Carnegie Mellon
Engineering

Volume 2, Number 2 • Spring 2005

MSE news

MATERIALS SCIENCE AND ENGINEERING

Silicon Carbide Crystal Growth Surface

NEW RESEARCH FROM PROFESSOR MAREK SKOWRONSKI AND HIS GROUP

Page 3

INSIDE

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a note from the department head

"Nothing endures but change."
—Heraclitus (540–480 BC)

"They say time changes things, but you actually have to change them yourself."
—Andy Warhol (1928–1987)

Dear MSE Graduates:

If one accepts that Heraclitus was correct, then Carnegie Mellon's famous alumnus, Andy Warhol, has given us a prescription for the method by which change should take place. Strategic planning is our attempt to change in a manner that is beneficial for the Department, the College, and the University and, currently, we are in midst of this planning exercise. As a result, we have rewritten the Departmental mission and vision statements and are developing a meaningful set of metrics by which to measure our Department's progress.

One often becomes aware of the results of change when one gains external recognition. This year, *US News and World Report* ranked MSE's undergraduate program #9. This made MSE only the second department in the College to be ranked in the top 10. I believe this is the result of our previous strategic planning efforts, during which our faculty decided to improve undergraduate education—and developed a system in which feedback from our undergraduates became a key part of the analysis of the success of each course. For example, senior exit interviews and alumni feedback resulted in a more meaningful "MSE Capstone" design experience.

As part of this review process, it became clear that a new faculty member—who would focus on issues that were not previously covered in Departmental courses, but that had become more important due to the continually developing ABET guidelines for engineering education—should be added to the Department. After an extensive search, Dr. Robert Heard was appointed as the first Associate Teaching Professor in the Department. He will improve our undergraduate program by managing all of our laboratories, teaching our "Materials Performance and Selection" class, and organizing the "MSE Capstone" design experience.

Change is also apparent through Departmental statistics, and this semester we reached a major landmark in our undergraduate body: 50% of our undergraduates are female. This is, in part, due to the popularity of the new joint degree with Biomedical Engineering.

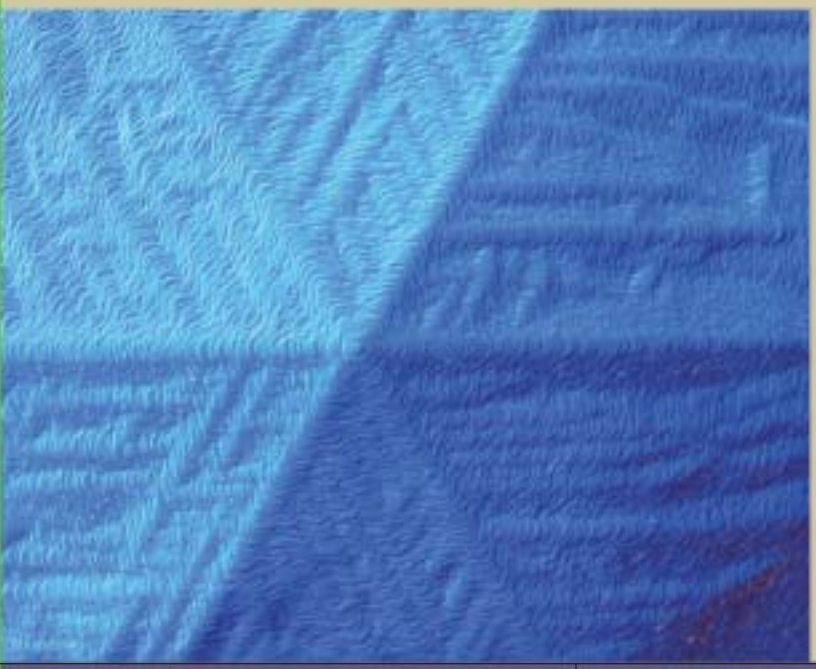
Another change, again related to our previous strategic plan, is that we have hired our first faculty member in many years who has expertise in polymers. Dr. Michael Bockstaller will join our faculty in April, after completing a postdoctoral position at MIT and in Germany. This is only the beginning of the inclusion of soft materials in our undergraduate and graduate curricula and, in the future, we plan to add at least two additional faculty members in this area.

In the last five years, there has been considerable change within the Department: four new chairs, three new faculty members, and two faculty members beginning the path to retirement. In addition, both undergraduate and graduate programs have been completely updated, and continual assessment has been implemented at the undergraduate level.

It is at this time that I must announce another change. After five years as Department Head and 18 years as a member of the faculty, I have decided to leave Carnegie Mellon to become Dean of Engineering at Rensselaer. This decision was not easy, as I have felt at home and made many friends at Carnegie Mellon; however, this new challenge is one that I feel I must accept. My future is as an alumnus of this great University and, as such, I will be very interested in its future path and success. I would like to take this opportunity to thank Carnegie Mellon, its alumni, and its current students, faculty, and staff for their friendship and support over the last 18 years.

The cover shows an optical microscopy image of the silicon carbide crystal growth surface. Growth progresses by step flow, with adatoms diffusing along the terraces and attaching themselves to steps. Central hillock is the emergence point of a super-screw dislocation. Images like this one were the basis for the Burton-Frank-Cabrera model of crystal growth.

Silicon Carbide Crystal Growth Surface



Silicon carbide in a single crystalline form is one of the most promising novel semiconductors, with applications in ultra-high voltage electronic devices. Some SiC-based structures are capable of blocking up to 20,000 V and handling mega-watts of power. The attractive properties of this material, such as high breakdown field, make it one of the most difficult to grow. SiC does not melt and can be grown only from the vapor phase at temperatures in excess of 2100° C. The SiC growth in Professor Skowronski's group is performed using the halide chemical vapor deposition method, starting with silicon tetrachloride and propane. This approach yielded some of the highest-purity SiC bulk crystals ever reported. Interestingly, although SiC is second only to diamond on the Mohs hardness scale, at the growth temperatures it is quite soft—softer, in fact, than most standard semiconductors, and soft enough that the temperature differences across the boule can plastically deform the growing crystal.

RECENT PH.D. THESES

Wayne Archibald
"Microstructural Characterization of Al Thin Films and Foils: Grain Boundary Topology, Properties, and Statistics"
Advisor: Katayun Barmak

Hun Jae Chung
"Effect of Doping on Silicon Carbide Crystals"
Advisor: Marek Skowronski

Zhaohui Fan
"The Study of Crystallization of Phase Change Materials and Their Applications for Data Storage"
Advisor: David Laughlin

Changsoo Kim
"Microstructural-Mechanical Property Relationships in WC-Co Composites"
Advisor: Gregory Rohrer

Jeffrey Maranchi
"Fundamental Experimental Studies of Amorphous Silicon Thin Film Anodes for Lithium-Ion Applications"
Advisor: Prashant Kumta

Neill McDonald
"Peritectic Solidification in Ferrous Alloys"
Advisor: Sridhar Seetharaman

Siddhartha Misra
"Hydrogen and Nitrogen Control in Taping and Ladle Operations"
Advisor: Richard Fruehan

Feroz A. Mohammad
"Study of Morphology, Mechanisms, and Interlayers in Ohmic Contacts to Silicon Carbide"
Advisor: Lisa Porter

Chando Park
"Microfabrication and Characterization of Fe_3O_4-Based Magnetic Tunnel Junction"
Advisors: Jiang-Gang Zhu and Robert White

Kumar Srinivasan
"L10 Fe-Pt on Nanocrystalline HITPERM Soft Magnetic Underlayers for Perpendicular Recording Media"
Advisor: David Laughlin

Shakul Tandon
"Theoretical and Experimental Study of Shape Effects on Magnetic Nano-Particles Using Simulation Assisted Lorentz Microscopy"
Advisor: Marc De Graef

Lisha Wang
"Atomic Ordering, Magnetic Domain Structure, and Magnetic Properties of L10 Type Ferromagnets"
Advisor: David Laughlin

"For those individuals who move on to other areas, the MSE curriculum provides a modern liberal education."

MSE Accreditation Activities

On December 20-21, 2004, the MSE faculty held a retreat to discuss the state of the Department. One of the discussion topics was the Program Educational Objectives (PEOs) for our undergraduate curriculum. In the context of Engineering Accreditation, we review our educational objectives every two years. The outcome of this discussion was a new set of objectives. In accordance with our curriculum assessment plan, we now publish these objectives, so that our alumni may provide feedback.

Six high-level educational objectives have been selected for the MSE undergraduate program. Our program will produce graduates who are able to:

1. **Apply science and engineering principles to materials systems; integrate their understanding of the principles of materials science and engineering as they apply to structure, properties, processing, and performance; and select materials to meet relevant performance criteria during the design of engineered systems and components**
2. **Work in teams, solve open-ended problems, develop skills for critical thinking, and communicate effectively with others verbally, in writing, and by listening**
3. **Employ the techniques, skills, and tools of modern materials engineering practice in a professional and ethical manner**
4. **Understand the impact of materials engineering solutions in a global and societal context, as well as continually evolve their knowledge of the field of materials science in response to the changing needs of society**
5. **Be successful in a top graduate school in materials science and engineering, or in a related discipline**
6. **Take positions as materials engineers and be successful in our field, or in related professional activities**

Achievement of these objectives will fulfill the educational component of the MSE mission statement; the objectives are also consistent with the mission statements for the University and the College of Engineering.

In addition to the PEOs, we have also formulated, and we continue to review, a set of 10 Program Outcomes. Based on the broad range of destinations for graduates of the MSE program, our curriculum is designed to provide a strong foundation in fundamental knowledge and skills. This provides an excellent basis for the substantial number of our graduates who go on to graduate school. For the equally substantial number who find employment in industry, the program provides the foundation on which a company can build its domain-specific knowledge. For those individuals who move on to other areas, the MSE curriculum provides a modern liberal education, i.e., one that inculcates a thoughtful, problem-solving approach to professional life. Our intended outcomes for the B.S. program are, therefore, that students should have acquired the following set of skills and attributes:

- An ability to apply a knowledge of mathematics, physics, chemistry, materials, and statistics to identify, formulate, and solve the problems encountered in the production or application of a material
- An ability to apply core concepts in materials science (structure, properties, processing, and performance) to identify, formulate, and solve contemporary materials engineering problems
- An ability to communicate effectively
- An ability to design and conduct experiments, as well as analyze and interpret the data derived from these experiments, with an emphasis on relating properties and processing to structure and on relating structure and properties to materials performance
- An ability to select materials to meet relevant performance criteria during the design of engineered systems and components
- An ability to function responsibly and ethically in a professional, multi-disciplinary environment, as an individual or as a member of a team
- An ability to employ the techniques, skills, and tools of modern materials engineering practice
- A recognition of the need for lifelong scholarship, as the field of materials science is continually evolving as new knowledge and materials are developed
- A knowledge of contemporary issues in the application of materials
- The broad education necessary to understand the impact of materials engineering solutions in a global and societal context

We invite comments from you on all or any of these statements. Realizing that curricula change over time, we are, in particular, interested in finding out whether or not we have achieved our educational objectives. In other words, in your present professional situation, do you feel that the MSE undergraduate curriculum has provided you with the proper skills to be successful in your career? If not, then what could we do to improve our curriculum? Have we forgotten to address any important items that should be part of our educational objectives?

Please send your comments to Professor Marc De Graef, Chair of the Undergraduate Program Assessment and Review Committee (degraef@cmu.edu, 412-268-8527).

New Faculty

On April 1, 2005, **Dr. Michael R. Bockstaller** will join the MSE faculty as an Assistant Professor. Dr. Bockstaller received his diploma in Chemistry from the Technical University of Karlsruhe (Germany) and his Ph.D. in Physical Chemistry from the Johannes Gutenberg University (Germany). He was a scientific assistant at the Max-Planck Institute for Polymer Research (Germany) and postdoctoral associate at the Department of Materials Science and Engineering at Massachusetts Institute of Technology. He is coming to Carnegie Mellon from the Technical University of Aachen (Germany), where he held a habilitation position. Dr. Bockstaller is a fellow of the Alexander von Humboldt Foundation and an Emmy Noether Grant recipient of the German Science Foundation. His research focus is on the organizing principles in soft and heterogeneous materials, from molecular to mesoscopic length-scales in the solid state and in solution. His current projects center on the implications of molecular architecture and geometric parameters on the morphology and properties of block copolymer/particle mixtures; the design of cell-binding IR absorbing nanocrystals and their application in optically controlled cell apoptosis; and the implication of pressure as a thermodynamic variable on the phase behavior and conformation of biogenic polymers in aqueous solution.

Dr. Robert A. Heard has joined the faculty of the Materials Science and Engineering Department as an Associate Teaching Professor. He teaches professional development in the "MSE Undergraduate Seminar" series and also oversees the laboratory portion of the freshman introductory course "Engineering the Materials of the Future." Dr. Heard is also the coordinator of

the MSE undergraduate Industrial Internship Program and, in future semesters, he will tackle the responsibilities for the "MSE Capstone" design course.

Dr. Heard received his Ph.D. in Metallurgy and Materials Science from the University of Toronto, Canada, in 1987, his M.S. in 1985, and his B.S. in 1983. His current interests are focused on the educational aspects of materials science and engineering, involving aspects of many other disciplines such as business, public policy, environmental engineering, and pedagogy.

He has served on the Board of Directors of the AIST, and is a member of AIST, ASM, TMS, and ASEE. He has authored 21 technical papers on materials processing, casting, plasma, and alternate iron technologies and authored a book on horizontal continuous casting. His awards include the Jerry Silver Award and the Charles Briggs Award from the Iron and Steel Society.

Grobstein Chair Awarded to Professor Towe

On November 17, 2004, the Materials Science and Engineering Department celebrated the appointment of Dr. Elias Towe as the first A. and E. Grobstein Memorial Professor of Materials Science and Engineering. This chair has been established through the estates of Albert and Ethel Grobstein.

Dr. Towe, who joined Carnegie Mellon in 2001, holds a joint appointment in Materials Science and Engineering and the Department of Electrical and Computer Engineering. He has received a number of prestigious awards that honor his accomplishments, and he is a fellow of three societies (IEEE, OSA, and the American Physical Society). In 2001, he won the Outstanding Technical Achievement Award from the Office of the US Secretary of Defense and, in the same year, he also won the Honeywell Technology Center Award for Advancement in Photonics.

Dr. Towe with guardian Mrs. Dorrie Bean.

"Carnegie Technical Schools" opened its doors on October 16, 1905, and enrolled 126 students. The name was changed to "Carnegie Institute of Technology" in April 1912 and, by June 1915, four students were granted professional degrees, including a degree in Metallurgical Engineering.

Since Professor Frederick Crabtree assumed the role as the first Department Head of Metallurgy and Mining in 1906, the Department has grown and prospered greatly. Over the past 99 years, we have seen many changes in education, facilities, and research; and the Department has been renamed twice to reflect these changes. One of the most significant transformations occurred this academic year when, for the first time, our undergraduate student body is 50% female.

There have been 13 leaders since the Department's inception. We invite you to take a look at our past, and remember those who have helped make MSE one of the premier engineering departments in the country.

Frederick Crabtree, 1906-1926

Professor Crabtree was the Department Head and organizer of the Department of Metallurgy and Mining. The curriculum was oriented to production metallurgy of the iron and steel industry, especially blast furnace technology. During World War I, hundreds of personnel in the US Ordinance Department were trained to inspect steel for munitions plants. Metallography was introduced into the curriculum.

James Aston, 1926-1935

Professor Aston invented an economical method for producing wrought iron. Courses in mining were discontinued. M.S. and Ph.D. degrees in Metallurgical Engineering were awarded for the first time. The Metals Research Laboratory was established.

Charles Law McCabe, 1960-1963

Professor McCabe adjusted the staff and curriculum to accommodate the rapidly developing interest and support of the concept of "materials science," without abandoning our strong metallurgical base.

William W. Mullins, 1963-1966

Professor Mullins adjusted the curriculum to make it more rigorous and effective in the use of quantitative methods in treating engineering problems. A major research program, funded by ARPA, was initiated to study corrosion cracking.

Harold W. Paxton, 1966-1971

Curriculum changes continued, necessitated in part by the academic reorganization resulting from the merger of Carnegie Tech and Mellon Institute to form Carnegie Mellon University. The faculty expended considerable effort in planning the move of the Department to Science Hall (now Wean Hall). Professor Paxton subsequently served as interim Department Head for six months in 1987, and a full year in 1990-1991, during searches for a new Department Head.

Robert F. Mehl, 1935-1960

Professor Mehl assembled an outstanding faculty of teachers and researchers in the Metals Research Laboratory, with a major emphasis on kinetics of reactions and theoretical aspects of physical metallurgy. X-ray diffraction equipment was introduced. Enrollment in the Department was greatly increased by fellowships sponsored by industry. Evening classes were offered for the first time. The undergraduate "Metals Club" was organized and became very active.

Richard W. Heckel, 1971-1976

The Department played an important role in the development of the Center for Joining Materials, an interdisciplinary research effort funded by NSF. An optional co-op program was adopted for undergraduate students, and the curriculum was adjusted to accommodate it.

Robert Sekerka, 1976-1982

Professor Sekerka significantly strengthened the faculty by attracting several outstanding scientists from industry to spearhead the Department's activities in diffusional phase transformation in solids, extractive and process metallurgy, surface science, and electronic and nonmetallic materials.

Anthony D. Rollett, 1995-2000

Interactive multimedia routines were created to facilitate the teaching of undergraduate courses. A five-year NSF grant was awarded to MSE to establish a Materials Research Center to measure the fundamental properties of grain boundaries.

Melvin Bernstein, 1982-1987

Professor Bernstein actively promoted industry-university cooperative efforts. The interdisciplinary Center for Iron and Steelmaking Research was established, and an Alcoa Chair in Physical Metallurgy was endowed.

Alan W. Cramb, 2000-2005

The Department was again ranked in the top 10 of undergraduate materials programs. Four new chairs were added to the Department: the Alcoa, the Mullins, the Bertucci, and the Grobstein. Two senior faculty members were hired in electronic materials, as was an assistant professor in polymers. Professor Cramb initiated the graduate student advisory committee and annual strategic Department retreats.

Paul Wynblatt, 1991-1995

The MEMS Department name was officially changed to the MSE Department. The graduate curriculum was extensively revised, and two new courses were added. A multidisciplinary research project was initiated on the preparation and properties of carbon fullerenes (Buckeyballs).

Anthony Thompson, 1988-1990

Professor Thompson initiated a 10-year program to upgrade and refurbish the undergraduate materials laboratories. The undergraduate curriculum was revised to provide a more balanced and integrated approach to materials science.

mse faculty: our greatest asset

The respected faculty members of the MSE Department are leading the field of materials science with their innovative research. The following pages provide a brief introduction to our current faculty—as well as their specific areas of research interest.

Katayun Barmak
Professor

Ph.D., Massachusetts Institute of Technology

Carnegie Mellon, 1999–

Dr. Barmak's research interests include processing, properties, crystal structure, grain structure, and texture of polycrystalline metal films for application in integrated circuits and magnetic recording media; thermodynamics and kinetics of reactions and phase transformations in nanostructuctured films; experimental, analytical, and simulational studies of transformations and associated microstructures in thin films; and properties of grain boundaries.

Michael R. Bockstaller
Assistant Professor

Ph.D., Johannes Gutenberg University

Carnegie Mellon, 2005–

Professor Bockstaller's research interests include polymer morphology; polymer-based nanostructures; polymer-based nanoparticle assemblies; phase behavior and structure-property relations (optical/magnetic) of organic-inorganic heterogeneous materials; phase behavior of water-soluble polymers (synthetic and biological) under *in vivo* conditions; field-responsive nanoparticles for drug delivery; x-ray and neutron scattering; and electron microscopy.

Robert F. Davis
Bertucci Professor

Ph.D., University of California at Berkeley

Carnegie Mellon, 2004–

Professor Davis' research focuses on the present suite of wide band-gap electronic materials of SiC, the III-Nitrides, and selected oxide materials such as ZnO-based alloys. These are technologically important for (1) opto-electronic devices including light-emitting diodes and semiconductor lasers that emit in the green, blue, and ultraviolet regions of the spectrum for applications in next-generation lighting, data storage, and optical indicators, and (2) micro-electronic devices for high-frequency, high-power, and high-temperature applications.

Marc De Graef
Professor

Ph.D., Catholic University Leuven

Carnegie Mellon, 1993–

Professor De Graef's research interests lie in the area of microstructural characterization of structural intermetallics and magnetic materials. His current focus is on the development of experimental and modeling techniques for the quantitative study of magnetic domain configurations in a variety of materials, including ferromagnetic shape memory alloys, magnetic thin films, and patterned structures. This study includes a theoretical analysis of the use of shape functions in the computation of shape-dependent material properties. A second research focus is on the acquisition and representation of the three-dimensional character of microstructures. Work in this area includes Monte-Carlo simulations to reconstruct microstructures numerically, and principal component analysis of microstructures in superalloys.

Richard J. Fruehan
University and U.S. Steel Professor

Ph.D., University of Pennsylvania

Carnegie Mellon, 1981–

Professor Fruehan's research is based primarily in metal production, with the goal of reducing energy and emissions. His group also is involved in the fundamentals of gas-metal and slag-metal reactions, refining of metals for high-quality products, and examining competitive, economic, and environmental issues related to metal production.

Warren M. Garrison, Jr.
Professor

Ph.D., University of California at Berkeley

Carnegie Mellon, 1984–

Professor Garrison's primary research interests are in the influence of microstructure on the mechanical behavior of metallic materials, with an emphasis on steels. Currently, his primary interests are the effects of inclusion distributions and fine-scale microstructure on the fracture toughness of ultra-high strength steels, and the effect of composition on the strength and toughness of martensitic precipitation strengthened stainless steels.

Robert A. Heard
Associate Teaching Professor

Ph.D., University of Toronto

Carnegie Mellon, 2003–

Dr. Heard's current interests are focused on the educational aspects of materials science and engineering, involving aspects of many other disciplines such as psychology, public policy, environmental engineering, business, pedagogy, and others.

Prashant N. Kumta
Professor

Ph.D., University of Arizona

Carnegie Mellon, 1990–

Professor Kumta's research interests cover the two broad areas of energy storage and biomaterials. The main focus of his research in both these areas is to develop novel low-temperature approaches and study the relationships of the process parameters, the ensuing microstructure, and crystallographic structure to the electrochemical activity in the former and the biological response in the latter. Current research in the energy storage area has been directed toward understanding the theory of solid-state materials, using first-principles methods, while developing novel low-temperature chemical, mechanochemical, and thin-film approaches to synthesize nano-structured particulate and nano-layered thin-film architectures for lithium-ion applications.

David E. Laughlin
Alcoa Professor

Ph.D., Massachusetts Institute of Technology

Carnegie Mellon, 1974–

The research interests of Professor Laughlin have centered on the investigation of phase transformations and the structure of materials by means of transmission electron microscopy. He has studied spinodal decomposition and ordering processes in several aluminum, copper, and nickel-based alloys, as well as in III-V compounds, by detailed analysis of their microstructure as well as electron diffraction patterns. Since 1986, he has been investigating the magnetic properties and microstructure of soft magnets (HITPERM), hard magnets (FePt and CoPt), and magnetic thin films for recording media and heads.

Michael E. McHenry
Professor

Ph.D., Massachusetts Institute of Technology

Carnegie Mellon, 1989–

The research interests of Professor McHenry are in developing an understanding of the magnetic properties of materials. This includes interfacing theoretical and experimental studies of magnetic and superconducting materials. He has studied flux pinning in high-temperature superconductors, as well as fundamental magnetic properties of magnetic surfaces, interfaces, and multilayers. He has a continuing interest in the magnetic properties of icosahedral structures, including the study of magnetic quasicrystals and the magnetic and superconducting properties of fullerenes.

Henry R. Piehler
Professor

D.Sc., Massachusetts Institute of Technology

Carnegie Mellon, 1967–

Professor Piehler's materials research areas are in physical and analytical modeling of deformation processing systems, and performance evaluation of mechanically fabricated components and products. His policy research areas are in productivity and innovation, plus the design of risk-management strategies and institutions. His specific studies focus on deformation processing and the mechanical behavior of materials, with special interests in sheet-metal formability and the properties of formed sheets; surgical materials and devices; powder metallurgy products, as well as composite and clad materials; standardization and regulatory processes; and engineering manpower utilization, productivity, and innovation.

Lisa M. Porter
Associate Professor

Ph.D., North Carolina State

Carnegie Mellon, 1997–

Dr. Porter's research activities are focused on the analysis of chemistry, microstructure, and electrical properties of electronically functional interfaces. Her research group is interested in a range of materials including, but not limited to, wide band-gap semiconductors; carbon-based semiconductors and nanostructures; metal-semiconductor interfaces; dielectric-semiconductor interfaces, as, for example, in metal-oxide-semiconductor (MOS) devices; and thin films. Her group is also interested in a range of applications and devices, including chemical and gas sensors, field-effect transistors (FETs), Schottky diodes, and solar cells.

mse faculty (cont.)

Gregory S. Rohrer
Mullins Professor

Ph.D., University of Pennsylvania

Carnegie Mellon, 1990–

Professor Rohrer's research is aimed at the quantitative study of interfacial properties, with the goal of defining structure-property relationships for interfaces. Current research in the area of polycrystalline structure has the goals of quantifying the population of different grain boundary types, measuring their properties, understanding the mechanism by which the network forms during processing, and understanding the influence that the network structure has on the macroscopic properties of the material. Current research in the area of metal oxide surfaces has the long-range goal of developing composite polar oxide materials that make the photolytic production of hydrogen economically feasible.

Anthony D. Rollett
Professor

Ph.D., Drexel University

Carnegie Mellon, 1995–

Professor Rollett's research lies in microstructure-property relationships in crystallographically textured materials; grain boundaries, their anisotropic properties, and their impact on microstructural evolution; grain growth and recrystallization; computer simulation of microstructural evolution and properties of materials; statistical methods for describing and constructing microstructures in three dimensions; and texture- and interface-sensitive properties, e.g., strength and fatigue resistance.

Paul A. Salvador
Associate Professor

Ph.D., Northwestern University

Carnegie Mellon, 1999–

Professor Salvador's research interests lie in the areas of thin-film synthesis/growth, characterization, and architectural design of inorganic crystalline materials. His current focus is on the design of materials having structural features engineered from the sub-nanometer to the micron-length scale. His group uses pulsed laser deposition and molecular beam epitaxy to grow crystals of oxides, nitrides, oxynitrides, metals, and composites (or heterostructures) of those materials for a variety of applications in the fields of energy, information storage, hard coatings, and radio frequency (RF) electronics.

Sridhar Seetharaman
Associate Professor

Ph.D., Massachusetts Institute of Technology

Carnegie Mellon, 2000–

Professor Seetharaman conducts experimental and computational studies of extraction, refining, and casting of metals such as steel, aluminum, and Ni-based superalloys. His experimental work includes *in situ* observations and thermophysical property measurements for process modeling. His computational work includes multi-scale modeling by combining micro-models of (1) kinetic phenomena, (2) thermodynamics, and (3) thermophysical properties with continuum models of heat transfer and fluid flow.

Marek Skowronski
Professor

Ph.D., Warsaw University

Carnegie Mellon, 1988–

Professor Skowronski's research covers most aspects of electronic materials, including crystal growth of semiconductors; deposition of epitaxial films of metals, semiconductors, and dielectrics; processing-induced defects; and degradation phenomena in electronic devices. The unifying theme of this research is the relationships between process conditions and device performance. Professor Skowronski's research projects attempt to balance twin goals: the demonstration of novel approaches to processing, and the development of a fundamental understanding of materials and processes.

Elias Towe
Grobstein Professor

Ph.D., Massachusetts Institute of Technology

Carnegie Mellon, 2001–

Professor Towe's group pursues research in basic optical and quantum phenomena in materials, for applications in novel photonic devices that enable a new generation of information processing systems for communication, computation, and sensing. His group is also interested in understanding new pathways and fundamental mechanisms for solar energy conversion devices. The current focus is on the use of phenomena (such as three-dimensional quantum-confinement effects in nanometer-scale structures) in the study of novel devices. Some examples include quantum-dot infrared detectors and imaging sensors, electrically pumped photonic crystal micro-cavity lasers with quantum-dot active regions, multi-spectral solar energy conversion devices, plasmonic bio-sensors, and fluorescence bio-sensing devices.

awards & recognition

Professor Sridhar Seetharaman has been appointed editor of *AIST Transactions*, a technical journal that publishes articles based on current research on all topics in the manufacture of iron and steel. *AIST Transactions* is published by the Association for Iron & Steel Technology.

MSE junior **Graham Doorley** has been selected as the recipient of the *Boeing Scholarship for Academic Leadership*. Doorley was selected because he possesses the values that Boeing strives for in candidates: leadership, teamwork, and academic excellence.

The **"MSE Capstone 1" design class** was awarded an honorable mention in the TMS Materials Science & Engineering Undergraduate Student Design Competition.

Professor Richard Fruehan has been named an Honorary Member of the Iron and Steel Institute of Japan.

Singelyn

Roberts

The annual Young Member's Night of the Pittsburgh Golden Triangle Chapter of ASM International proved to be a winning night for many MSE students. Senior **Jennifer Singelyn** received the *Outstanding Senior Award*, doctoral student **Christopher Roberts** was named *Chapter Outstanding Young Member*, and junior **Diana Chan** and sophomore **Nicole Cates** were each presented with the *Past Chairpersons' Education Assistance Award*.

Chan

Cates

Pang

MSE students fared equally well in the poster competetion, with doctoral student **Ying Pang** receiving first place (graduate competition) for her poster "Correlation Between GB Segregation and Character in Nb-Doped TiO_2." Junior **Eric Vanderson** received first place (undergraduate competition) for his poster "Deformation Behavior of Rolled Cu-Nb Micro and Nano Composites." Juniors **Selina Brownridge** and **Diana Chan** shared second place for their "Comparative Analysis of Processing Techniques on Y-Ba-Cu-O Superconductor," and senior **Jennifer Singelyn** was awarded the third-place prize for "Gels for Tissue Engineering."

On January 20, CIT held its annual staff awards ceremony. **Jason Wolf**, Supervisor of the MSE X-Ray Laboratory, was selected as the recipient of the *Burritt Education Award*. This award was founded in memory of Timothy J. Burritt, former undergraduate advisor for the College of Engineering, to recognize staff members who successfully maintain a balance of work and schooling, while pursuing further education. Jason was awarded his M.S. degree in August 2004.

Madeline Lesko, Program Assistant for the Center for Iron and Steelmaking Research (CISR), was acknowledged for her 20 years of service and dedication to the College.

Suzanne Smith, Manager of Departmental Administration and Student Affairs, was awarded the *CIT Staff Recognition Award*, which is based on job performance, dedication, positive attitude, and contributions as a team player.

MSE Is Ranked in the Top 10 by *US News and World Report!*

US News and World Report's "America's Best Colleges 2005" report ranked the MSE Department #9 in the undergraduate materials engineering category.

▲ Jason Wolf and Suzanne Smith

◄ Madeline Lesko

MSE news

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