstep.org.

Please note that the Associates Program only offers financial assistance with registration to short courses or seminars sponsored by the IMS and does not offer assistance to those presented by others, as are these seminars.

Associates Program Staff Presentations

January 14, 2004: Myer Ezrin, Director of the IMS Associates Program, spoke on "Patent Infringement and Product Liability Litigation Involving Chemicals and Plastics" at the meeting of the SPE Western New England Chapter.

February 18-19, 2004: Myer Ezrin will attend and present paper at SPE Global Plastics Environmental Conference, Detroit. The paper is entitled "Aromatic Hydrocarbon Content of Plastics Packaging Materials." The main point is proof that hydrocarbons contaminating many packaging materials originate from gasoline in air.

March 12, 2004: Gary Lavigne will present "A Syringe-

less Injection Device for the Introduction of Solids and Liquids into a Split/Splitless Capillary Injection Port" at the Annual Pittsburgh Conference on Analytical Chemistry in Chicago.

May 16-20, 2004: Myer Ezrin's call for papers on Analytical Methods for Plastics Failure Analysis at a joint session of Polymer Analysis Division and Failure Analysis and Prevention Special Interest Group has led to nine or more papers submitted. M. Ezrin and G. Lavigne will have a paper in this joint session on GC/MS at SPE ANTEC in Chicago.

Spring Semester Starts

Spring semester 2004 classes start Tuesday, January 20, 2004. Some courses that may be of interest include the following.

CHEG-358	Composites	R. Parnas
CHEM-384	Polymer Characterization II	G. Sotzing
CHEG-352	Polymer Properties	M. Shaw
BME 271	Biomaterials	M. Wei
MMAT-309	Transport Phenomena in Materials Processing	H. Brody
MMAT-320-1	Physical Ceramics	T. Kattamis
MMAT-320-2	Advanced Transmission Electron Microscopy	M. Aindow
MMAT-266	Mechanical Behavior of Materials	H. Marcus
MMAT-277	Processing of Materials in the Liquid and Vapor State	T. Kattamis
MMAT-307	Solidification of Metals and Alloys	H. Brody
MMAT 276	Thermal/Mechanical Processing of Materials	L. Shaw

Some courses require pre-approval of the instructor.

CONNSTEP Seminars

Reducing Energy Costs Through Lean Manufacturing

Fee: \$50.00

Experience the benefits of the lean manufacturing at this interactive seminar that will demonstrate the potential benefits of Lean Manufacturing on the plant floor. Learn the principles of Lean and apply them in a hands-on factory simulation. See how the benefits of Lean equate to waste reduction and energy saving. Limited to 25 people on a first-come, first served basis.

February 18, 2004

8:00AM – Noon

Location: Hartford area

TPM as a Leverage Point for Reducing Energy Usage and Improving Facility Operations

Fee: \$50.00

TPM (Total Productive Maintenance) is a systematic approach to maximize the productivity and extend the life of equipment. TPM creates an environment that encourages improvement efforts in safety, quality, cost, delivery, and creativity. During this seminar, you will be introduced to techniques that allow for the identification and elimination of major equipment related losses, as well as energy and maintenance savings. Attendees will be shown examples of how TPM is being accomplished at many major manufacturing facilities and how to achieve multiple positive impacts from a single improved operating practice.

April 6, 2004

8:00 AM – Noon

Location: CONNSTEP office
233 Mill St., Waterbury

Pumping System Assessment Tool (PSAT)

Fee: \$60.00

PSAT is a software program developed by the U.S. Department of Energy (DOE) to assist in assessing energy savings opportunities in pumping systems. This course is designed for plant engineering and operations staff, and addresses performance problems encountered in everyday production situation. Learn how the software functions and ways to use this software to evaluate your system's performance.

June 2004

8:00 AM – 4 PM

Location: Bridgeport area

COMING SOON

The following seminars are under development and will be offered in the spring.

Plastics Injection Molding Energy Conservation

This seminar will focus on typical energy consumption in a plastic injection molding facility and energy conservation opportunities. The seminar is being developed with University of Massachusetts Industrial Assessment Center (IAC), and representation from the CT Plastics Cluster. Participants will be presented with a guide to the resources available to them.

Tentatively scheduled for February – March.

2004 New Innovative Gas Technology Forum

This seminar will focus on new gas technologies that can help industry conserve energy and save money. Seminar is being developed with Yankee Gas, CNG and Southern Connecticut Gas. Tentatively scheduled for April.

For more information, please contact Judy Wlodarczyk, CONNSTEP, 860-644-9718 or jwloarc@connstep.org.

IMS Associates Program

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Using the Practice Field as a Laboratory for Research

UConn football players ingested a pill with a computer chip inside that could be read by a hand-held sensor as part of research on heat, hydration and exercise conducted by UConn scientists. The departments of kinesiology and UConn athletics teamed up for a heat acclimatization study, conducted this summer during the first eight days of pre-season football practice, to find out how new NCAA practice guidelines were affecting players.

The complete article detailing this program is available on-line at <http://alumnimagazine.uconn.edu/fwin03rr.html>.

Homeland Security Conference

ICATHS (International Conference on Advanced Technology for Homeland Security) 2003, the premier Homeland Security Conference of 2003, took place September 25-26, 2003 on the Storrs campus of the University of Connecticut. The conference featured a diverse agenda anchored by technologies for Homeland Security as well as the politics and policies of Homeland Security. ICATHS included nationally recognized experts in technology and policy. See <http://www.engr.uconn.edu/icaths/> for additional details.

Software Grant Largest Gift in UConn's History

UGS PLM Solutions, a subsidiary of EDS, the world's largest independent information technology services company, is awarding the University a software grant with a commercial value of \$146.1 million - the largest contribution UConn has ever received.

The grant-in-kind, announced November 13 at a press conference in the Information Technologies Engineering Building, will provide students and faculty in the School of Engineering with a suite of leading industry software that will help them conceive, design, engineer and validate projects using the same tools today's leading manufacturing and technology companies employ.

For the complete article see <http://www.advance.uconn.edu/03111701.htm>.

Can a Materials Engineering Student Help You?

The Department of Metallurgy and Materials Engineering has eight Junior level students in their new undergraduate program. These exceptionally bright and enthusiastic students are looking for intern opportunities in industry this summer. Benefits from summer internships are obvious for companies needing additional assistance during the summer months or wanting to fill future positions with carefully screened candidates. As another option, companies can enlist the help of

both faculty and students in solving technical problems by sponsoring a senior design project next year. Students work with the sponsoring company and normally spend ten or more hours a week on their project for 30 weeks. For more information, please contact, Nitin Padture, Interim Department Head, at 860-486-4206 or by email at nitin.padtur@uconn.edu.