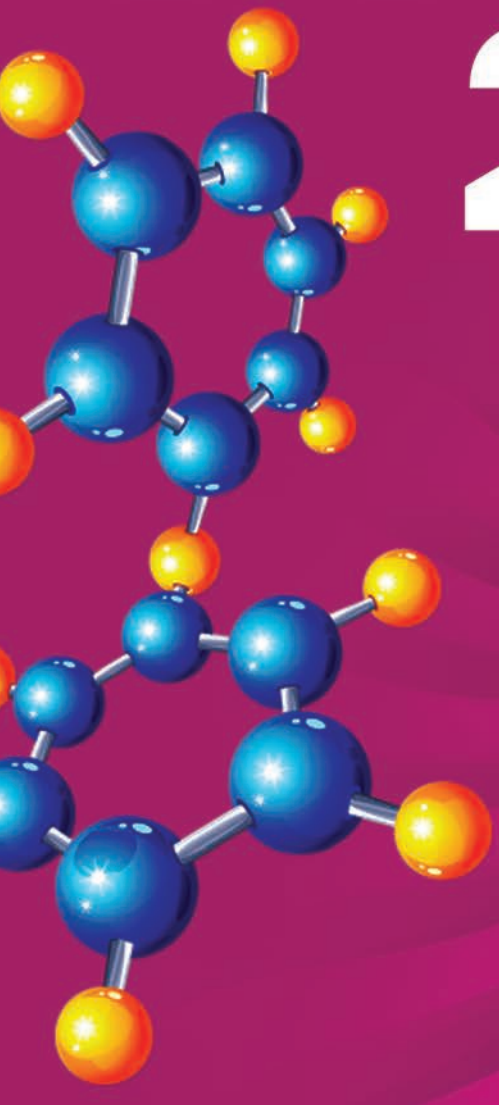
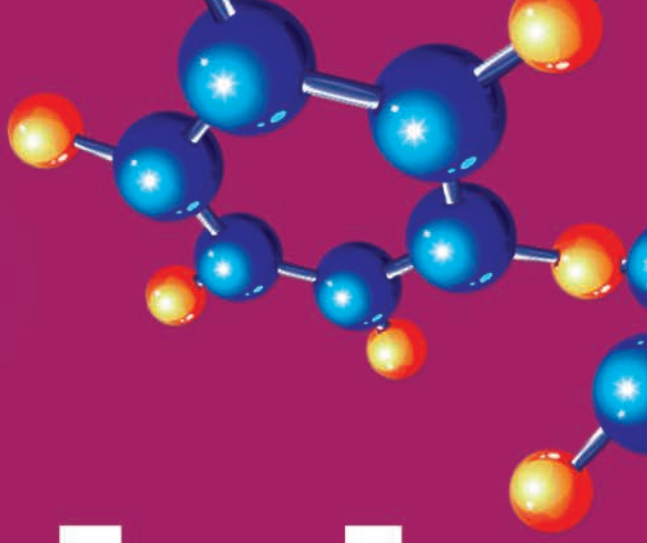
UCONN
SCHOOL OF ENGINEERING

materials science & ENGINEERING 2015





mse.engr.uconn.edu

This outreach bulletin is produced for the students, alumni, faculty, corporate supporters, and friends of the Department of Materials Science & Engineering at the University of Connecticut.

Please direct any questions or comments to mseinfo@engr.uconn.edu.

STUDENT STAFF WRITERS:
Giorgina Paiella
Kelly A. Salzo

CONTRIBUTORS:
Colin Poitras

PHOTOGRAPHY:
Roger Castonguay (The Defining Studios)
Peter Morenus
Christopher LaRosa
Heike Brueckner, et al.

CONTENT EDITOR & DESIGN:
Heike Brueckner

KEEP IN TOUCH

To stay informed about ongoing news and events happening at UConn's Materials Science & Engineering Department, visit our website regularly:
www.MSE.engr.uconn.edu

www.facebook.com/UConnMSE

UConn Materials Science & Engineering Alumni Group

Dear prospective, current, and former students,

Welcome to our 2015 outreach bulletin! As we turn toward another exciting year in MSE, it is my great pleasure to reflect upon the past year and our exciting strides in research, instruction, accolades, and mentorship.

UConn MSE is on the front line of cutting-edge, multidisciplinary materials research. This year, MSE faculty and students have penned over 100 publications in high-impact research journals, and they have received over 4500 citations. In this newsletter, we feature three of these groundbreaking research papers. Dr. Ramamurthy "Rampi" Ramprasad, along with research group members and collaborators, published an article titled "Why Pt Survives but Pd Suffers From SOx Poisoning" in *JPC Letters* (page 14). "Next-Generation Electrocaloric and Pyrocaloric Materials for Solid-State Electrothermal Interconversion," a paper my colleagues and I published, was featured in the *MRS Bulletin*. Dr. Bryan Huey and his colleagues uncovered new information about the kinetic properties of multiferroic materials. These promising findings, featured in the December 2014 issue of *Nature*, may be a key breakthrough for scientists looking to create a new generation of low-energy, highly efficient, instant-on computers (page 13).

We are as proud as ever of our faculty, who are not only recognized as distinguished members of the international materials community, but who also serve as outstanding role models and mentors to our students. Dr. Avinash Dongare was awarded the 2015 TMS SMD Young Leaders Professional Development Award from The Minerals, Metals & Materials Society (TMS), an award created to enhance the professional development of dynamic young members of TMS's five technical divisions. Dr. Dongare was also awarded an NSF Faculty Early Development Program CAREER Award for his research project "Mesoscale Modeling of Defect Structure Evolution in Metal Materials" (page 15). Dr. Radenka Maric was selected as a 2015 Woman of Innovation by the Connecticut Technology Council (CTC). Professor Maric was named a top category winner in research innovation and leadership (page 4). Dr. Mark Aindow, MSE professor and associate director of the Institute of Materials Science (IMS) was awarded the 2015 School of Engineering Outstanding Faculty Mentor Award. This award recognizes faculty members who have shown an exceptional commitment to mentoring and advising other faculty, particularly junior colleagues (page 15). Dr. Harold Brody was selected by the MSE graduating class of 2015 as the recipient of the Materials Science and Engineering Award for Teaching Excellence (page 15). The award was created to recognize faculty members who have positively influenced MSE students in regard to their academic, research, extracurricular, and personal development. Seniors praised Professor Brody's ability to challenge them to expand upon their intellectual horizons and think like engineers.

Three years after MSE was formed as a distinct department, the program continues to expand at impressive rates. We have experienced significant growth in the number of bright minds joining our program as a result of our continued outreach and recruitment efforts that promote the hands-on experience, job opportunities, and top-rate faculty that a University of Connecticut MSE education has to offer. By the end of the Spring 2015 semester, our undergraduate enrollment surged to 167 students. 38 of these students graduated in May—our largest graduating class yet. Our students continue to shatter boundaries and redefine the STEM fields. As you will find in our Female STEM Trailblazers feature, our outstanding female students and faculty members serve as exemplary role models to future leaders in the materials discipline (page 3).

In this outreach bulletin you will find stories that demonstrate how far a UConn MSE education has taken our students—from participating in international competitions to climbing Kilimanjaro. We are exceptionally proud of their diverse paths and accomplishments.

With my best regards,

S. Pamir Alpay

Female STEM Trailblazers

Paiyz Mikael and Alexandra Merkouriou Named Outstanding Women Scholars

MSE Ph.D. graduate Paiyz Mikael and 2015 graduate Alexandra Merkouriou have recently been named outstanding women scholars.

The outstanding senior women academic achievement awards were established in 1993 as part of the University of Connecticut's 100 Years of Women celebration. The awards recognize outstanding female undergraduates and graduate students from each of UConn's fourteen schools and colleges for their academic excellence and dedication to research and service within the university community. The 2015 distinguished female scholars were honored at the Outstanding Senior Women Academic Achievement Awards Ceremony on Friday, May 8 at the UConn Alumni Center.

Paiyz graduated with an honors degree in biology from Southern Connecticut State University before coming to UConn to pursue her master's in biomedical engineering and Ph.D. in materials science and engineering. Paiyz's doctoral dissertation, "Hybrid Matrix Design for Cartilage-mediated Segmental Bone Tissue Engineering," focuses on the development of mechanically superior 3D scaffolds for segmental bone defects. Her research centers on a bone tissue creation process that takes place naturally during fetal development. The process requires the development of a polymeric-hydrogel scaffold system that is mechanically compatible with the mechanical properties of bone. The use of a biodegradable smart scaffold and autologous stem cells is extremely promising and has immediate potential for clinical application.

(Left to Right) Dr. Kent Holsinger (Vice Provost for Graduate Education, Dean of the Graduate School, and EEB Professor), Paiyz Mikael, and Dr. Mun Choi (Provost and Executive Vice President for Academic Affairs)

The first two years of Paiyz's graduate work were supported by a prestigious National Science Foundation GK-12 fellowship, which allowed her to work closely with teachers and students at Hartford's A.I. Prince Technical High School. She developed fun, hands-on STEM activities in the classroom and helped to establish mentoring collaboration between the high school and a neighboring charter middle school. Paiyz is dedicated to encouraging young students, especially young women, to become future mentors and leaders in STEM. She has served as the leading graduate student at the GE-UConn girls' summer camp and an engineering instructor at the Renzulli Academy summer program, in addition to mentoring several undergraduate and graduate students. Advisor Dr. Syam Nukavarapu reflects, "Paiyz is the go-to student in my lab."

Alexandra is a member of the 2015 MSE undergraduate class. Beginning in the summer after her freshman year, Alexandra has served as the assistant lab manager in the undergraduate MSE labs, which she credits as the "launch pad" of her later experiences in MSE. During her sophomore year, Alexandra helped MSE lab manager Adam Wentworth with the junior MSE lab (MSE 3055) and was ultimately introduced to Professor Bryan Huey. Under Dr. Huey's advisement, she worked on several projects, including an analysis of the topography of several materials and mapping the piezoelectric properties of lead zirconate titanate. For the past two years, Alexandra has served as the president of Material Advantage, a student organization that promotes professional development among its members while also developing outreach activities that teach K-12 students about materials engineering. The club's annual banquet not only serves as a fundraiser for the organization, but also provides undergraduate and graduate MSE students the opportunity to network with professors and industry professionals. In addition to dedicated members and officers, Alexandra notes that none of Material Advantage's events would have been possible without the continual support of Dr. Avinash Dongare and Dr. Pamir Alpay. This past year, Alexandra also served as the leader of Time Capsule to Mars (TC2M), a collaboration among seven American universities to send a time capsule to the surface of Mars.

(Left to Right) Dr. Daniel Burkey (Associate Dean for Undergraduate Education and Diversity and CBE Professor), Alexandra Merkouriou, Kathleen Holgerson (Director of the Women's Center), and Dr. Mun Choi (Provost and Executive Vice President for Academic Affairs)

During her undergraduate career, Alexandra was selected as an intern at Unilever in Trumbull, CT, which ultimately became the corporate sponsor of her senior design capstone project. She was awarded third place at senior design day for her project, "Bimodal HDPE Resin Grades for Bottle Weight Reduction and Equivalency," which she completed under the advisement of Dr. Pamir Alpay. In July, Alexandra will start working in the Edison Engineering Development Program at GE.

When prompted for a favorite professor and course in MSE, Alexandra reflects:

> That's really difficult— I don't have just one. The whole department has been instrumental to my success and I could not have done it without them. Selecting a favorite class is just as difficult. Looking back at all of my classes since freshman year, I'd have to say that it was less about the exact content of the class and more about how it was presented that really stood out to me. I could always count on Dr. Goberman to show true passion and excitement for materials, and his classes always got me even more excited about where my life could be heading. Dr. Huey's classes always challenged me to think outside the box and reassured me that creativity is really important, even if most of our classes dealt with equations and theories. Dr. Brody's classes taught me what it meant to be an engineer and work in a team. I'd have to say that it's because of my team that I made it to where I am today. And finally, Dr. Aindow's classes showed me what it meant to be a materials scientist. He always had a great way of tying in what we learned from our other classes and bringing it all into perspective.

As outstanding women scholars, Paiyz and Alexandra serve as exemplary role models to future female students and leaders in MSE. ■

Professor Radenka Maric and MSE Graduate Student Sapna Gupta Named 2015 Women of Innovation

Congratulations to Dr. Radenka Maric and Sapna Gupta, who have recently been named 2015 Women of Innovation by the Connecticut Technology Council (CTC).

The CTC honored fifty-six Connecticut women for innovation and leadership in the science, math, technology, and engineering disciplines at the 11th annual Women of Innovation Awards Gala on April 1. Ten of these women were granted awards in the academic, entrepreneurial, large business, small business, youth, collegian, and community innovation and leadership categories. Professor Maric was named a category winner in research innovation and leadership, and Sapna was recognized as a category winner in collegian innovation and leadership.

Professor Maric is the CT Clean Energy Fund Professor of Sustainable Energy in the Department of Chemical and Biomedical Engineering (CBE) and Department of Materials Science and Engineering (MSE). Dr. Maric's research interests include structural ceramics, hydrogen production and separation, and the development of new materials and novel structures for energy storage and conversion. In particular, Professor Maric's research focuses on improving the performance-to-cost ratio of fuel cell materials and components via changes to microstructure and composition. She is the author of over 150 scientific publications.

Sapna is a Ph.D. candidate in the MSE department working under the advisement of Professor Prabhakar Singh, director of the Center for Clean Energy Engineering. Her research interests include ceramics, high temperature electrochemical systems, mixed electrically and ionically conducting high temperature materials, and the characterization and evaluation of chemical and structural stability of materials in an aggressive environment. Sapna is the founder and president of UConn Keramos and serves as a delegate to The American Ceramic Society (ACerS) President's Council of Student Advisors. She is the recipient of many fellowships, awards, and distinctions, including an honorable mention for the Fuel Cell Seminar and Energy Exhibition's 2014 Baker Student Researcher Award.

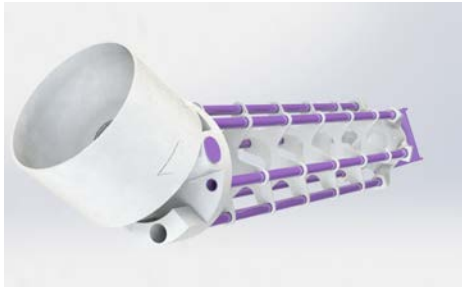
Sapna Gupta, MSE Ph.D. candidate

In recent years, the UConn MSE department has been strongly represented at the Women of Innovation Awards Gala. Last year, Ph.D. student Zengmin Xia was named a 2014 category winner for collegian innovation and leadership. Through their innovative research and community involvement, Dr. Maric and Sapna continue this legacy, serving as exceptional role models to future generations of female leaders in the STEM fields. ■

3D Printing Club Wows Judges at 2015 Brandeis Printathon

The 3D Printing Club, 3DPC, won first place at Printathon 2015, a 24-hour 3D printing competition hosted at Brandeis University. Competing against five other teams, including teams from Brandeis and Columbia, UConn "blew the judges away" with their 3D printed prosthetic leg for bikers. The winning design attaches to a bike pedal and allows an amputee greater mobility control. Judging was based on creativity, complexity, functionality, and adherence to the social justice theme of the contest.

The UConn 3DPC team at Printathon 2015. (Left to right) Lucian Chaprar (sophomore, Digital Media and Design), Rory Fahy (junior, Biology), Tim Henning (freshman, Digital Media and Design), Leslie Prunier (sophomore, Mechanical Engineering), and Adam Wentworth (club advisor and MSE lab manager)



UConn 3DPC's winning 3D printed prosthetic leg design

The team was comprised of club advisor and MSE lab manager Adam Wentworth, Lucian Chapar, Leslie Prunier, Rory Fahy, Tim Henning, and Aaron Hagewood. 3DPC has been in the spotlight after their impressive competition victory, appearing in articles on The Justice and 3DPrint.com. The team will have their winning design printed by 3D printing marketplace Shapeways and receive $500 of Shapeways printing credit.

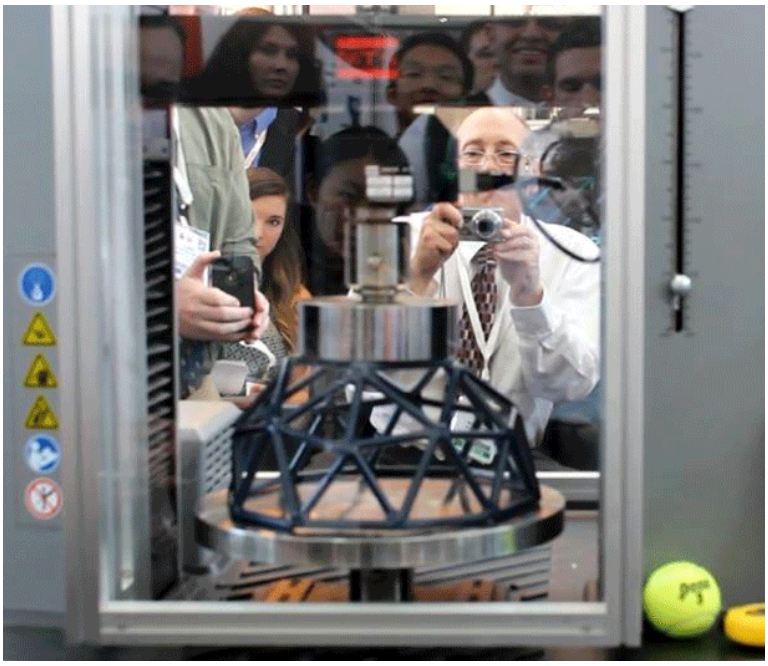
3DPC is one of the most popular clubs on the UConn campus. Founded in 2013 by MSE alumnus Rafael Patel, the club now boasts over 165 members. 3DPC has also participated in the UConn-Yale Hackathon and the Inside 3D Printing Conference at the Javits Convention Center in New York City, in addition to an appearance at the UConn Co-op. ■

UConn Material Advantage Members Impress With "DomesDay" Design

ASM International hosted its first "DomesDay" Geodesic Dome Design Competition at the Materials Science and Technology (MS&T) conference in Pittsburgh, PA. The competition invited Material Advantage student teams to design a twelve-inch scale model of a geodesic dome that could potentially be used to provide efficient shelter for individuals living in third world nations.

MSE seniors Luke McCarthy, James Kos, and Nick Poulos represented UConn at the competition. Their modified geodesic design comprised of welded A36 structural steel maxed out the compression tester at over 11,000 lbs., doubling the load of the nearest competitor and setting the team apart as the only dome design that did not fail during testing. UConn placed second behind Virginia Tech's cast aluminum dome, largely because UConn's design exceeded the maximum force allowed to factor into the judges' final decision.

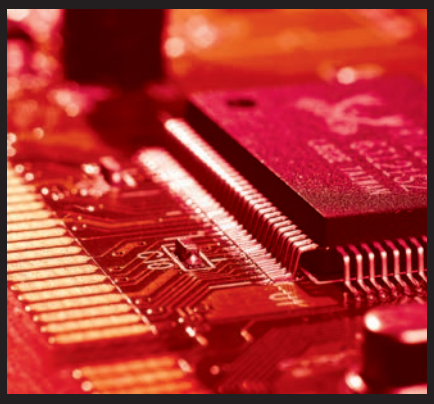
Although McCarthy, Kos, and Poulos graduated in the spring, members of UConn Material Advantage look forward to participating in the competition again this fall. ■



The UConn Dome during the peak of testing

Educating
The Next Generation of Engineers

Seize the unique opportunity to become a Senior Design industry partner and tap into the exceptional student talent, distinguished faculty, and state-of-the-art materials processing and characterization laboratory equipment that the UConn Department of Materials Science and Engineering has to offer!



Our MSE program was established to meet the high local demand for materials engineering professionals. Our students enjoy excellent employment opportunities, a choice of five academic concentrations (biomaterials, energy materials, nanomaterials, metallurgy, and electronic materials), first-rate faculty instruction, and hands-on laboratory experience and research opportunities. UConn MSE is the number one public MSE program in the Northeast, boasting a student-to-faculty ratio of 13 to 1, industry co-ops, internships, and departmental scholarships.

The UConn MSE experience culminates with Senior Design, a two-semester project that provides students with exposure to real-world engineering problems, stimulating design challenges, collaboration with local companies, and potential future employment opportunities.

As an industry partner, you can expect collaborative impact with UConn MSE and the Institute of Materials Science, project updates and documentation, secure proprietary information, and the opportunity to hire skilled, engaged engineering students. Visit our Senior Design webpage for more information!

www.mse.engr.uconn.edu/undergraduate-program/senior-design

Materials Science & Engineering

University of Connecticut
Department of Materials Science & Engineering
97 North Eagleville Road, Unit 3136
Storrs, CT 06269-3136

www.mse.engr.uconn.edu

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Senior Design Day 2015

MSE seniors presented their senior design projects on Friday, May 1st, 2015 at Gampel Pavilion. With a total of 21 projects and 41 students participating, the event showcased the department's exeptional student talent.

Congratulations to our graduating seniors and the MSE Senior Design Project final presentation winners!

1st Prize: $1,500

Zeiss MultiSEM Sample Mount
by Eric Bousfield, Stephen Ecsedy, and Kyle Keeley
Industry Sponsor: Carl Zeiss Microscopy, LLC
Industry Advisor: Pascal Anger, Dr. Kyle Crosby
Faculty Advisor: Prof. Puxian Gao

(Left to right) Robert Klancko, Eric Bousfield, Kyle Keeley, Stephen Ecsedy, and Professor Rainer Hebert

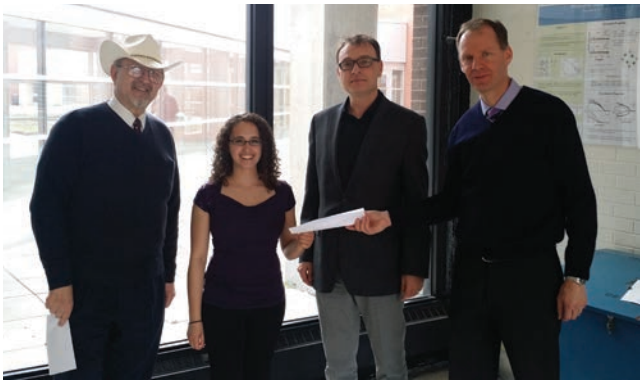
2nd Prize: $1,000

Impact Testing of Circuit Breaker Enclosures to Simulate Short Circuit Conditions
by Douglas Hendrix and Nicholas DeMello
Industry Sponsor: GE Energy Management
Industry Advisor: Haritha Namduri
Faculty Advisor: Prof. Bryan Huey

(Left to right) Robert Klancko, Nicholas DeMello, Douglas Hendrix, and Professor Rainer Hebert

3rd Prize: $750

Bimodal HDPE Resin Grades for Bottle Weight Reduction and Equivalency by Alexandra Merkouriou
Industry Sponsor: Unilever
Industry Advisor: Warren Kleeman, Julie Zaniewski
Faculty Advisor: Prof. Pamir Alpay



(Left to right) Robert Klancko, Alexandra Merkouriou, Professor Pamir Alpay, and Professor Rainer Hebert

Other Capstone Design Projects:

Additive Metal Processing for Production of Surgical Device Components by Pamela Dyer and Andrew Fasano
Industry Sponsor: Covidien
Industry Advisor: Dr. William Powers
Faculty Advisor: Prof. Rainer Hebert

Salt Penetrometry for Design of Reduced Defect Filters
by Marc Bennett, Noveen Delaram, and Jason Monnes
Industry Sponsor: KX -Technologies, Inc
Industry Advisor: Bruce Taylor, William Li
Faculty Advisor: Prof. Rampi Ramprasad, Dr. Fiona Leek

Marmon Utility ESP Cable Systems
by Cody Andelin and Jackson McMillan
Industry Sponsor: Marmon Utility-Kerite Pump Cable
Industry Advisor: Mohamed Alameh, Michael Norton
Faculty Advisor: Prof. Prabhakar Singh

Al-Li Alloy Peening and Impact on HCF Behavior
by Timothy James
Industry Sponsor: Pratt & Whitney
Industry Advisor: James Hensen
Faculty Advisor: Prof. Avinash Dongare

Impact of Alloy Overaging on Mechanical Properties
by Riordan Hoffman and James Lee
Industry Sponsor: Pratt & Whitney
Industry Advisor: Dr. Max A. Kaplan
Faculty Advisor: Prof. Seok-Woo Lee

Temperature and Time Limitations on PTFE Material
by Luke McCarthy and Samuel Wentworth
Industry Sponsor: Pratt & Whitney
Industry Advisor: Curtis Riewe
Faculty Advisor: Prof. Serge Nakhmanson

Oxidation Effects on Nickel Base Superalloys at Intermediate Temperatures by Benjamin Bedard
Industry Sponsor: Pratt & Whitney
Industry Advisor: Dr. Mario Bochiechi
Faculty Advisor: Prof. Mark Aindow

Local Heat Treatment
by James Kos
Industry Sponsor: PTR-Precision Technologies, Inc
Industry Advisor: Amber Black, Gary LaFlamme, John Rugh
Faculty Advisor: Prof. Pamir Alpay

Hydrogen Embrittlement of Cu Cables
by Samantha Brantley and Wieslaw Kapalczinksi
Industry Sponsor: Rockbestos-Suprenant Cable Corporation, Inc
Industry Advisor: Daniel Masakowski, Ivan Stannard
Faculty Advisor: Prof. Rainer Hebert

Tooling and Processing Optimization for Complex Geometry, Nonferrous Castings by Kevin La and Lauren Salisbury
Industry Sponsor: Sikorsky Aircraft Corporation and Sikorsky Innovations, Inc
Industry Advisor: William Fallon, Paul Inguanti
Faculty Advisor: Prof. Hal Brody

Design of Stress Relief Heat Treatments of Austenitic Stainless Steels by Allie Clark and Jennifer Heiser
Industry Sponsor: Ulbrich Stainless Steels and Special Metals, Inc.
Industry Advisor: Sean Ketchum, Will Keenan
Faculty Advisor: Prof. Hal Brody

DMLS In 718 Heat Treatment
by Jordan Parley and Timothy Siu
Industry Sponsor: UTC Aerospace Systems
Industry Advisor: Dr. Sergey Mironets
Faculty Advisor: Prof. Rainer Hebert

Evaluation of Electrical Discharge Machining (EDM) of Aerospace Alloys by Eric Anderson and David Twohill
Industry Sponsor: UTC Aerospace Systems
Industry Advisor: Stephen Pasakarnis
Faculty Advisor: Prof. Seok-Woo Lee

Mechanical Properties of AL6061 with Al4043 Welds
by Benjamin Bilancieri, Terry Ng, and Nicholas Poulos
Industry Sponsor: UTC Aerospace Systems
Industry Advisor: Callie Benson
Faculty Advisor: Prof. Rainer Hebert, Prof. Theo Kattamis

UTAS Additive Manufacturing of a Cold Plate
by Gabrielle Charno and Spencer Lambrecht
Industry Sponsor: UTC Aerospace Systems
Industry Advisor: Colette Fennessy
Faculty Advisor: Prof. Rainer Hebert

Improving Tensile Strength Consistency Around High Carbon Steel Rings by Brenden Mil-Homens and Joseph Pacheco
Industry Sponsor: Nucor
Industry Advisor: Charlie Hyatt
Faculty Advisor: Prof. Rainer Hebert

Non-Destructive Test for Incoming Nylon Fabrics Prior to Metalizing by Rheanna Ward and Kacie Wells
Industry Sponsor: Swift Textile Metallizing
Industry Advisor: Antonio Luna
Faculty Advisor: Prof. Rainer Hebert, Dr. Fiona Leek

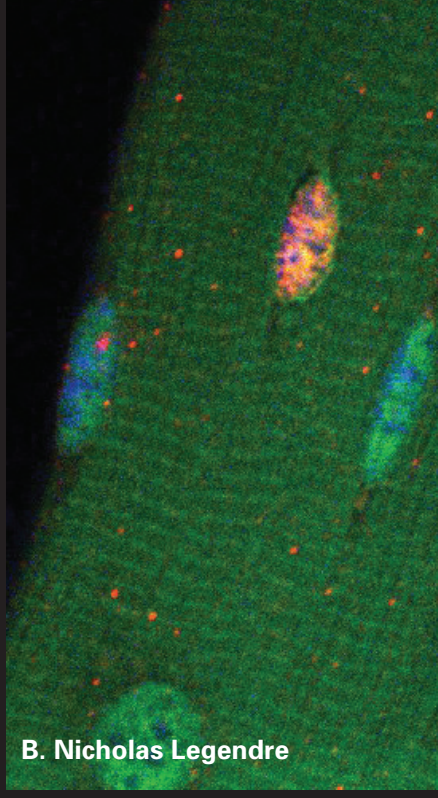
Improved Methods of Pretreating Polymer Fiber Prior to Metalizing by Alexander Westlund and Bartek Wojciechowski
Industry Sponsor: Swift Textile Metallizing
Industry Advisor: Antonio Luna
Faculty Advisor: Prof. Radenka Maric

MSE Undergraduate Labs Receive X-Ray Diffraction System

Thanks to Professor Christian Brückner and the UConn chemistry department, MSE has acquired a like-new Bruker D8 Advance X-Ray Diffraction System. Located in room 303 of the Engineering II building, the equipment will further enhance the capabilities of the MSE undergraduate labs.

Lab manager Adam Wentworth states, "The system will serve to educate students about modern diffraction systems in senior-level Materials Characterization (MSE 4003) as well as residual stress analysis and material identification in our capstone design project courses (MSE 4901W and 4902W)." ■

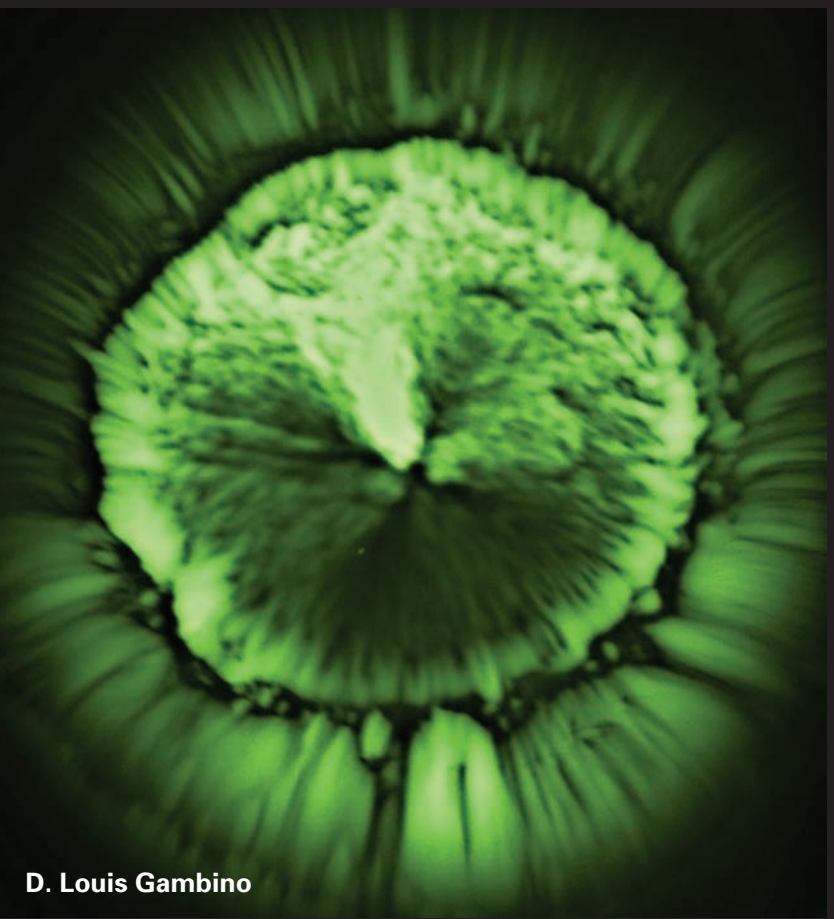
A. Sourav Biswas & David Kriz



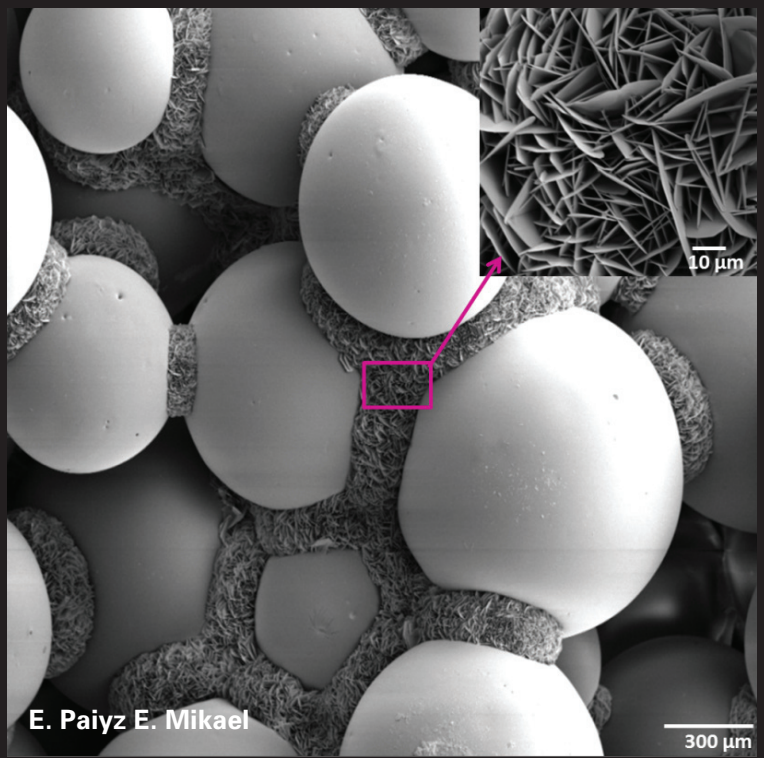
B. Nicholas Legendre

KERAMOS MICRO

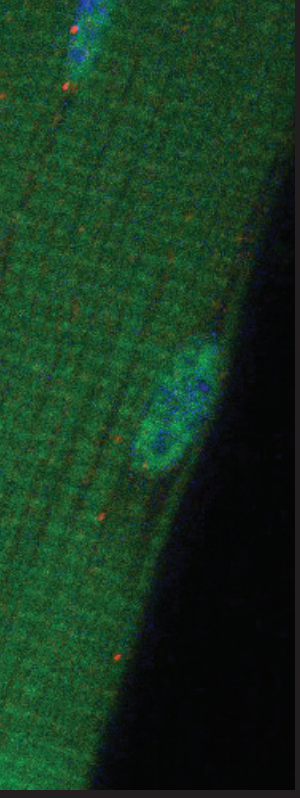
The UConn Keramos Chapter hosted a micrograph contest that encouraged students to highlight the precision of materials science techniques and the beauty of materials at the microscopic level. MSE and IMS professionals evaluated the micrograph submissions for technical and artistic merit. Cash prizes: $100 first place, $75 second place, $50 third place.

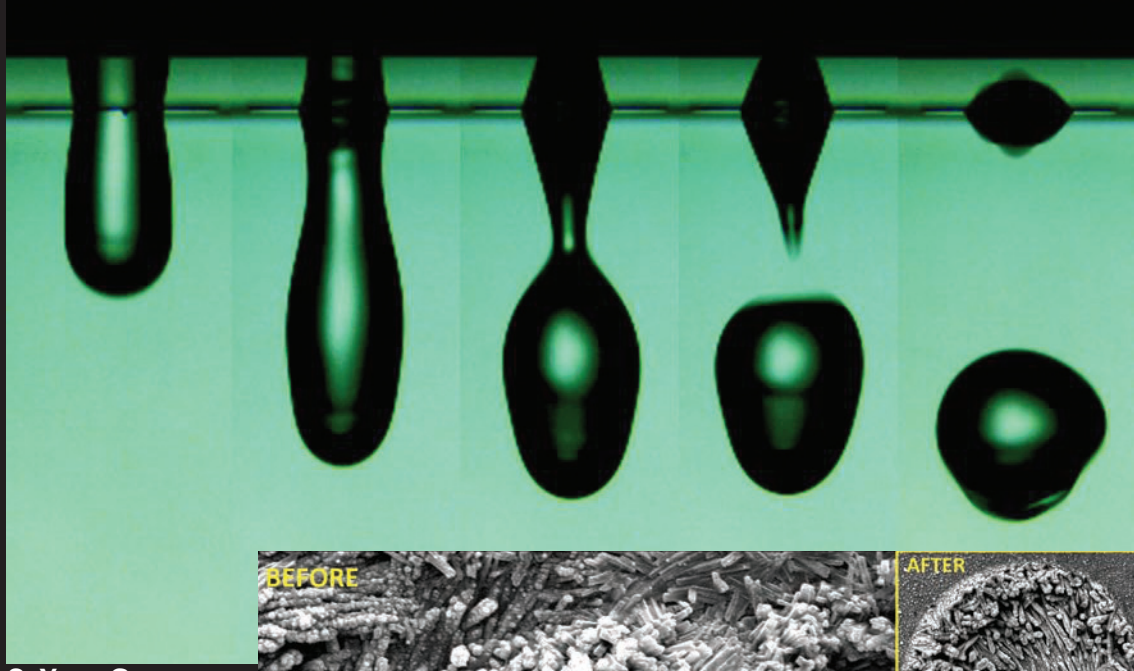


D. Louis Gambino



E. Paiyz E. Mikael

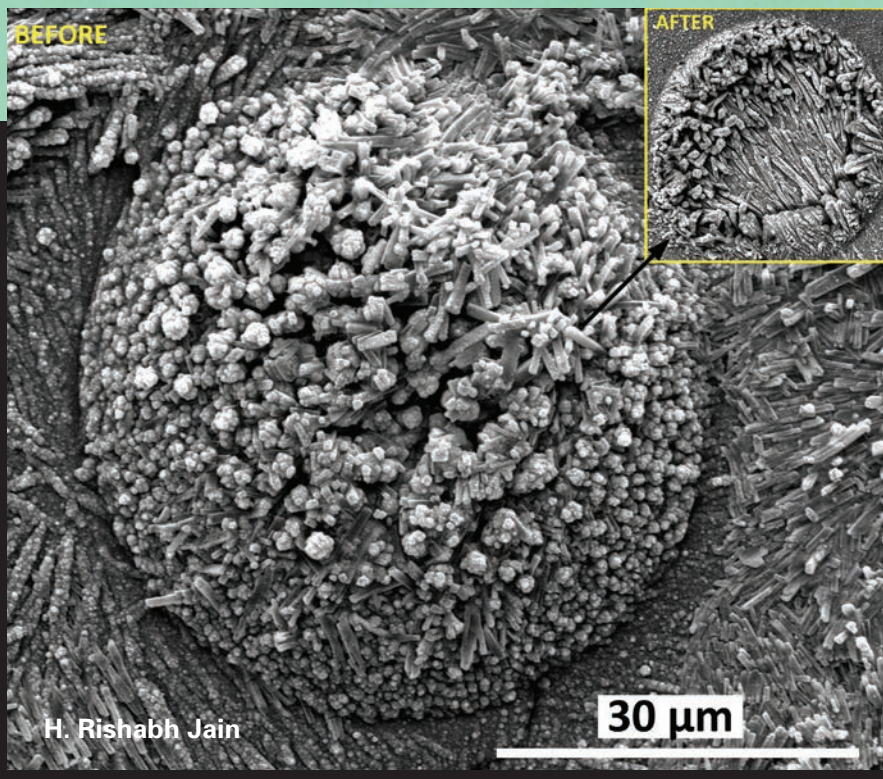




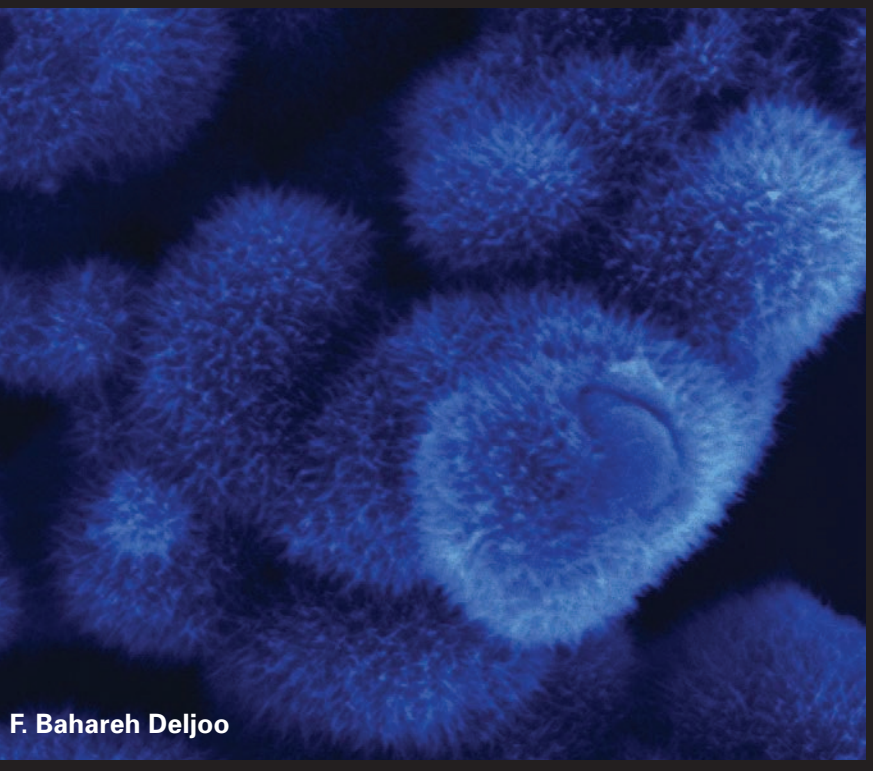
C. Yang Guo

OSCOPY CONTEST

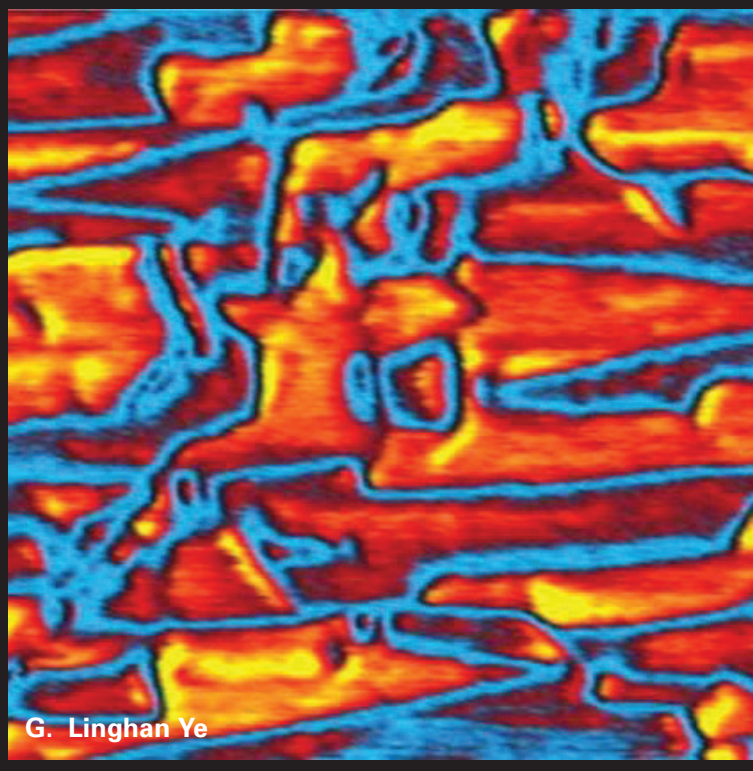
A. Sourav Biswas & David Kriz, "Brain in Jar" (1st prize)
B. Nicholas Legendre, "An Isolated and Regenerated Mouse Myofiber"
C. Yang Guo, "Stroboscopic Imaging of Jetting Behavior" (2nd prize)
D. Louis Gambino, "My Moon, My Sun"
E. Paiyz E. Mikael, "PLGA-MWCNTs Composite Scaffold for Bone Regeneration" (3rd prize)
F. Bahareh Deljoo, "Vagrant of Sea Urchins"
G. Linghan Ye, "BiFeO3 Domain via PFM"
H. Rishabh Jain, "Micro Bubble"



H. Rishabh Jain



F. Bahareh Deljoo



G. Linghan Ye

MSE Celebrates the Class of 2015

On Saturday, May 9th in Gampel Pavilion, the School of Engineering convened for 2015 Commencement. Dean Dr. Kazem Kazerounian and Provost Dr. Mun Choi delivered welcoming remarks and UConn alumnus Timothy "Scott" Case delivered the commencement address before being presented with an honorary doctorate degree.

MSE proudly graduated thirty-eight students in the class of 2015. Department Head Dr. Pamir Alpay reflects:

> The MSE Class of 2015 is an excellent, talented group of students, and I am confident that they will achieve wonderful things in their careers. We strive to provide our students with the best materials engineering education possible. Year in and year out, we are excited to instruct outstanding students who go on to become leaders in research, industry, and academia. Congratulations to the Class of '15!

Bachelor of Science Graduates

Andelin, Cody Jonathan
Anderson, Eric Leif
Bedard, Benjamin A. (Honors Scholar)
Bousfield, Eric A.
Brantley, Samantha Pilar
Charno, Gabrielle Elise
Clark, Allie Elizabeth
Delaram, Noveen
DeMello, Nicholas Emerson
Dyer, Pamela Michelle
Ecsedy, Stephen Thomas
Giarratana, Giovann
Heiser, Jennifer Lynn
Hendrix, Douglas Roscoe
James, Timothy
Kapalczynski, Wieslaw Jerzy
Keeley, Kyle Simpson
Kos, James Leland
La, Kevin Ve
Lambrecht, Spencer Alexander
Macmillan, Jackson Ward
Manni, Anthony Dante
McCarthy, Luke
Merkouriou, Alexandra
Mil-Homens, Brenden Spencer
Monnes, Jason Andrew
Ng, Terry
Pacheco Jr., Joseph David
Parley, Jordan Alexander
Poulos, Nicholas Christopher
Salisbury, Lauren Michelle
Siu, Timothy Tze Quan
Twohill, David Robert
Ward, Jestine Rheanna
Wells, Kacie May
Wentworth, Samuel
Westlund, Alexander Wilson
Wojciechowski, Bartek Leszek



Master of Science Graduates

Joseph Desmarais, Major Advisor: Ramamurthy Ramprasad
Tulsi Patel, Major Advisor: Pamir Alpay
Caitlyn Thorpe, Major Advisor: Pamir Alpay
Yang Wu, Major Advisor: Bryan Huey

Ph.D. Graduates

James L. Bosse
Major Advisor: Bryan Huey
Doctoral Dissertation: Nanoscale Performance Mapping of Semiconducting Materials with Multiparametric Atomic Force Microscopy

Yenny Paola Cardona Quintero
Major Advisor: Ramamurthy Ramprasad
Doctoral Dissertation: Self-assembled Monolayers on Surfaces and at Interfaces

Paiyz Esmat Mikael
Major Advisor: Syam P. Nukavarapu
Doctoral Dissertation: Advanced Scaffold Design for Cartilage Mediated Bone Tissue Engineering

Richard Perez Moyet
Major Advisor: George A. Rossetti Jr
Doctoral Dissertation: Thermophysical Properties of Perovskite Ferroelectrics and their Applications in Energy Harvesting

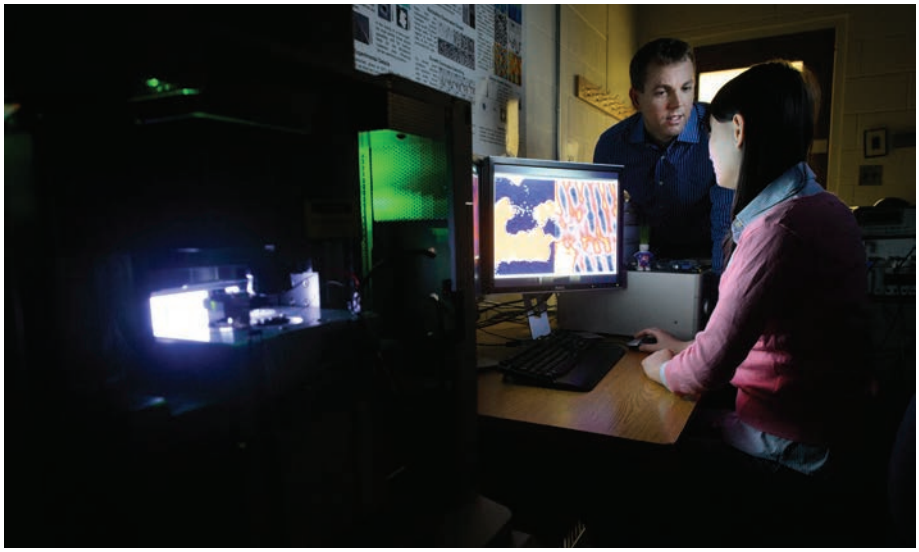
Max Manuel Villa
Major Advisor: Mei Wei
Doctoral Dissertation: In Vivo 2-Photon Microscopy and Collagen-Hydroxyapatite Scaffolds for Bone Tissue Engineering

Chenchen Wang
Major Advisor: Ramamurthy Ramprasad
Doctoral Dissertation: Polymer Dielectrics Design Using First Principles Computations and Machine Learning

Xiaofeng Wang
Major Advisor: Trent M. Molter
Doctoral Dissertation: Systematic Study of Materials and Structures for Optimizing Performance of Polymer Electrolyte Membrane Fuel Cells

Jessica Lea Woodman
Major Advisor: Liisa T. Kuhn
Doctoral Dissertation: Selection of a Nanoparticle Stabilizer for a Calcium Phosphate Drug Delivery System

Building the Next Generation of Efficient Computers



Graduate student Linghan Ye and Associate Professor Bryan Huey review microscope data at the Institute of Materials Science (Peter Morenus/UConn Photo)

UConn researcher Bryan Huey has uncovered new information about the kinetic properties of multiferroic materials that could be a key breakthrough for scientists looking to create a new generation of low-energy, highly efficient, instant-on computers.

One of the drawbacks of computers today is that accessing memory creates heat and wastes energy.

Materials known as multiferroics have shown great promise for creating a low-energy memory storage and processing device because they have the rare ability to be both magnetic and ferroelectric, meaning they can be sensitive to magnetic and electric fields simultaneously.

But there is one major drawback. Most such materials only function in extremely cold temperatures, due to their inherent thermodynamic barriers and other conflicting properties. Scientists were convinced that using multiferroics at room temperature – which is essential if they are to work in computers – was impractical.

The fastest atomic force microscope in the U.S.

That belief changed recently when Huey, working in collaboration with multiferroics experts at the University of California, Berkeley and Cornell University, aimed his lab's powerful atomic force microscopy (AFM) system at a multiferroic compound known as bismuth ferrite and discovered a previously unknown two-step ferroelectric switching process.

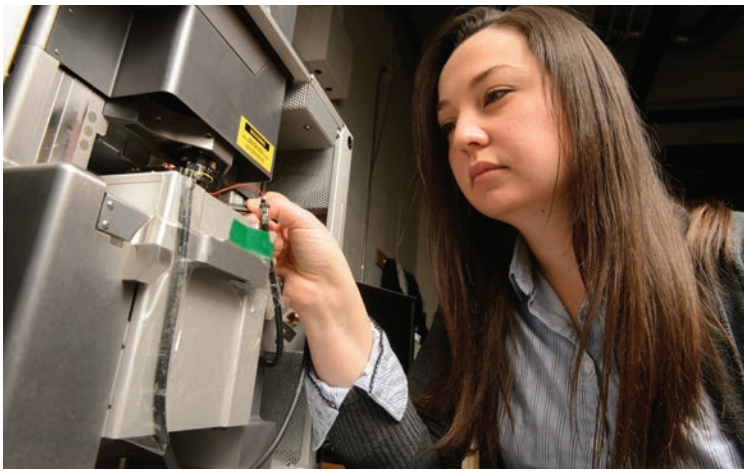
The insight gave his fellow scientists the leverage they were looking for to overcome the prior barriers, and develop a unique spintronic memory device that switches its magnetization with the application of an electric field rather than an electrical current, which is more energy-consuming. This enabled – for the first time – a novel low-energy, highly efficient nonvolatile memory device known as a spin valve that operates at room temperature. The device could be a harbinger of the future when it comes to faster, cheaper, and cooler temperature ways for storing and processing data.

The findings were featured in the Dec. 17, 2014 issue of *Nature*, considered one of the world's most prestigious scientific research journals.

"Recognizing magnetic domains is how information is stored and read," says Huey, an associate professor of materials science and engineering. "By coupling the magnetic and electric fields, we've shown that you can make a more efficient electromagnetic device that will sense a magnetic field change 10 times more efficiently than comparable technologies."

The research project was led by Ramamoorthy Ramesh, an expert in multiferroics affiliated with the U.S. Department of Energy's Lawrence Berkeley National Laboratory and a longtime collaborator of Huey's. John Heron, Darrell Schlom, and Dan Ralph of Cornell University also worked on the project. Heron served as the paper's lead author, and spent several weeks in Huey's lab during the effort.

"The advantage here is low-energy consumption," Heron told the Cornell Chronicle. "[The device] requires low voltage, without current, to switch it. Devices that use currents consume more energy and dissipate a significant amount of that energy in the form of heat. That is what's heating up your computer and draining your batteries."



Graduate student Yasemin Kutes adjusts a microscope (Peter Morenus/UConn Photo)

The new device has some limitations in its current stage. It operates on only one computer bit and is prone to failure after only a couple of switches. By comparison, commercially popular flash memory systems can switch 10,000 times or

more before showing signs of fatigue. But Huey and his colleagues are optimistic that those barriers can be overcome with further study.

One of the most important findings in the research was made by two of Huey's graduate students, James Bosse and Linghan Ye, who provided critical data to the team by capturing the steps of the switching process in three dimensions using atomic force microscopy, something that had never been done so precisely before.

"By measuring in all three dimensions, we now know the switching steps for every single position, and at the nanoscale," says Huey.

The work builds on UConn's unique atomic force microscopy expertise and capabilities. Huey's NanoMeasurement lab, a campus-user facility housed in the Institute of Materials Science, supports basic research and industrial projects in such diverse fields as pharmaceutical science, biomedicine, advanced metallurgy, microelectronics, and solar cells.

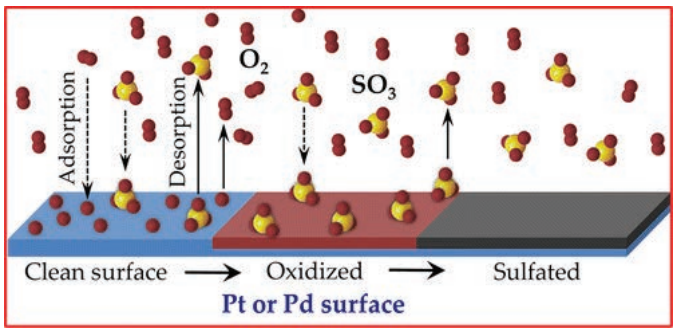
The atomic force microscopy systems in Huey's lab are some of the most powerful in the country. They are based on a commercial platform (Asylum Research), but include several custom modifications and extensive additional hardware for higher speed and automated control of variables such as externally applied electric fields, optical illumination, and temperature gradients. The work often blurs the lines between materials science, electrical engineering, and computer science, as Huey's research staff rapidly generates gigabytes of data – ironically – while investigating faster and more efficient data storage technologies.

"We have the fastest AFM in the U.S. for measuring properties. We also have one of the most flexible systems in the world for coupling AFM and light," says Huey. "I'm fortunate to have bright, motivated students along with supportive colleagues and administration."

Working with partners in industry and academia from around the world, Huey and the graduate students in his research group are making scientific advances in a variety of areas: Yasemin Kutes is using the lab's enhanced microscopy systems to map and improve how solar cells perform; Manuel Rivas studies micro-electrical mechanical systems for next generation GPS systems; James Steffes is working to improve multilayer capacitors; Vincent Palumbo worked with future lithography systems for manufacturing microelectronics; Varun Vyas recorded how biological cells and tissue respond to minute forces; and Justin Luria just arrived with a highly competitive Department of Energy fellowship to study ways to improve the lifetime of solar cells and LED's.

Undergraduates are equally important to what goes on in the lab: Alexandra Merkouriou studied why some coral is sensitive to global warming; Zachary Thatcher will soon be a co-author on a paper about fuel cells, Aliya Carter is doing an honors project on energy efficient smart-windows, and Aaron Gladstein is working with Technion (Israel) on smart fibers. ■
By Colin Poitras, UConn Today

"Why Pt Survives but Pd Suffers From SOx Poisoning" Published in *JPC Letters*



Graduate student Hom Sharma (Department of Chemical Engineering) and co-authors Dr. Vinit Sharma and Professor Rampi Ramprasad (Department of Materials Science and Engineering), in conjunction with Dr. Ashish B. Mhadeshwar, presently with ExxonMobil Corporation, have published their paper, "Why Pt Survives but Pd Suffers From SOx Poisoning," in the *Journal of Physical Chemistry Letters*.

It is widely known that the combustion of gasoline in automobiles produces harmful emissions, including carbon monoxide, nitrogen oxides, and unburned hydrocarbons. Environmental regulations require that these harmful emissions be capped at a given limit, which is achieved by converting most of the harmful emissions into harmless gases. Catalysts like platinum (Pt) and palladium (Pd) aid this conversion process. Although palladium is much cheaper than platinum, palladium is poisoned by sulfur oxides (SOx) present in the emissions, while platinum is not. Sulfur poisoning is also referred to as sulfation, a process that produces palladium sulfate (PdSO4) from the reaction between palladium, SOx, and oxygen.

"Why Pt Survives but Pd Suffers From SOx Poisoning" addresses the puzzle of why palladium undergoes sulfation while platinum resists it. The authors use computational quantum mechanics and statistical thermodynamics to explain the intriguing difference between these two catalysts, including the different characteristics that they display under given conditions. The authors also identify key descriptors that correlate to heightened sulfation tendencies, which will prove highly valuable to future research on cheaper, sulfur-resistant catalysts. ■

Dr. Avinash Dongare Receives Two Prestigious Research and Leadership Awards

Assistant Professor Avinash Dongare

MSE Assistant Professor Avinash Dongare has been awarded an NSF Faculty Early Development Program CAREER Award for his research project "Mesoscale Modeling of Defect Structure Evolution in Metal Materials". The award is granted through the NSF Division of Civil, Mechanical & Manufacturing Innovation (CMMI), whose mission is to "fund fundamental research and education in support of the foundation's strategic goals directed at advances in the disciplines of civil, mechanical, industrial and manufacturing engineering, and materials design." Dr. Dongare's research for this award will focus on advanced computational mechanics for the virtual analysis of structural metallic material for use in extreme environments.

Professor Dongare has also been named a 2015 recipient of the Young Leaders Professional Development Award from the Structural Materials Division (SMD) of The Minerals, Metals, and Materials Society (TMS). The award encourages the professional growth of outstanding young members of TMS's five technical divisions through networking opportunities and society activities. Professor Dongare was formally presented with his award at the TMS Annual Meeting in Orlando, Florida.

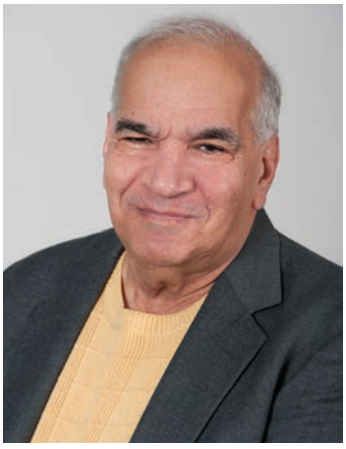
This award recognizes Professor Dongare's contributions to research as well as his continued efforts toward outreach activities in materials science and engineering.

Dr. Dongare's Computational Materials and Mechanics Group (CMMG) focuses on the development and application of advanced computational methods ranging from the atomic-scales to the meso-scales in order to model the response and behavior of materials in various environments. Dr. Dongare also serves as the faculty advisor of the UConn Material Advantage student chapter, one of the most active and successful student chapters nationwide.

Professor Dongare received his Ph.D. in materials science and engineering from the University of Virginia. His accomplishments include the prestigious National Research Council (NRC) Research Associateship Award from the U.S. Army Research Office for his postdoctoral research in 2007 as well as the National Science Foundation's (NSF) Faculty Early Career Development (CAREER) Award in 2015. ■

Professor Harold Brody Recognized for Teaching Excellence

MSE Distinguished Professor Harold Brody has been named the 2015 recipient of the Materials Science and Engineering Award for Teaching Excellence.



Distinguished Professor H. Brody

The University of Connecticut Materials Science and Engineering Award for Teaching Excellence is awarded to the MSE faculty member who receives the greatest number of votes from the MSE senior class. The award was created in order to recognize faculty members who have positively influenced students' academic, research, extracurricular, and personal development.

Seniors praised Professor Brody's ability to challenge them as both individuals and engineers. In their statements nominating him for the award, students noted that Dr. Brody is extremely knowledgeable and dedicated to his students and the materials field. One student reflected, "Dr. Brody forced us to go beyond our limits as students and engage in our work, strengthening us as students and preparing us for nothing but success in our future careers." ■

Dr. Mark Aindow Receives Outstanding Faculty Award

Dr. Mark Aindow, MSE Professor and Associate Director for the Institute of Materials Science (IMS) has been awarded the 2015 School of Engineering Outstanding Faculty Mentor Award.

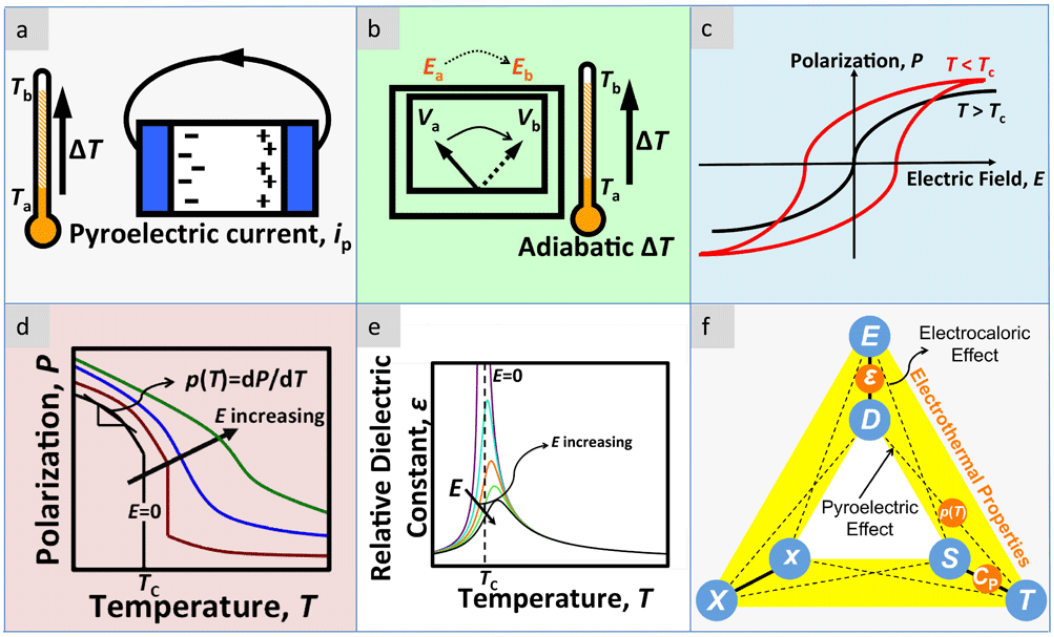
Professor Mark Aindow

This award recognizes faculty members who have shown an exceptional commitment to mentoring and advising other faculty, particularly junior colleagues. The School of Engineering considers mentoring other faculty members to be one of the most important contributions to the engineering community.

As the most recent recipient of this award, Dr. Aindow is dedicated to providing support and mentorship to the professional development of his fellow faculty members. With a Ph.D. in materials science and engineering from the University of Liverpool, two years of experience as a postdoctoral research fellow, experience as a past Royal Society/CAS Exchange Scholar and editor for the Journal of Materials Science, several years of experience as a professor, and now experience as the Associate Director for IMS, Dr. Aindow is an extraordinary resource for his colleagues. ■

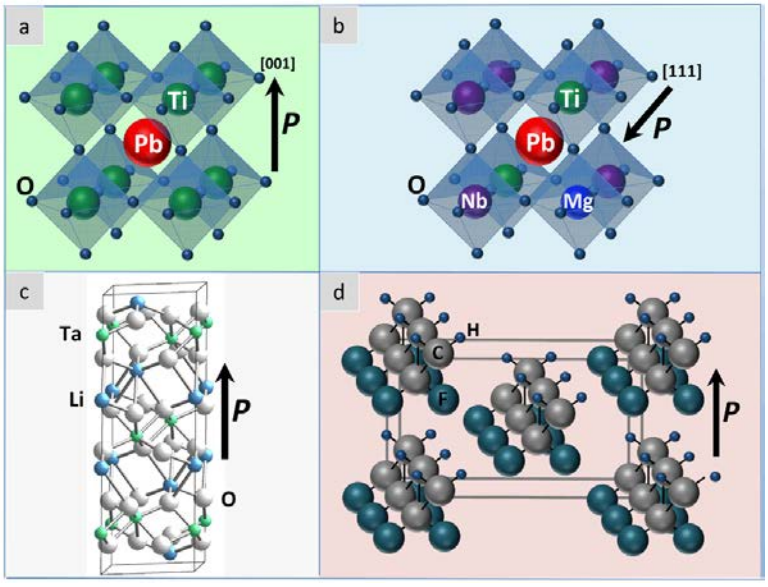
"Next-Generation Electrocaloric and Pyrocaloric Materials for Solid-State Electrothermal Interconversion" Featured in *MRS Bulletin*

MSE Department Head Professor S. Pamir Alpay, in conjunction with colleagues Dr. Joseph Mantese (MSE Industrial Advisory Board and United Technologies Research Fellow), Dr. Susan Trolier-McKinstry (Pennsylvania State University), Dr. Qiming Zhang (Pennsylvania State University), and Roger W. Whatmore (Imperial College London), has published an article in the *Materials Research Society (MRS) Bulletin*.



a. *Pyroelectric effect: a change in the temperature results in a variation in the polarization that generates a pyroelectric current.* **b.** *Electrocaloric effect: A change in the applied electric potential from Va to Vb generates an electric field change DE that results in an adiabatic temperature variation DT.* **c.** *Polarization (P) – applied electric field (E) response of a ferroelectric material above and below TC. Below TC, there is a hysteretic behavior associated with nucleation and growth of electrical domains.* **d.** *The variation of polarization with respect to an applied electric field E of a ferroelectric. The electric field destroys the phase transformation at TC.* **e.** *The change in the relative dielectric constant eR as a function of E. The lambda-type anomaly at TC is smeared with the application of theelectric field.* **f.** *The Heckmann diagram correlating applied stress s, applied electric field E, and temperature T in a ferroelectric material. D, S, e, eR, p, and CP are the dielectric displacement, entropy, strain, relative dielectric constant, pyroelectric coefficient, and heat capacity at constant pressure, respectively.*

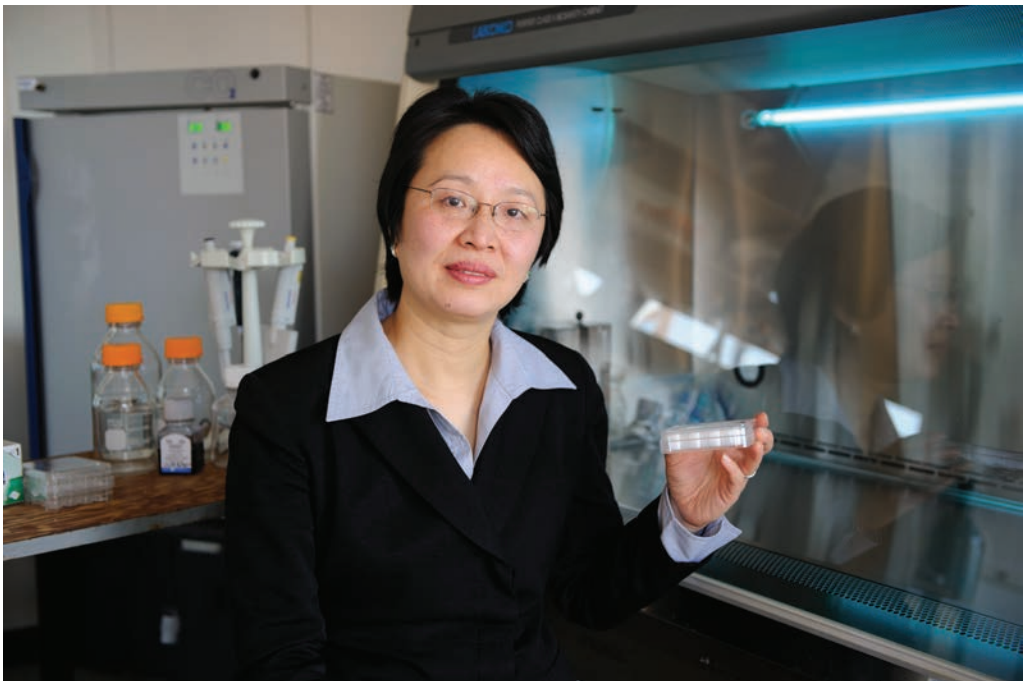
The paper, "Next-Generation Electrocaloric and Pyrocaloric Materials for Solid-State Electrothermal Interconversion," details thin-film electrocaloric and pyroelectric electrothermal interconversion energy sources that have recently emerged as viable and promising for solid-state cooling and power generation. These newer materials are favorable in the conversion of thermal to electrical energy because they support larger electric fields and therefore allow for operation at higher voltages. The authors provide an overview of current state-of-the-art materials, thermodynamic cycles, and future directions for electrothermal interconversion research. ■



Crystal structures of four most common pyroelectric materials:
a. *PbTiO3,*
b. *x·Pb(Mg1/3Nb2/3)O3-(1-x)·PbTiO3 (PMN-PT) in the rhombohedral phase,*
c. *LiTaO3, and*
d. *polyvinylidene difluoride(PVDF), -(C2H2F2)n-. The direction of the spontaneous polarization is also shown.*

Five Questions with Mei Wei

Professor Mei Wei (MSE/IMS/GEMS) joined UConn's Department of Materials Science and Engineering in 2002 as assistant professor. After receiving her Ph.D. from the University of New South Wales in Australia in 1998, she completed her postdoctoral study at Kyoto University Japan and at the Queensland University of Technology in Australia. Dr. Wei's current research focuses on fabrication of novel tissue engineering scaffolds for bone and osteochondral repair, biomimetic apatite coatings for bone repair and drug/protein carrier, synthesis of magnetic nanoparticles/nanoworms for contrast agent, cancer treatment and drug delivery, establishment of in vivo time-lapsed imaging platform for in situ visualization of cell-scaffold interplay, and development of dense apatite-polymer fiber absorbable composites as bone fixation devices.



Professor Mei Wei (Peter Morenus/UConn Photo)

The Connecticut Technology Council (CTC) named Dr. Wei one of the 2007 Women of Innovation for her contributions as an exceptional role model to future generations of female leaders in the STEM fields. In 2013 she was elected as a member of the Connecticut Academy of Science and Engineering (CASE) and also became Associate Dean for Research and Graduate Education in 2013. In 2015, she was appointed as the Associate Editor of the *Journal of Biomedical Materials Research Part A*, a major journal in the biomaterials field.

We sat down with Mei Wei to talk about her experiences as a professor, her role as Associate Dean, and her reaction to receiving the Women of Innovation award.

How did you become involved in materials science & engineering and why did you decide to become a professor?

I followed the footsteps of my parents, both of whom are professors in materials science and engineering. With a special interest in medicine, I decided to work on biomaterials.

In 2007 you received the Women of Innovation award. What has been your experience as a woman in a science, technology, engineering, and math (STEM) field?

Women are still the minority in engineering, although the percentage of women in engineering has been increasing in the past few years. Many of our female faculty members were the first females in their departments. Traditionally, it is believed that engineering is a male-only field. However, more and more women have proved to society that women can be successful in engineering. This is an important message to be sent to the community and to the young female students to encourage young talented minds to pursue STEM studies.

Why did you decide to take on the demanding role of Associate Dean for Research and Graduate Education?

As a senior female faculty member in engineering, I feel the responsibility to help the junior faculty and graduate students, especially the female faculty and students. A large proportion of my duty as the Associate Dean for Research and Graduate Education is devoted to mentoring junior faculty and graduate students. We would like to create a nurturing and friendly environment for faculty and students to conduct research and study.

What advice can you offer to students who are pursuing a career in materials science and engineering?

Materials science and engineering is an area full of potential and promises. The study and research may not always go smoothly. Be persistent and you will see a bright future. ■

For more information on Professor Wei's research please visit: http://weilaboratory.engr.uconn.edu/.

MSE Alumni Feature: Brian Gardener

Not many students can say that their education has taken them around the world. But for MSE alumnus Brian Gardener, what started out as a college hobby turned into a goal to climb the seven highest mountains in the world.

Alumnus Brian Gardener (right) on Mount Kilimanjaro

Brian graduated as a member of the MSE class of 2009. "My experience in MSE was excellent," he reflects. "UConn has a big school feel to it, but as a small program, the department provided a nice feel of personal care." Since graduation, Brian has been living in Providence, Rhode Island. He works as a technical sales specialist at Checon Corporation, a company that manufactures electrical components.

In college, Brian would ski most weekends during the winter ski season. While pursuing his career, he has had the opportunity to take his hobby to the next level, travelling around the world to ski climb France, Switzerland, and Italy. Brian climbed Mount Rainier in June 2014 and Mont Blanc in September 2014, the tallest mountain in the Alps. "Without a question, Chamonix was the most 'magazine picture worthy' region that I have been to so far," Brian states on his Mont Blanc experience. This past February, Brian spent ten days in Tanzania climbing Kilimanjaro with his father, and he climbed Pico De Orizaba in Mexico with a friend in March.

This November, Brian plans to venture to Ecuador to climb Cotopaxi and Chimborazo, the latter of which is the farthest land point from the center of the earth. In May 2016, Brian plans to climb Mount McKinley, the tallest mountain peak in North America and one of the coldest mountains on the planet. In the future, Brian hopes to summit Everest as part of his goal to climb the seven summits, the highest mountains on each continent.

Brian's favorite quote is attributed to mountaineer Ed Viesturs: "Getting to the top is optional, getting back down is mandatory." Brian reflects, "How I view that is, you have to be okay with turning around and coming back later for another attempt. It's all about challenging yourself and setting new personal records." ■

Check out Brian's YouTube channel for videos from his climbing adventures!

MSE Alumnus Dr. D. Maddala Receives ASM Emerging Professional Achievement Award

Dr. Dharma Maddala

MSE alumnus Dr. Dharma Maddala has recently been named a recipient of the ASM Emerging Professional Achievement Award. Dr. Maddala received his Ph.D. from UConn MSE in 2011. His dissertation research focused on the wear behavior of metallic glasses and his knowledge of metallurgy led him to a senior scientist position in the engineered surfaces group at ALCOA's Technology Center in New Kensington, PA. Earlier this year, Dr. Maddala was promoted to staff surface scientist. In addition to his materials work, he also serves as the chair of the ASM Pittsburgh Chapter, a chapter of the world's largest association of metals-centric materials scientists and engineers. The ASM Emerging Professional Achievement Award recognizes outstanding young ASM members who have made significant contributions to ASM International through dedicated service to the organization. ■

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Department of Materials Science & Engineering
97 North Eagleville Road, Unit 3136
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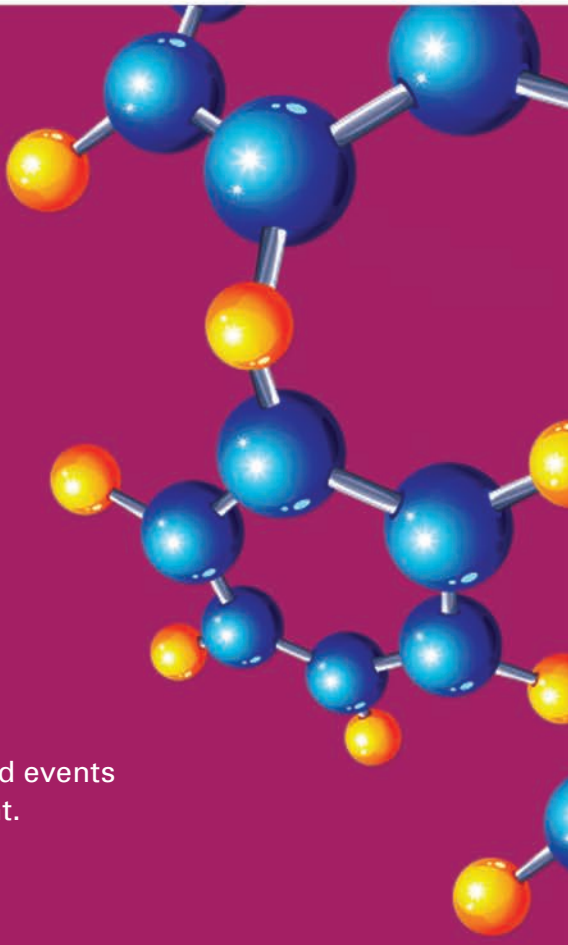

Stay informed about ongoing news and events happening at UConn's MSE Department.

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