MaterialsWorld

UF DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING | FALL 2014

CELEBRATING PAUL HOLLOWAY

BIODEGRADABLE ORTHOPEDIC IMPLANTS

REINVENTING UNDERGRADUATE LABORATORIES

UF | UNIVERSITY of FLORIDA

Chair's Message

DEAR FRIENDS

The beginning of the Fall semester is always an exciting time on campus. We see the thousands of new students, both undergraduate and graduate, who bring their dreams and ambitions to campus. This reminds us as faculty and staff of the great responsibility and privilege we have in helping these students to realize these dreams.

We also welcome back our returning students, many of whom have spent the summer on an internship or at another university. I am constantly amazed at the transformational power such experiences have in enhancing the students intellectually and in increasing their confidence. Also, in a number of cases they return with a job offer that will launch their careers.

The arrival of new faculty also opens up new and exciting possibilities for extending our research portfolio and enhancing our teaching. We have welcomed three new faculty members over the last year: Drs. Antonio Webb, Andreas Enqvist and Richard Hennig. They are profiled elsewhere in this Newsletter. Please join me in welcoming them to Gator Engineering.

The arrival of new faculty opens up exciting possibilities for **extending our research portfolio** and enhancing our teaching.

Also highlighted here are just a few of the recent accomplishments of our current students, our alums and our current faculty. The diversity and importance of these accomplishments speaks to the huge positive impacts that materials science and engineering and nuclear engineering have on our lives and those of our fellow citizens.

As I write this message we have just heard that Dr. Kent Fuchs, currently provost at Cornell University, has accepted the position as the 12th President of the University of Florida. He is an impressive individual, and also an engineer.

Finally, we are always delighted to hear from MSE and NE alumni. Drop us a line and let us know about your accomplishments and career developments. We look forward to celebrating you in future newsletter publications.

With Best Wishes,

Simon

ACKNOWLEDGMENTS

WRITING:
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MSE Faculty and Staff, Douglas Coats

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A pdf of this Newsletter is available at http://www.mse.ufl.edu/fall2014newsletter.

Celebrating **Paul Holloway**

Flanked by numerous friends and family members, Professor Paul Holloway was celebrated for 35 illustrious years on the faculty of the Department of Materials Science and Engineering.

A retirement party was held last November at the Harn Museum of Art in honor of his retirement. Attendees, which included longtime friends and colleagues of Paul and his wife Bette, took the opportunity to thank him and celebrate his accomplishments.

Most importantly, many of his family members were also present. These included his son and daughter-in-law Mike and Kathy and their children Amanda, Jacob and Nathan; daughter Kim; Paul's oldest brother, Stephen, and wife Brenda; and his youngest brother, Gene, and wife Myra, as well as Bette's niece, Susan. Paul's other son, Brian, and his wife Laura, joined in on the festivities from the UK via Facetime on an iPhone.

Despite being widely celebrated for his outstanding research, none of his research accomplishments tops Paul's list as his most important legacy, which he identifies as the more than 50 Ph.D. students he has mentored over the years. These students have gone on to illustrious careers after leaving Holloway's tutelage.

For example, one of his students, Phillip Russell, graduated from his research group in 1982, spent many years at North Carolina State University before returning to his undergraduate alma mater, Appalachian State University, where he is now a Distinguished Professor of Science Education and Physics. A more recent graduate from his group, Dr. Sean Jones, (featured elsewhere in this issue) is a senior policy analyst in the White House Office of Science and Technology Policy.

Holloway has long been a professional leader, most conspicuously in the American Vacuum Society (AVS). He was made an Honorary Member of the AVS in 1997, having previously served as president in 1987.

UF MSE member, Dr. Susan Sinnott, who was the 2013 AVS President, says that Holloway's major contributions to AVS include establishing the Plasma Science and Technology Division, which is currently one of the largest and most active divisions.

"He also worked to establish good relations between the society and AVS members and symposia attendees from China," Sinnott said.

Holloway's legacy in the AVS isn't solely focused on expanding the organization, however.

"It was during his Presidency that Paul's participation in the annual 5K run gained particular attention," Sinnott said. "All the presidents to follow were obliged to run the 5K and their performance judged against Paul's!"

In recognition of his service to the development of young talent, the Thin Films Division of the AVS instituted the Paul H. Holloway Young Investigator Award.

"Receiving the Paul H. Holloway Award, handed out by Paul himself, at the AVS meeting in Long Beach in 2013 was an important honor for me," said Linköping University's Dr. Per Eklund.

"The award stands out as distinguished peer recognition of actual achievements (not only potential or ideas) as a young researcher and is highly meritorious for me as an up-and-coming research leader."

"While Paul's research prominence is well-known to the community, we at UF also recognize his huge contributions to the department and university," MSE chair Simon Phillpot said. "When I joined MSE in 2003, I quickly learned that, while not the most vocal faculty member, Paul always represents a voice of thoughtful and compassionate reason."

"On so many occasions, his contribution to a difficult discussion has been decisive; crystallizing the issues and offering a thoughtful solution. I am delighted that he is still a strong presence in the department and that we continue to benefit from his wisdom and good humor."

The Holloway legacy continues. Most recently, a generous anonymous donor and the department have established an endowed scholarship named after Holloway and his wife. The Bette and Paul Holloway Scholarship Fund supports travel for both undergraduates and graduate students. "Bette and Paul recognize that there are valuable workshop opportunities for students in both technical areas and in the development of their broader professional skills that are currently not being met," Phillpot said.

Faculty Welcome

Welcome new MSE Faculty

PROFESSOR ANTONIO WEBB joined MSE in August 2013 as an assistant professor, after holding the same position in the biochemical engineering program at the University of Georgia for the prior two years.

Webb received his PhD in 2008 in biomedical engineering from Northwestern University. He then held a postdoc position from 2008-2011 at Northwestern, where he also launched a start-up company, VesselTek Biomedical.

His research interests include the development of biodegradable elastomeric biomaterials for applications in tissue engineering, regenerative medicine and medical devices. Webb said his research group is currently developing new types of drug-eluting stents that prevent blood clot formation. Working in medical-related research, Webb relishes having access to collaborators in that field at UF. He is member of the Biomedical Engineering Society and the American Heart Association.

PROFESSOR ANDREAS ENQVIST, armed with a strong interest in nuclear safeguards, joined the Nuclear Engineering program in late Fall 2013 as an assistant professor of nuclear engineering.

Enqvist received a Master of Science in physics in 2005 at Sweden's Gothenburg University. He then graduated with a PhD at the Department of Nuclear Engineering at Chalmers University of Technology in 2010, also in Sweden.

Gainesville was not his first experience in the U.S. though. Enqvist worked in a postdoc position from 2010 to 2013 at the University of Michigan Department of Nuclear Engineering and Radiological Sciences.

Enqvist is a strong believer in using problem solving in his teaching and says that interaction with students gets them to apply those skills.

Enqvist was the recipient of the Sigvard Eklund Prize for best nuclear PhD thesis in Sweden 2010. He is the faculty advisor of the UF chapter of the American Nuclear Society and a member of the Institute of Nuclear Materials Management. His research focus is nuclear safeguards, along with materials control and accountability, centered on the detection statistics of radiation from fissile materials, and the physics underpinning particle-detector interactions.

PROFESSOR RICHARD HENNIG arrived at UF in August 2014 to join the Materials Sciences and Engineering faculty. This wasn't his first time in Gainesville, though. Hennig had visited the city in the early 1990's and remembers the university bookstore and alligators.

This time around, Hennig was attracted to the department's existing expertise in computational materials science and the university's investment in high-performance computing.

Hennig received a Diplom in physics at Germany's University of Göttingen in 1997 and then his Ph.D. in physics from Washington University in St. Louis in 2000. He then held a postdoc position at Ohio State University. Hennig's most recent experience includes being a member of the MSE faculty at Cornell University from 2006-2014.

In the classroom, Hennig wants to guide his students to ask lots of questions and to be engaged in discussions. He also wants students to learn how important computation is.

His research includes computational materials science, structure prediction algorithms and two-dimensional materials. Hennig is the vice-chair of the computational materials science committee of The Minerals, Metals and Materials Society.

Faculty Awards

SEMI AWARD WINNER

In Spring of 2014 **DR. KEVIN JONES** was awarded the 2013 SEMI award for North America, the highest honor from the global industry association Semiconductor Equipment and Materials International (SEMI). He and Dr. Mark Law (Professor of Electrical and Computer Engineering) were recognized for developing a flexible computer code in 1990 that modeled semiconductor fabrication processes. It later became a cornerstone for the modern era of computational modeling. Florida Object-Oriented Process Simulator (FLOOPS) is widely used for multi-dimensional modeling for advanced integrated circuit fabrication processes. Use of FLOOPS has enabled continued advances in complementary metal–oxide–semiconductor (CMOS) transistor performance. The 3-D nature of FLOOPS proved especially valuable as CMOS transistor design shifted from planar to multi-gate forms. Kevin is a Fellow of the Materials Research Society and IEEE.

R&D 100 AWARD WINNER

DR. KELLY JORDAN and his partners at Adelphi have won a 2013 R&D 100 Award for the "High Flux Neutron Source" beam instrument. They developed a microwave-driven neutron generator that uses the deuteron-deuteron fusion reaction to provide high fluxes of fast neutrons to small samples of nuclear materials. Such active analysis is particularly useful for determining the material components of nuclear materials. Previously, samples were required to be placed a distance from the neutron source emitter where the flux of the fast neutron was small. The new generator improves the situation by positioning the sample to be irradiated in the acceleration chamber next to the high voltage target that is producing the fast neutrons. Small laboratories can now have neutron fluxes at a fraction of the current cost.

AVS PRESIDENT

DR. SUSAN SINNOTT was the 2013 President of the American Vacuum Society (AVS). AVS is an eclectic society, with divisions, groups, and geographically distributed chapters. During her term as President, Susan increased communication among the various distributed branches of the Society and extended the society's electronic footprint. The AVS also approved a new membership category for technology professionals who will be able to make use of the member benefits available on the upgraded website. Importantly, the number of AVS student chapters grew by 55% in 2013! The AVS now has more opportunities to engage the next generation of scientists and engineers through the student chapters. She was also named a Fellow at the 2013 meeting of the American Physical Society. In addition, Susan is a fellow of the Materials Research Society, the American Ceramics Society, AVS, and the American Association for the Advancement of Science.

BRADLEY STOUGHTON AWARD

DR. MICHELE MANUEL was awarded the 2013 Bradley Stoughton Award for Young Teachers. This award, given by ASM, was established in 1952 to recognize early career educators in the fields of materials science, materials engineering, design and processing for their ability to impart knowledge and enthusiasm to students. She was also awarded the AVS Recognition in Leadership. The AVS states the purpose of this recognition as "... to recognize individuals who not only excel in science and/or engineering, but who also, through mentoring, have enhanced the careers of future generations who might not otherwise have considered or had access to opportunities in science, engineering, and technology. Their leadership in the effort to develop fully the world's human resources is critical to the best scientific and engineering progress." Michele also received the TMS Early Career Award for 2014. This award recognizes an assistant professor for technical accomplishments, for advancing the academic institution where employed, and for broadening the technological profile of TMS.

PROMOTIONS

Laurie Gower to Professor
Kelly Jordan to Associate Professor with tenure
Jiangeng Xue to Professor
Michele Manuel to Associate Professor with tenure

Michele Manuel develops **biodegradable implants**

Ask anyone who has a surgical pin in their body, and they likely will tell you they wish it would just go away.

In the future, it just might, with help from research by Michele Manuel, an associate professor of MSE.

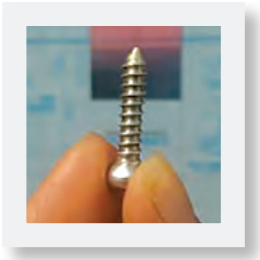
Manuel has developed a surgical pin made from magnesium and is working to control the rate at which the pin degrades in the body. In laboratory tests, the pin offers several advantages over the plastic and stainless steel or titanium pins currently used.

"We don't always want to put in a metal implant and leave it there forever," Manuel said. "The idea with this pin is that it would dissolve over time, and after it's finished, your body is basically in the same state it was before you had an injury.

"Everybody knows someone who has an implant in their body that they wish wasn't there," Manuel said. "Surgical pins don't have to become permanent fixtures in the body."

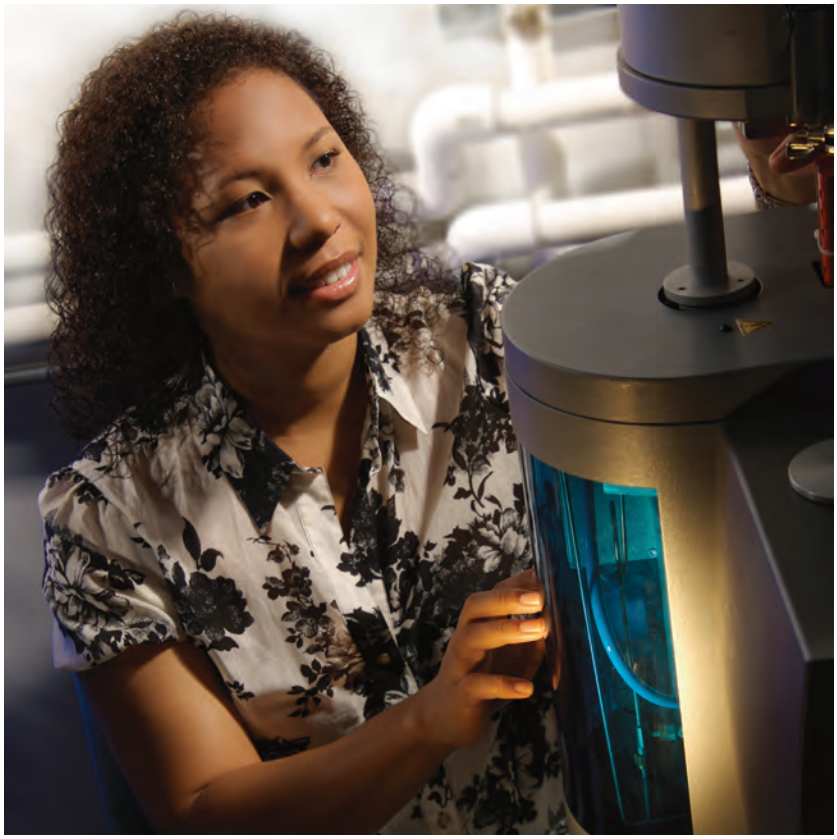
The pin not only biodegrades, but also aids healing. Magnesium builds bone, so it can function both as a pin and as a nutrient.

"You have to have magnesium to live, and many people take magnesium supplements," Manuel said. "So this is a good orthopedic application. It's not only an implant that serves a medical need in terms of fixing bones, it's also serving a nutritional need as well, so that's why you see a lot of activity in the surrounding tissue."



The use of magnesium isn't new, Manuel said. More than a century ago, physicians experimented with magnesium implants but ran into problems because magnesium produces hydrogen as it breaks down, which creates hydrogen gas bubbles under the skin that are clearly visible. Doctors of the era tried to remove the hydrogen gas with syringes but eventually gave up until new, improved metals were developed.

The trick to using magnesium, Manuel said, is controlling the rate at which it breaks down to give the body time to absorb the hydrogen.



"Your body can handle the hydrogen, just not in such large doses that pockets form," Manuel said. "So if we can slow down how fast the magnesium degrades so it releases hydrogen more slowly, the body would take up the hydrogen the way it would take up any other gas and release it."

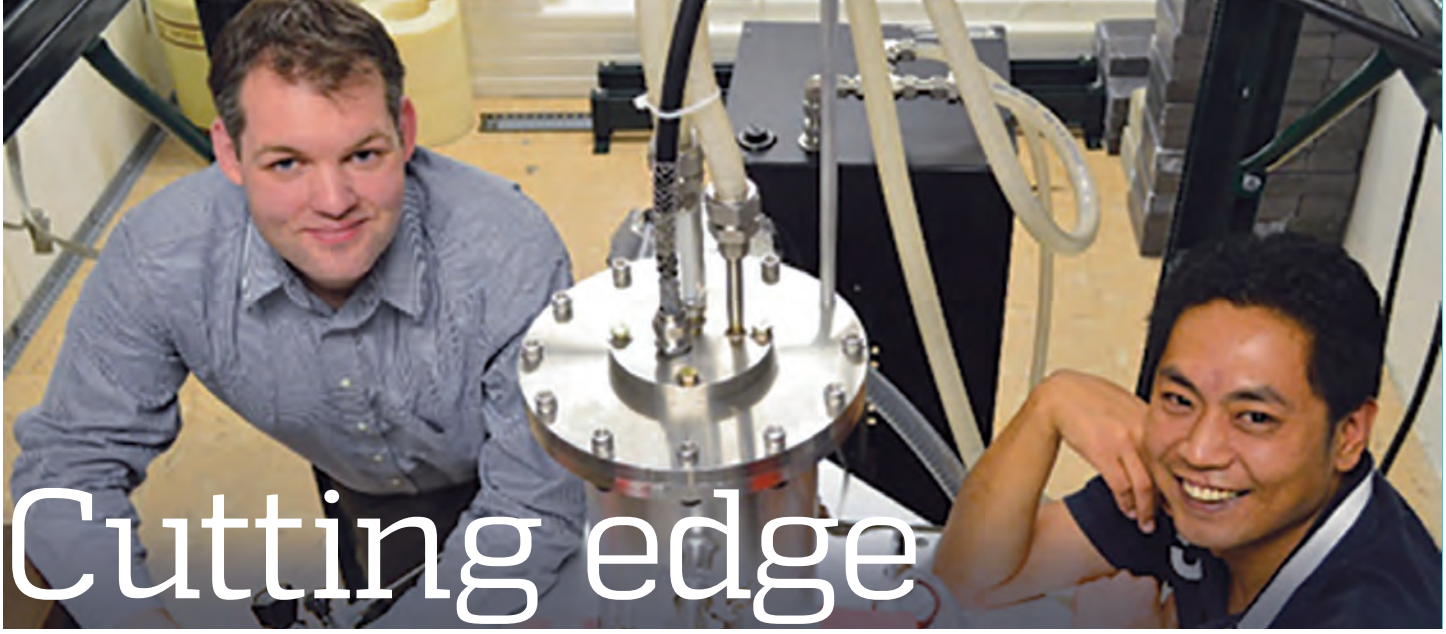
In lab tests, Manuel has compared the magnesium pin with clinical implant materials. Surgical pins are shaped like screws, so in addition to controlling the rate at which the magnesium breaks down, Manuel is trying to determine how much torque can be applied before the screw is stripped.

In lab tests, the magnesium pin has been inserted into the tibia of rats. X-rays show the rate at which the magnesium pins dissolve, and at six weeks the new bone is indistinguishable from the bone before the break.

Another use of the magnesium could be as a coating for an implant to promote bone growth.

As Manuel's research continues, entrepreneurs at UF's Innovation Hub are keeping watch, with an eye toward bringing the technology to market.

"People who have sensitivity to metal or inflammation from a foreign material in the body could benefit from this," Manuel said. "There are a lot of different applications that could be possible."



Cutting edge

Nuclear Engineering Program

The inception of nuclear engineering at UF dates back to March 1951, when UF held an Engineering and Radiological Health and Civil Defense Conference. The University of Florida Training Reactor (UFTR) went critical in May 1959. Nuclear Engineering at UF has continually evolved to educate nuclear engineers and perform cutting-edge nuclear research for almost 60 years. Over the past decade, the program (formerly known at the Nuclear and Radiological Engineering Department) has continued to improve in terms of quality and number of students, research funding, facilities and laboratories. The growth has created new challenges in meeting infrastructure, facilities/laboratories and personnel requirements. The program was reconfigured in May 2011 to take advantage of current trends in the discipline and to leverage strengths in the College of Engineering. The Medical Physics Graduate Program joined the Department of Biomedical Engineering. The Nuclear Engineering Program (NEP) is now integrated into the Department of Materials Science and Engineering (MSE), which has strengths in nuclear materials. In June 2014, Dr. James Baciak was appointed Director of NEP.

Throughout the changes in the organization of the program, enrollment has remained strong. The number of undergraduates continues to remain steady at around 100-110 students (roughly 20-30 students per year). The graduate enrollment is growing. In Fall 2011, we had 12 students enrolled in our graduate program (MS and PhD students). In Fall 2012, we has 19 students, and this past Fall semester (2014) we had 23 students enrolled. It is expected that the number of graduate students over the next 2-5 years will continue to grow. We anticipate our graduate student enrollment at the beginning of the Fall 2015 semester to be 30 students (based on projections in funding), with a goal that we have 40-50 graduate students in Fall 2020. NEP has excellent institutional support, and in the past 30 months we have recruited and hired 3 excellent faculty members. Moreover at the end of October, Dr. Leigh Winfrey, currently at Virginia Tech., accepted our offer to come to UF. She will join the program as an associate professor in December 2014.

The Nuclear Engineering Program's laboratory facilities have grown by 50% over the past year, as new capabilities have come on-line. These new capabilities enhance our particular strengths in nuclear materials, radiation detection and measurement systems, and reactor physics. The established laboratories function to provide education and research opportunities for students, and include: 1) The Advanced Radiation Detection Laboratory with the mission to develop new neutron and gamma-ray detection instrumentation; 2) the Fast Neutron Irradiation Facility, a new D-D neutron generator facility for materials investigation (recipient of an R&D 100 Award in 2013); 3) the Nuclear Materials Laboratory which investigates the effects of nuclear reactor environments on new materials; 4) the Advanced Nuclear Fuels Laboratory which develops new nuclear reactor fuels with improved performance characteristics; 5) the X-Ray Backscatter Imaging Laboratory for non-destructive testing and evaluation of materials and structures; and 6) The University of Florida Training Reactor (UFTR) which is a 100 kW Argonaut-type research reactor. In 2006, with assistance from the DOE Reduced Enrichment for Research and Test Reactors Program, we successfully completed the conversion of the UFTR nuclear fuel from high-enriched to low-enriched uranium. Currently, with major funding and investment from multiple industrial partners, we are completing the installation of a fully digital control system for the UFTR, and completing the re-licensing of the reactor (with the expectation of being fully operational in 2015). Efforts are underway to build new experimental workstations at the different ports of the UFTR and expand the research capabilities of the facility.

Over the past 2 years, the Nuclear Engineering Program and its 5 primary faculty have been able to secure nearly $10 million in externally funded research and grant awards from a wide range of sources, including the Department of Energy – Office of Nuclear Energy, Department of Energy – National Nuclear Security Administration, Defense Threat Reduction Agency, Nuclear Regulatory Commission, Department of Homeland Security – Domestic Nuclear Detection Office, multiple national laboratories and industrial partners. We have growing research collaborations with multiple domestic and international universities, and a growing presence in a number of professional organizations and scientific conferences.

The next several years in the Nuclear Engineering Program will be exciting as we grow to become a top nuclear engineering program in the United States!

Faculty Spotlight

MSE has **world class faculty** and leading research experts

1. Cammy R. Abernathy
Professor & Dean of Engineering
Ph.D. Stanford
Synthesis of thin-film electronic materials and devices using metal organic chemical vapor deposition and molecular beam epitaxy

2. Josephine Allen
Assistant Professor
Ph.D. Northwestern University
Biomaterials, drug delivery, cell-material interactions, stem cell differentiation, tissue engineering and regenerative medicine

3. Jennifer Andrew
Assistant Professor
Ph.D. University of California Santa Barbara
Functional nanomaterials, polymer-inorganic composites for disease diagnosis, simple tests for many diseases, including cancer and tuberculosis

4. James (Jim) Baciak
Florida Power and Light Professor and Nuclear Engineering, Associate Chair and Nuclear Engineering Program Director
Ph.D. University of Michigan
Radiation detection and measurements, nuclear non-proliferation and safeguards, new radiation detection materials, non-destructive testing, radiation imaging, environmental sampling

5. Christopher Batich
Vladimir A. Grodsky Professor
Ph.D. Rutgers University
Biomaterials and drug delivery, materials for gene delivery, polymers for treating cancer, tissue regeneration

6. Anthony Brennan
Margaret A. Ross Professor
Ph.D. Virginia Polytechnic Institute & State University
Antifouling, bioadhesion, designed interfaces, directed cell responses, tissue engineering

7. Jon Dobson
Professor
Ph.D. Swiss Federal Institute of Technology, ETH – Zurich
Nanoparticle-based biomedical applications, magnetic iron biomineralization and neurodegenerative disease, biomedical/biomagnetic devices

8. Elliot Douglas
Associate Professor & Dean's Fellow for Engineering Education
Ph.D. University of Massachusetts – Amherst
Engineering problem solving, critical thinking, active learning

9. Edward Dugan
Assistant Director of Nuclear Engineering Program
Ph.D. University of Florida
X-ray backscatter imaging, reactor analysis, nuclear power plant dynamics and control, space nuclear power and propulsion, radiation transport and Monte Carlo simulations, radiographic imaging techniques applied to non-destructive examination

10. Andreas Enqvist
Assistant Professor
Ph.D. Chalmers University of Technology, Sweden
Nuclear safeguards/materials control and accountability, detection statistics of radiation from fissile materials and physics behind particle-detector interactions

11. Gerhard Fuchs
Associate Professor
Ph.D. Rensselaer Polytechnic Institute
High temperature materials, coatings/environmental resistance, nuclear materials, computational materials science, industry driven

12. Katherin Goluoglu
Lecturer
M.S. University of Tennessee
Nuclear criticality safety, facility safety, safeguards and security

13. Sedat Goluoglu
Professor
Ph.D. University of Tennessee
High performance computing, nuclear criticality safety, neutron and gamma cross section processing, time-dependent transport, reactor physics, Monte Carlo transport, nuclear safeguards and security

14. Laurie Gower
Professor
Ph.D. University of Massachusetts – Amherst
Biomineralization-formation of bones, teeth, shells; biomimetic processing of organic-inorganic hybrid materials, biomimetic bone substitutes and repair of dental lesions, pathological biomineralization, electroactive peptide linkers for biosensors and dynamic patterning

15. Richard Hennig
Associate Professor
Ph.D. Washington University
Computational materials science, ab-initio methods, structure prediction algorithms, two-dimensional materials, materials for energy technologies, solid-liquid interfaces

16. Paul Holloway
Verink Professor of Materials Science Emeritus
Ph.D. Rensselaer Polytechnic Institute
Photonic and electronic materials. luminescent materials, colloidal nanoparticles, surface science and analysis, thin films

17. Kevin Jones
Frederick N. Rhines Professor
Ph.D. University of California Berkeley
Semiconductor processing, structure property relationships in devices, advanced microelectronics fabrication, anodes for Li ion batteries

18. Kelly Jordan
Associate Professor, Director of the University of Florida Training Reactor

Ph.D. University of California Berkeley
Experimental reactor physics, Monte Carlo methods development, radiation measurement techniques, non-proliferation and nuclear security

19. Michele Manuel
Associate Professor
Ph.D. Northwestern University
Design, metallurgy, medical technology, materials under extreme environments

20. Jack Mecholsky
Professor
Ph.D. Catholic University of America
Fracture of brittle materials, fractal geometry and fracture, quantitative fractography, mechanical behavior of biomaterials

21. Brij Moudgil
Distinguished Professor
Ph.D. Columbia University
Engineered particles and greener surfactant and polymer systems for applications in minerals, chemicals and microelectronics, biomedical, advanced materials and agricultural industries

22. Juan Nino
Professor
Ph.D. Pennsylvania State University
Materials development for energy-related applications and investigation of structure-property relationships in active ceramics

23. David Norton
Professor and Vice President for Research
Ph.D. Louisiana State University
Electronic, photonic, and magnetic thin film materials; electronic oxide materials; thin film deposition

24. Steve Pearton
Distinguished Professor & Alumni Professor of Materials Science
Ph.D. University of Tasmania, Australia
Semiconductors, device processing, LEDS, transistors, sensors

25. Scott Perry
Professor
Ph.D. University of Texas at Austin
Materials interfaces, fundamentals of friction and lubrication, atomic scale wear, hydrogel surface properties

26. Simon Phillpot
Professor & Chair
Ph.D. University of Florida
Computational materials science, phonon-mediated heat transport, ferroelectrics and dielectrics, nuclear fuel, simulation methodologies

27. Nancy Ruzycki
Lecturer & Director of Undergraduate Laboratories
Ph.D. Tulane University
Engineering education, characterization techniques, surface physics, solid state devices, dye-sensitized solar cells

28. Wolfgang Sigmund
Professor
Ph.D. Johannes Gutenberg University of Mainz, Germany
Photolysis and photocatalysis, surface science and quantum levitation, electronic biomaterials, processing of ceramic materials, colloids and nanomaterials

29. Rajiv Singh
Professor
Ph.D. North Carolina State University
Advanced semiconductor manufacturing, processing and application of super hard materials, engineered substrates

30. Susan Sinnott
Alumni Professor of Materials Science
Ph.D. Iowa State University
Polymer metallization through plasma surface treatment, surface chemistry and catalysis, oxidation of metal nitrides, metal-ferroelectric material interfaces, nuclear fuel material microstructures, alloys for extreme environments, friction, nanomaterials

31. Franky So
Rolf E. Hummel Professor of Electronic Materials & Associate Chair for Research
Ph.D. University of Southern California
Organic electronic materials and devices, device physics, carrier transports and carrier recombination dynamics, device processing, OLEDs, photovoltaics and sensors, quantum dots and nanoparticles synthesis and devices

32. Henry Sodano
Associate Professor
Ph.D. Virginia Polytechnic Institute & State University
Functionally graded materials and interfaces, ferroelectric and dielectric materials, nanomaterials synthesis, sensor development, energy harvesting from nanostructures, self-healing polymers

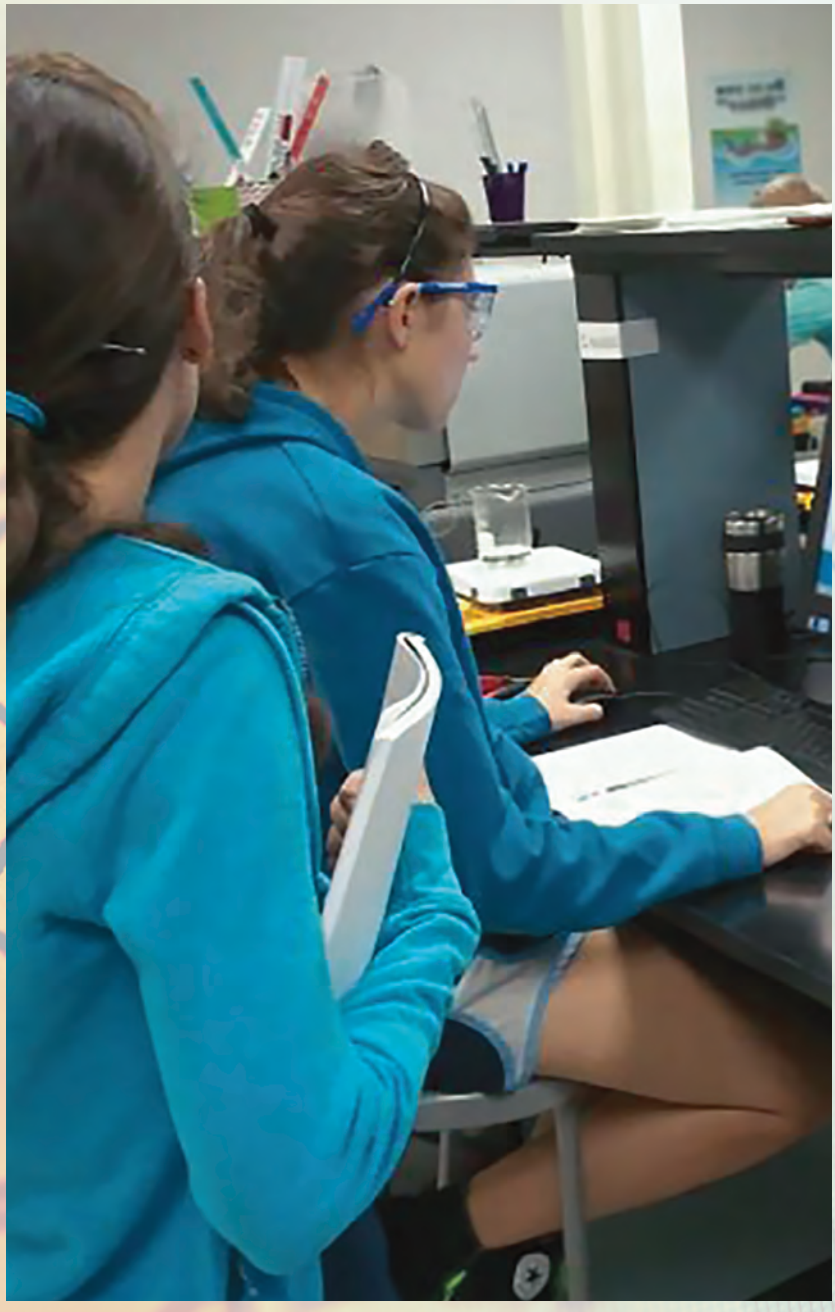
33. James Tulenko
Emeritus Professor
M.S. Massachusetts Institute of Technology
Nuclear fuel, nuclear waste management, nuclear fuel processing, nuclear spent fuel storage, nuclear fuel cycles

34. Antonio Webb
Assistant Professor
Ph.D. Northwestern University
Elastomeric biomaterials, drug delivery, medical devices, tissue engineering/regenerative medicine, entrepreneurship, translational research

35. Jiangeng Xue
Professor
Ph.D. Princeton
Organic electronic materials, organic-inorganic hybrid materials, photovoltaics and light-emitting devices, nanostructures and energy materials, surfaces and interfaces

36. Yong Yang
Assistant Professor
Ph.D. University of Wisconsin – Madison
Radiation damage, aging management of light water reactors, advanced cladding and fuel materials, corrosion in nuclear reactors

Reinventing
Undergraduate Laboratories



COMMUNICATION, CREATIVITY, TEAMWORK. These are just three of the objectives laid out by the new curriculum in the UF Department of Materials Science & Engineering to better serve student learning outcomes. The other objectives involve: instrumentation, models, experiment, data analysis, design, learning from failure, psychomotor learning, safety, ethics in the lab and sensory awareness.

With the hiring of Dr. Nancy Ruzycki as faculty lecturer and director of the undergraduate laboratories in March 2013, the department has begun to reinvent the undergraduate laboratory experience. The 2013 fall semester junior class completed the first round of labs under the new curriculum.

Under the main mission of student teaching, each lab is a multi-week exploration for students, where core fundamental concepts from their coursework are applied to a project. Each week, students discuss and present findings from their work, refine their work and at the end of the lab, create some type of professional student product.

All of the labs involve a set of collaborative student projects, which reflect the application of conceptual learning. Projects in the fall ranged from designing a LabVIEW software program to measure and understand the temperature response of materials, to analysis of polymeric materials, to determining the relationship between heat treatment, microstructure and mechanical properties of brass alloys. For the spring semester projects, students conducted case studies in failure analysis, competed in a ceramic dielectric materials challenge and created phase diagrams for an alloy by conducting phase transformation experiments.

The lab projects in the fall semester are carefully aligned with junior course work on metals, ceramics, polymers and principles of materials thermodynamics. Spring labs are aligned with

the coursework in electronic materials, characterization and materials kinetics.

"None of our labs are 'cookbook' recipes," said Tara Scott, an MSE senior from Oviedo. "Sometimes we don't know what is going to happen or how our procedure will change throughout the process in order to make up for any unexpected lurking variables."

In one project, a group of three that included Scott researched how to process a ceramic pellet with the best dielectric constant. The dielectric constant is directly related to the ability of a material to hold charge for electronic applications, Scott said.

"Each team required a budget, experimental design and weekly reports to record the research process. Winning teams at different frequencies received extra credit," Scott explained. "Sadly, our group did not win, but we ended up with a great presentation."

With any group project, communication is vital and is a critical component of the evaluation. As Dr. Ruzycki says, "student products are reflective of professional communication that engineers are expected to use in either an industrial or academic career."

Of course, to fulfill the curriculum's objectives, proper modern equipment is needed. The department has begun a major investment in the acquisition of tools, instrumentation and equipment necessary to provide students with access to state-of-the-art materials characterization tools.

The most impactful recent acquisition has been a cutting-edge desktop Scanning Electron Microscope (SEM) with Energy Dispersive Spectroscopy. As Ruzycki describes it, "while deceptively simple to operate, this SEM allows undergraduate students to characterize materials with the same level of sophistication as professional engineers. Seeing the surface of a material with near atomic-scale resolution has a truly transformational impact on student understanding." Other recent acquisitions include an X-Ray Diffractometer and high-level microscopes. Instrument data acquisition units were also purchased for real-time data logging.

The students in the lab were extremely receptive to the technology available to them.

"Lab equipment helps turn PowerPoint lectures into real-life applications," Scott said. "My favorite equipment to use is definitely the SEM. The machine can provide upwards of 100,000x magnification, better than any optical microscope available."

Since the labs incorporate multiple courses for its content, other faculty members have been involved in the work. Professors Anthony Brennan and Jennifer Andrew have provided access to and use of Differential Scanning Calorimetry and Fourier Transform Infrared Spectroscopy.

"Materials Engineering often requires the use of analytical equipment," Justin Dansbury, an MSE senior from Merritt Island said. "The Phenom desktop scanning electron microscope used in the laboratory taught students the fundamentals of SEM by a hands-on approach."

"These are real pieces of equipment that we will know how to use before getting to graduate school or into industry," Scott said.

Not only do the lab students have access to high-end equipment during regular class hours, but they also have access to it outside teaching hours. This lets the students further hone their skills and become more highly trained.

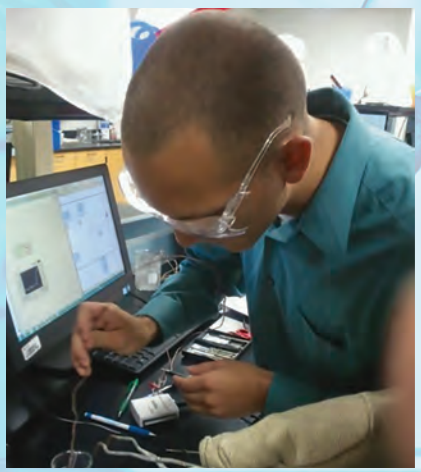
This philosophy has already paid dividends for the department. In the past year, more than 10 undergraduate student publications or conference posters have resulted from research conducted on equipment within the undergraduate laboratories.

As part of the lab design, students learn to use skills and techniques like an engineer – in the context of the problem-solving process to collect information and confirm or challenge models.

Ruzycki's background was well-suited to the lab director position and to lead through teaching and problem solving. She came to the department having performed work in modeling physics instruction. Additionally, she has experience as a STEM instructional specialist with the Florida Department of Education.

"The laboratory learning experience was greatly enhanced because of Dr. Ruzycki's efforts," said Dansbury, who has already had experience working with Boeing. "The high level of expectation in regard to collaborative critical thinking, required in many industries, will have a profound effect on our professional careers."

In addition to the junior materials science lab, other lab courses were revamped as well. These included the electronic materials laboratory, where the lab was aligned to the companion class in semiconductor processing, and the senior ceramics processing laboratory, where a corporate sponsor has students working on a research project for a ceramic dielectric; this is aligned with the students' senior ceramic processing course.



"Seeing the surface of a material has a truly **transformational impact** on student understanding."

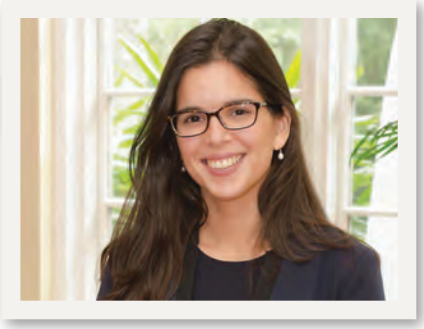
In the electronic materials laboratory, students go through all the steps of the fabrication and testing process for a silicon based device using UF's Nanoscale Research Facility laboratory.

The transformation is not complete, however. The undergraduate laboratory also is acquiring more equipment, including the donation of an SIS(Bruker) Nanos Atomic Probe Microscope, and a separate donation by emeritus professor, Dr. Paul Hollaway. This will help the development of more labs in characterization of electronic materials.

"Without a doubt, Dr. Ruzycki's class has helped me become a better engineer," Dansbury said. "After college, I plan on continuing my career with Boeing as a materials and processes engineer."

The critical importance of undergraduate laboratories in the development of future engineers and scientists is well established. Creating laboratory experiences that align with course work and reinforce concepts, skills and techniques critical to the success of future engineers and scientists is the expressed goal for Dr. Ruzycki's work. "We want to transform materials engineering education at the undergraduate level to create a 'New Engineer' who is confident in applying concepts to real world applications in order to design, create and innovate."

Student News



COMMENCEMENT SPEAKER

CLAUDIA SOTOMAYOR, a graduating MSE senior, was the Female Commencement Speaker at the 2014 Spring Engineering Graduation Ceremony. Her studies have focused on semiconductor physics, learning how chemical and electrical principles fuse together to create modern electronic devices. In the summer of 2011 the National Science Foundation Research Experiences for Undergraduates program allowed her to study the synthesis and characterization of geranium nanocrystals at the University of New Mexico in Albuquerque. The following year she interned at Micron Technology in Virginia for 8 months, conducting failure analysis investigations on integrated circuits using focused ion beams and transmission electron microscopes. Of the experience, Claudia says, "As part of my job I saw individual atoms in a perfect crystal lattice, and as an engineer and scientist one can only feel awe." She later completed another extended co-op at SpaceX in California, to help build and design today's most innovative rockets and space capsules. Claudia, who grew up in Cuba during the 1990s, hopes to use her skills to facilitate the technological advancement of humanity. Her love and respect for the engineering profession have instilled a sense of duty to the coming generations, to help them appreciate and understand science as a vessel for progress and even personal fulfillment. After graduation, Ms. Sotomayor moved to southern California to work at Semtech as a semiconductor failure analysis engineer.

TMS BOWL

THE UNIVERSITY OF FLORIDA WON THE TMS MATERIALS BOWL, beating 11 other university teams. The competition consisted of a "Jeopardy"-style trivia competition in single elimination rounds.

Team members were Glenn Bean, Hunter Henderson, Peter Feldtmann and Steven Chiu. Each team member was awarded $250, while the UF Materials Advantage chapter received $500.

LEWIS C. HOFFMAN SCHOLARSHIP AWARD

THE ELECTRONICS DIVISION OF THE AMERICAN CERAMIC SOCIETY has named UF MSE undergraduate student Clayton Cozzan the recipient of the 2013 Lewis C. Hoffman Scholarship Award "in recognition of his excellence in the classroom accompanied by many significant contributions to research, and for his excellent essay titled 'Creativity prevails at the nanoscale; dominant mechanisms, exciting applications, and the promising outlook for multi-functional electroceramics.'" The award was presented at the Electronic Materials and Applications 2014 conference in Orlando, an international meeting for engineers, scientists, and manufacturers interested in materials for electronics for energy and sensor applications. Clayton has also been awarded a prestigious National Science Foundation Graduate Research Fellowship. Clayton is currently a first year PhD student in Materials Science and Engineering at University of California, Santa Barbara

AMERICAN NUCLEAR SOCIETY DESIGN COMPETITION WINNERS

EVERY YEAR THE AMERICAN NUCLEAR SOCIETY holds a design competition to select the best student design projects. A panel of judges from industry reviews the submitted projects and selects two undergraduate teams and two graduate teams to make oral presentations in front of a second panel of judges at the society's Annual Meeting in Washington D.C. The team from the University of Florida won the 2013 graduate competition, ahead of the team from the University of Michigan. The Florida team, whose design project was "An Innovative Accident Tolerant UO_2 Composite Fuel for Use in LWRs," was represented by (left to right in photo) graduate students Andrew Cartas, Danny Permar and Jitesh Kuntawala; Professor James Tulenko was their graduate advisor.

Alumna Spotlight

Creativity, hard work and a little luck can go a long ways in the engineering world.

ELIZABETH DESTEPHENS, Vice President for Reserves & Corporate Development at California Resources Corporation, is proof of how much those attributes can benefit a career. A 2003 graduate of the UF Department of Materials Science and Engineering, DeStephens went from being denied interviews to being the highest ranking technical woman at a multi-billion dollar organization.

The UF Career Resource Center had arranged for students to submit their resumes to the center's website. Prospective employers would then pick from this pool to interview for jobs and internships. DeStephens, who attended high school at the prestigious North Carolina School of Science and Math, was not chosen.

Instead of giving up on pursuing her interests, DeStephens made sure that industry was aware of her abilities. Fortunately, a university-wide career fair was coming soon.

"I researched each company, attended the info sessions, asked a couple of informed questions, handed the recruiters a copy of my resume, and told them why I thought I'd be a good fit for a specific job within their company," she told Materials World. "Most were able to fit me in for interviews during the Career Fair, and I received several offers."

One of those offers was from ExxonMobil – the world's largest publicly traded international oil and gas company.

DeStephens began her career at the company as a corrosion engineer and a natural gas business analyst. Subsequently, she was vice president of acquisitions & divestitures at Raymond James & Associates and a senior reservoir engineer with Ryder Scott Company, where she advised on Securities Exchange Commission compliance, as well as oil and gas asset valuations around the world. She then worked for Occidental Petroleum in an acquisitions and divestitures capacity.

Recently, she accepted an executive position with Occidental's spin off, California Resources Corporation. In her current role, DeStephens is responsible for leading the company's estimation of oil and gas reserves reported annually to the Securities and Exchange Commission.

Since graduating from UF, she also has earned a master's degree in petroleum engineering from the University of Houston, has become a licensed Petroleum Professional Engineer (P.E.) in Texas, and will complete an MBA from the Massachusetts Institute of Technology in 2015.

"MSE faculty and courses challenged me to **think and be creative.**"

Despite her incredibly dynamic and demanding work, DeStephens still makes time to give back to both her profession and her community. She was the Chair of the Society of Petroleum Engineers (SPE) Licensing and Registration Subcommittee, which writes the P.E. licensing exam and volunteers for numerous industry-related student events. She regularly speaks at area universities on resume writing, interviewing, and professionalism.

On the community end, DeStephens serves on the Board of Directors of Classroom Champions, a nonprofit organization that connects Olympian/Paralympian mentors with underserved classrooms. She is also a member of the Houston Gator Club, life member of the UFAA, past UFAA Region 8 Young Alumni Representative, and member of the Department of Materials Science Engineering Advisory Council.

DeStephens has learned to give full attention to whichever task is at hand.

"I've learned to say 'no,' understand my limitations and prioritize the organizations, events and activities which are most important to me. When I'm working on a task, I eliminate all distractions. I will turn off my phone, close my Web browser, and shut off email notifications. I also start each day by writing out a list of attainable goals for that day, which link into longer-term objectives."

Such a successful career and heavy community involvement stems from her experience in MSE.

"MSE prepared me for my career in two main ways. I'd say the biggest benefit was that the MSE faculty and courses challenged me to think and be creative. Unlike other degrees that require a high degree of memorization, the undergrad degree in MSE encouraged independent thinking, lots of group work, writing, presenting and creative problem solving."

Her advice to current MSE students? "Ask lots of questions and put yourself into learning and discovery situations where you are uncomfortable. It's OK to try and fail. I've failed more times than I can count."

"Accept the failure, move forward, and improve."

Outstanding **Alumni**

At the end of year banquet in April 2014, the department recognized two individuals for their outstanding accomplishments and as role models:

2014 DISTINGUISHED MSE ALUMNUS

DR. SEAN JONES, *Senior Policy Analyst, White House Office of Science and Technology Policy*

Dr. Sean L. Jones is a Senior Policy Analyst with the White House Office of Science and Technology Policy (OSTP) on detail from the National Science Foundation (NSF). His OSTP portfolio includes graduate education reform, grant reform, aquaculture, plant genomics, and broadening participation of underrepresented groups in STEM. At NSF, he serves as a Program Director in the Division of Materials Research, where he co-manages the Materials Research Science and Engineering Centers (MRSECs) program along with the Partnership for Research and Education in Materials (PREM) program and participates as a Directorate representative for sustainable chemistry (SusChEM), the i-Corps program, as well as the Program Director Academy, where he serves as a facilitator training new program officers. Prior to joining NSF, Dr. Jones has served as the Director of Engineering for Applied Plasmonics, Chair and Professor for both the optical and electronic engineering departments at Norfolk State University, and as Technical Manager and Distinguished Member of Technical Staff at Bell Laboratories of Lucent Technologies. He has authored numerous publications and has been awarded 9 U.S. patents. He is an industry-recognized expert in the production of optical waveguides and is the co-inventor of the high bandwidth multimode optical fiber used in Fiber-To-The-X (FTTX) applications such as FiOS and Fiber-to-the-Home applications. Dr. Jones received his Ph.D. under the supervision of Dr. Paul Holloway.

2014 OUTSTANDING YOUNG MSE ALUMNUS

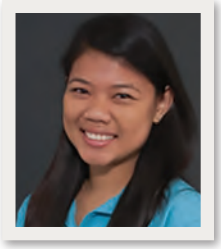
DR. DOUGLAS IRVING, *Associate Professor of Materials Science and Engineering, North Carolina State University*

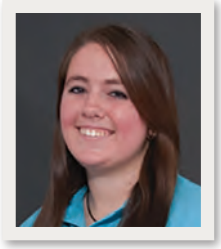
Douglas Irving received his B.S. in Physics from Furman University in 1997 and his M.S. and Ph.D. as a member of Susan Sinnott's group in the Department of Materials Science and Engineering at the University of Florida in 2002 and 2004, respectively. Before joining the faculty at NC State as a tenure-track Assistant Professor, he was a postdoctoral associate and a research professor in the group of Donald W. Brenner. Doug received the Faculty Early Career Development (CAREER) award from the Condensed Matter and Materials Theory program at the National Science Foundation in 2012, and was inducted into the Academy of Outstanding Teachers in 2013. His and his group's research has been selected as part of the IOPSelect collection for their Fast Track Communication in *Journal of Physics: Condensed Matter* in 2013, was distinguished as a Highlight of 2010 in the journal of *Modelling and Simulation in Materials Science and Engineering* in 2011, and has been honored with four best poster/presentation awards at international conferences. Doug is the author of 34 publications (30 in peer reviewed journals) and has 23 invited presentations, which includes one keynote presentation. In 2014, Doug joined the editorial advisory board of *Computational Materials Science,* and he is a member of AVS, TMS, MRS, USACM, Sigma Xi, and Keramos.

Staying in Touch with MSE

We are always delighted to hear from alumni in Materials Science and Engineering and Nuclear Engineering either remotely or when you visit. We welcome brief updates of your professional and/or personal accomplishments and will highlight such updates in future issues of Materials World.

MATERIALS SCIENCE AND NUCLEAR ENGINEERING AMBASSADORS (MSNEA) PROGRAM





TO ENRICH THE VISITS of alumni, prospective students and other visitors to the department, we have recently formed the Materials Science and Nuclear Engineering Ambassadors (MSNEA) program. The ambassadors are eager, accomplished and articulate undergraduates who are happy to show you around, take you to and from appointments and to give you a student perspective on life in MSE. The inaugural class of ten Ambassadors is led by co-Presidents Grace Ooi (left) and Kelly Hallisey (right), seniors in MSE and NE respectively.

MSE MILESTONES

As part of the 50th Anniversary Celebration in 2009, the Department commissioned an anniversary wall listing all of the BS, MS and PhD graduates of the program up to that time. Many graduates have visited the department and enjoyed finding their names and those of their friends and peers. An ultra-high definition image can be viewed at gradboard.mse.ufl.edu, allowing easy scanning and zooming through the lists.

SUPPORTING MATERIALS SCIENCE AND ENGINEERING AND NUCLEAR ENGINEERING

I'D LIKE TO INVITE YOU to consider supporting the Department of Materials Science and Engineering and the Nuclear Engineering Program at the University of Florida. As an alumnus/alumna your support allows our faculty to advance skilled research, our students to achieve their educational goals, and our programs to exceed those of our peers. We are grateful for your partnership in helping us shape and transform the next generation of materials science and nuclear engineering students and have included here links for you to make an unrestricted gift online.

If you have specific philanthropic goals or areas of interest and would like to learn more about how you can support the Department of Materials Science and Engineering or the Nuclear Engineering Program, please contact Kelly Harvey, Associate Director of Development, at 352-392-6795 or kharvey@eng.ufl.edu.

You may visit our website to make a secured gift in support of MSE and/or NE by visiting one of the following links:

- To make an unrestricted gift to the Department of Materials Science and Engineering visit: www.uff.ufl.edu/appeals/Materials
- To make an unrestricted gift to the Nuclear Engineering Program visit: www.uff.ufl.edu/appeals/Nuclear
- To make a gift to support the Bette and Paul Holloway Scholarship visit: www.uff.ufl.edu/appeals/Holloway
- If you would prefer to make your gift with a check, please mail your check with the form below to:

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Department of Materials Science and Engineering
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❑ Please accept my gift in the amount of _____ and designate it to:

- ❑ Materials Science and Engineering (Fund 000525)
- ❑ Nuclear Engineering (Fund 000421)
- ❑ Bette and Paul Holloway Scholarship (Fund 019375) _

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BY THE NUMBERS

UF DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

137 students — Nuclear Engineering

392 students — Materials Science and Engineering

529 total enrolled

#2 NRC RANKING OF MSE PH.D. PROGRAM

MSE FEMALE UNDERGRADUATES
35%

32 TENURED AND TENURE-TRACK FACULTY

$13M RESEARCH EXPENDITURES IN 2013

136 ACTIVE RESEARCH CONTRACTS

RANK AMONG MSE DEPARTMENTS – NUMBER OF DEGREES AWARDED IN 2012

#2 — Ph.D.

#1 — M.S.

#7 — B.S.

MSE FACULTY HOLD
57 Society Fellowships
15 Editorships
8 Endowed Professorships

117 DEPARTMENT H INDEX

182 REFEREED PUBLICATIONS IN 2013

10157 CITATIONS OF MSE WORK IN 2013

MSE PH.D. STUDENTS FROM UNDER REPRESENTED GROUPS
14%

UNDERGRADUATES FROM UNDER REPRESENTED GROUPS
26%