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MSEMatters Fall 2009

Department of Materials Science & Engineering

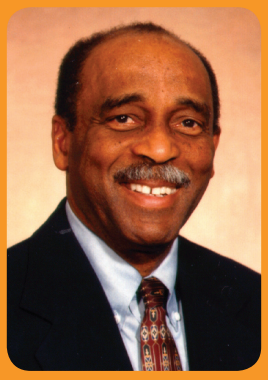
THE UNIVERSITY of TENNESSEE KNOXVILLE
COLLEGE of ENGINEERING

MSE MATTERS

MATERIALS SCIENCE AND ENGINEERING

A Newsletter for Alumni and Friends of the UT MSE Department FALL 2009

Message from the Associate Department Head



Dr. Roberto Benson

Welcome to another edition of the Department of Materials Science and Engineering (MSE) newsletter. As the MSE associate department head, I am writing this column to fill in for Dr. George Pharr, who is on sabbatical this year.

We have a great deal of new and interesting information to share in this issue. Two of our young faculty members, Dr. Yanfei Gao and Dr. Veerle Keppens, have articles showcasing their outstanding research.

We are also featuring an update on our MSE undergraduate program, which is currently being supervised by our other associate department head, Dr. Kevin Kit. Other student news includes an article about two of our undergraduate students who spent this summer participating in the NSF-funded Research Experience for Undergraduates (REU) program at the South Dakota School of Mines and Technology. Coordinator for the program was MSE alumnus Dr. Michael West.

The Joint Institute for Advanced Materials (JIAM) Building initiative continues, with plans for a groundbreaking on the Cherokee Farm campus in 2010. The department was highly honored when our head, Dr. Pharr, was selected as the JIAM director.

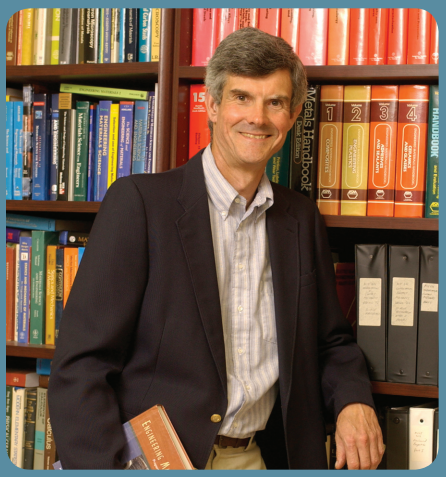
We hope you enjoy this issue of the MSE newsletter and as always we welcome your comments and suggestions. Please get in touch with us at ***mse@utk.edu*** any time.

We look forward to hearing from you.

Sincerely,

Roberto Benson,
Associate Department Head

Dr. George Pharr appointed as New Director of UT-ORNL Joint Institute for Advanced Materials (JIAM)



Dr. George Pharr

Dr. George Pharr, a UT Knoxville chancellor's professor and head of the Department of Materials Science and Engineering, was appointed as the new director of the UT-ORNL Joint Institute for Advanced Materials (JIAM) in February of 2009. Pharr has served as the institute's deputy director for two years. In his role as director, he will oversee the institute's continued development, including helping to guide the design of a planned $30 million facility to be built at UT's Cherokee Farm campus.

In addition to the new building, Pharr, who has been a UT-ORNL joint researcher since coming to UT Knoxville in 1998, hopes to leverage the institute's significant talent at the university and the laboratory.

"We have built a great base of people in JIAM, and we have an opportunity now to begin thinking in new ways about how to build on that base," said Pharr. With an eye toward increased external research funding, Pharr plans to institute a program that will provide research "seed money" to materials scientists and engineers. They can then develop research projects that will attract outside grants and build the institute.

"With his background as a joint researcher, George has the perfect combination of experience to lead the joint institute," said Wayne T. Davis, dean of the UT Knoxville College of Engineering.

JIAM has its roots in the Tennessee Advanced Materials Laboratory, founded in 2001, of which Pharr was a founding member. Funded with $20 million from the federal government and $10 million from the state of Tennessee, JIAM's new facility will be a state-of-the-art materials research center upon completion. UT administrators are presently planning to construct this building on the university's new Cherokee Farm Campus, located on the banks of the Tennessee River just a few minutes from the main campus. Preliminary infrastructure work on the site and the building began this year with a groundbreaking tentatively planned for late 2010.

JIAM is one of five UT-ORNL joint institutes. The National Institute for Computational Science is home to UT Knoxville's $65 million Kraken supercomputer, one of the world's most powerful. Other joint institutes include the Joint Institute for Biological Science, the Joint Institute for Neutron Science and the Joint Institute for Heavy Ion Research.

Research Feature: Dr. Veerle Keppens

Dr. Veerle Keppens

Dr. Veerle Keppens, an associate professor in the Department of Materials Science and Engineering, is a former Fulbright/NATO post-doctoral fellow who hails from Belgium. She has received numerous accolades during her tenure at UT, including the College of Engineering Research Fellow Award and the MSE Faculty Award for Excellence in Service in 2009, and she consistently publishes articles and gives technical presentations. Keppens also supports three doctoral and one master's students.

Keppens focuses her research on understanding the elastic constants and lattice dynamics of novel materials, including transition metal oxides, frustrated magnets, spin glasses and thermoelectric materials. Much of her current thrust focuses on studies of inclusion compounds such as skutterudites and clathrates. Her research group works with Resonant Ultrasound Spectroscopy, Keppens' area of expertise, an effective technique for determining the elastic moduli of solids, based on the measurement of the resonances of a freely vibrating body.

Her fundamental research on skutterudites and clathrates fits within the search for alternative power solutions. In addition to contributing to the discovery of new energy sources, it will lead to a better understanding of what might work in the quest for cheaper, more efficient fuel. By measuring a new class of superconductors synthesized at Oak Ridge National Laboratory, Keppens hopes to provide valuable information about the physics governing the structural, magnetic and superconducting transitions in these materials.

Undergraduate Interest Grows in the Department of Materials Science

Undergraduate interest in the Department of Materials Science and Engineering at UT has grown over the last few years. The classes of 2012 and 2013 currently number over 30 each. These increases are due to the recruitment and retention efforts of the Freshman Outreach Committee and increased visibility of the high quality research in the department. Additionally, news coverage of Oak Ridge National Laboratory, including the Center for Nanophase Materials Science and the Spallation Neutron Source, provides greater exposure for materials science and engineering, and Governor Phil Bredesen's efforts to establish the Tennessee Solar Institute as a joint UT/ORNL center has helped even more.

The spring 2009 meeting of the Department of Materials Science and Engineering Board of Advisors was productive. The Board Members include: Dr. Linda Horton (Oak Ridge National Laboratory), Dr. Warren Oliver (Agilent Technologies), Ian Baker (Dartmouth College), Dr. Ray Stark (retired - Honeywell Specialty Materials), Dr. Lars Eriksson (Siemens) and Dr. Sam Weaver (Cool Energy). The board provided the department with valuable advice regarding efforts to increase both undergraduate enrollments and the department's national visibility and in developing a long term strategic plan.

The MSE Undergraduate Affairs Committee has been busy introducing changes to the undergraduate curriculum so that it remains relevant to industry and research needs. The group has created a Nanomaterials Concentration that is pending approval from the University. MSE students already have the option of obtaining a Biomaterials Concentration. This committee is also preparing for the 2011 ABET accreditation review.

National Science Foundation-funded Research Experience for Undergraduates

School of Mines and Technology

During the summer 2009, Katie Strader and Marybeth Parker—undergraduates in materials sceince and engineering—participated in the National Science Foundation-funded Research Experience for Undergraduates at the South Dakota School of Mines and Technology. Dr. Michael West (PhD/MSE '06) coordinates the program.

"I performed research with Dr. West on the Comparison of Friction Stir Welded MA956 Superalloy with and without Post Weld Heat Treatment," said Strader. "I learned about friction stir welding, prepared samples that had been friction stir welded, performed grain size analysis, annealed our samples in a tube furnace given and argon-atmosphere and used the SEM for analysis."

"My project was eliminating voids in FDM processed polymers," said Parker. "I worked with PPSU, polycarbonate and ULTEM 9085 that had been processed by fused deposition. This left voids in the sample that decrease the mechanical properties, and I created a procedure for eliminating these voids by applying temperature and pressure."

"Marybeth and I were able to enjoy the beauty of South Dakota by visiting Mount Rushmore, Crazy Horse, the Badlands, the nearby Native American reservation and the black hills surrounding the area," added Strader.

Center for Materials Processing

Sixteen rising sophomores were supported as research assistants by 14 MSE faculty with matching funds provided by the Center for Materials Processing during the summer of 2009. Laura Poland worked with Dr. Wei He, and Brett Lewis worked with Dr. Chuck Melcher.

"I purified chitosan, a biomaterial from the exoskeleton of crustaceans, which was used in a hydrogel preparation," Poland said. "The hydrogel may be used to as a scaffold for growing cells to replenish neural cells in patients. In addition to learning more about biomaterials for the central nervous system, I performed primary cell cultures."

"I worked on determining the recovery time of lutetium oxyorthosilicate (LSO) after exposed to various levels of radiation and treatment," said Lewis. "I also studied the effect that annealing has on the light output of LSO. I gained extensive experience using a diamond saw and preparing samples of various types of material for different measurements. I prepared samples and performed measurements on LSO crystals for possible use in an experimental portable scanning device used to detect malignant cancerous tissue during surgery."

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MSE Faculty: Dr. Yanfei Gao


Dr. Yanfei Gao

Dr. Yanfei Gao directs his research to include small scale mechanical behavior, nanostructural evolution, nanostructured multifunctional materials, computational mechanics of deformation and failure mechanisms for advanced structural materials. Through both his appointment as a joint faculty member at the Computational Materials Science Group at the Oak Ridge National Laboratory and his role as an assistant professor in the Department of Materials Science and Engineering, Gao is able to tackle his many research interests through theoretical investigations.

His work in small scale mechanical behavior explores defect nucleation, propagation, multiplication and annihilation as well as the effects of the dislocation microstructure on the mechanical behavior of material structures on the range of micro- to nanometers.

Gao collaborates with his colleagues at ORNL to work in the area of controlled synthesis of nanostructured thin films and surfaces. Additionally, Gao researches multiferroic thin films, mechanical characterization of nanostructured low-dimensional materials and indention-related material phenomena. He's currently co-leading a team effort in the understanding of atomic phononic/electronic friction, which has interesting energy applications.

Gao received his Ph.D. from Princeton University in 2003. He has co-authored more than 30 journal papers and has given numerous talks at professional conferences and academic institutes. Gao has received several research grants from external sources—approximately $1.7 million, including four National Science Foundation grants—in a wide spectrum of research projects.

Originally from China, Gao resides in Knoxville with his wife Hong Liu and their two sons, Morgan and Malcolm.

Two MSE Department Professors Win COE Awards


Dr. Philip Rack

The College of Engineering Research Fellow Awards were established in 2004 to recognize and reward outstanding achievements in research. Recipients are presented a plaque at the college's awards dinner in the spring. The selected faculty members also receive additional funding and support.


Dr. Veerle Keppens

The Department of Materials Science and Engineering was honored to have two professors, Dr. Philip Rack and Dr. Veerle Keppens, who received this outstanding recognition at the Faculty and Staff Awards Dinner on April 23, 2009.

Rack, an associate professor in the MSE department, also was recognized as a Research Fellow in 2006 and 2007. He conducts research in electronic and opto-electronic materials and devices and thin film processing.

Keppens, also an associate professor in the department, received the award in recognition of her research in areas that include elastic constants and lattice dynamics of novel materials, including transition metal oxides, frustrated magnets and spin glasses and thermoelectric materials.

"We are very pleased that these two faculty members from MSE received this distinction," said Dr. Roberto Benson, associate department head. "They are excellent representations for the caliber of research that our department wants to achieve."

The MSE Honors Banquet Presents Awards

The Department of Materials Science and Engineering Honors Banquet was held on Tuesday, April 7, 2009. The following awards were presented:

Graduate Student Award for Excellence in Teaching: **Ryan Hammonds**

Graduate Student Award for Excellence in Research: **Shuangxi Song** and **E-Wen Huang**

Raymond A. Buchanan Award for Outstanding Junior: **William Brandon Goodwin**

E. Eugene Stansbury Award for Outstanding Senior: **Dewey Joshua Burgess**

Outstanding Staff Award: **Sandra Maples**

Faculty Award for Excellence in Teaching: **Dr. Claudia Rawn**

Faculty Award for Excellence in Research: **Dr. Philip Rack**

Faculty Award for Excellence in Service: **Dr. Veerle Keppens**


Ryan Hammonds


Dewey Joshua Burgess with Dr. George Pharr


Shuangxi Song, Dr. George Pharr and E-Wen Huang


Dr. Claudia Rawn with Dr. George Pharr


Dr. Veerle Keppens with Dr. George Pharr

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National Science Foundation continued from pg. 2

Polymer engineering graduate student Tiffany Flick interned at Boston Scientific at their Fremont, Calif. site during the summer of 2009. Boston Scientific is a Fortune 500 company and is the world's largest medical device company dedicated to less-invasive medicine. Flick worked in the Supplier Quality Neurovascular/Imaging Division.

"My responsibilities as an intern included rectifying material contamination issues, statistical analysis for determination of process validation and accompanying supplier audits," Flick said. "My internship with Boston Scientific was a wonderful experience and provided direction for my professional career."

Department of Materials Science and Engineering Faculty

Roberto Benson ..... Associate Head & Professor
Gajanan Bhat ..... Professor
Hahn Choo ..... Associate Professor
Narendra Dahotre ..... Professor
Gerd Duscher ..... Associate Professor
Takeshi Egami ..... Distinguished Scientist & Professor
Yanfei Gao ..... Assistant Professor
Easo George ..... Professor
Wei He ..... Assistant Professor
Bin Hu ..... Assistant Professor
David Joy ..... Distinguished Scientist & Professor
Ramki Kalyanaraman ..... Associate Professor
Veerle Keppens ..... Associate Professor
Kevin Kit ..... Associate Professor
Peter Liaw ..... Professor, Ivan Racheff Chair of Excellence
C.T. Liu ..... Distinguished Research Professor
Carl Lundin ..... Professor
Carl McHargue ..... Professor
Thomas Meek ..... Associate Professor
Chuck Melcher ..... Research Professor
James Morris ..... Associate Professor
T. G. Nieh ..... Professor
George Pharr ..... Department Head & Professor
Philip Rack ..... Associate Professor
Claudia Rawn ..... Assistant Professor
Mike Simpson ..... Professor
Joseph Spruiell ..... Professor Emeritus
Larry Wadsworth ..... Professor Emeritus
Shanfeng Wang ..... Assistant Professor

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