UCF

University of Central Florida

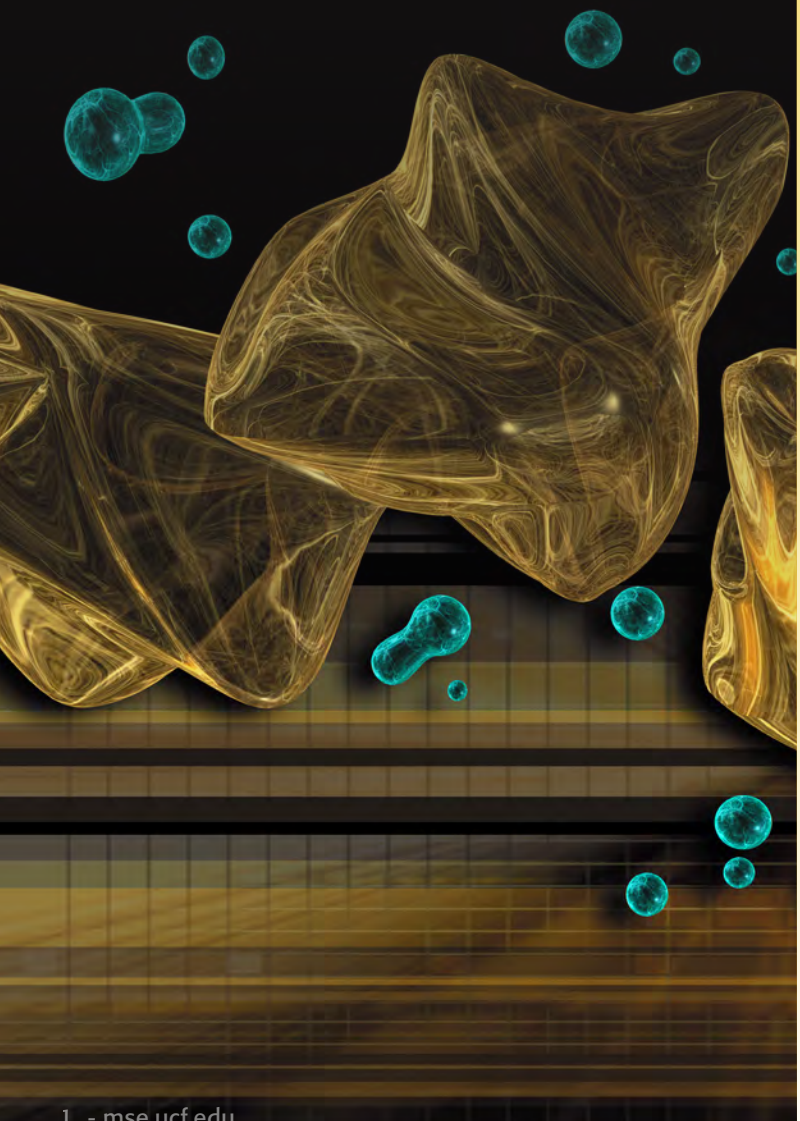
Materials Science and Engineering Department

Newsletter

September 2018

mse.ucf.edu
ampac.ucf.edu

TOC



Letter from the Chair

Dear Friends and Alumni:

What a year we have had!!! MSE Department continues to grow by leaps and bounds. We are now at a strength of 23 faculty. Our newest addition is Dr. P. Banerjee from Washington, St Louis, joining us as an Associate Prof as part of the catalysis center. We also welcome six Nano Center faculty: Drs. Jayan Thomas, Swami Rajaraman, Eric Jung, Yang Yang, Yajie Dong, Tania Roy. All who chose MSE as their tenure home. They bring collective expertise from advanced manufacturing, wearables, sensors, optics to multifunctional materials.

Our innovative faculty continue to excel in securing grants from federal and industrial agencies and publish high impact papers in journals and while paying great attention to technology commercialization. We have also seen an increase in our graduate enrollment and external research funding. We have a good number of patent disclosures filed, and eleven patents are issued. Cutting-edge research in photovoltaics, biomaterials to resist infection, nuclear materials, 2D hetero-semiconductor materials are highlighted in this issue.

I am also very proud of our amazing graduate students. They continue to excel in academics and research winning awards from prestigious conferences, Goldwater fellowship, Order of Pegasus, Dissertation and Austin Grogan fellowship, Emerging Space Leader at Germany, etc.

Through this newsletter, I would also like to reach out to our wonderful alumni and friends to share your stories and accomplishments. MSE alumni are creating impact not only in the industries but also advancing their career. Your generous support for the growth of our department will be greatly appreciated (https://www.ucffoundation.org/givetocecs)

I am very proud of my faculty, students, and staff for their outstanding service through hard work and dedication. I would thank each and every one of you for your continued support and inspiration. I wish you all another great year of success.

To all the alumni who have moved away, come and visit us in Orlando. You are always a part of us.

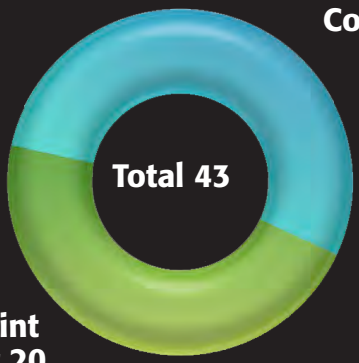
GO KNIGHTS!

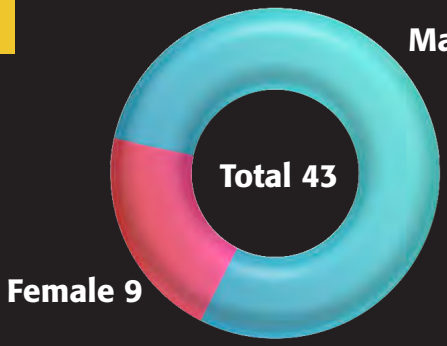
Sudipta Seal

Chair, MSE

MSE at a Glance

Faculty Demographics*





* (includes 2 lecturers)

Student Demographics

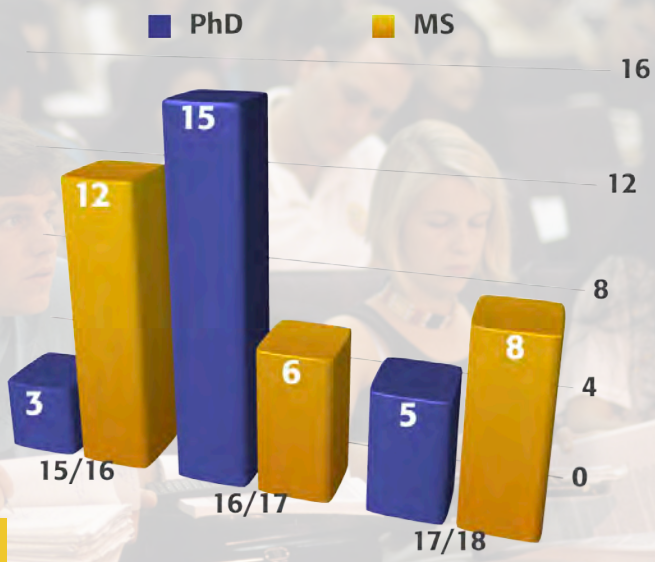
PhD Students

Total - 44
Women - 16
Men - 28
Under Represented Minority - 2
International - 27

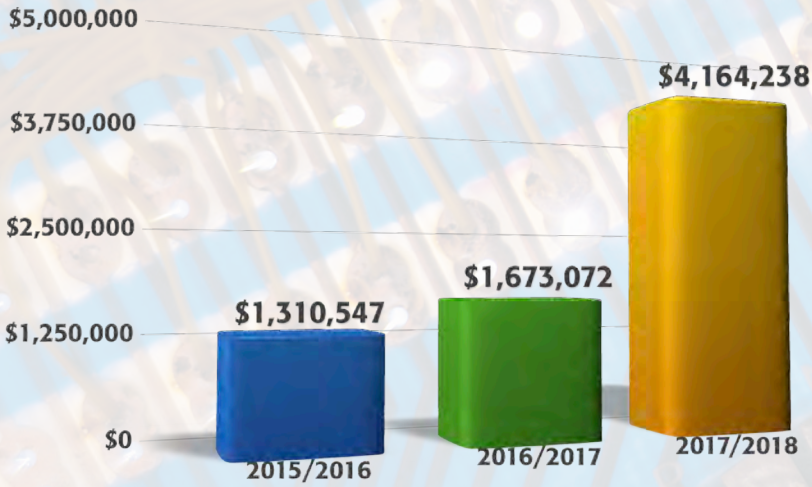
MS Students

Total - 13
Women - 7
Men - 6
Under Represented Minority - 1
International - 2

Student Degrees



Research Funding MSE/AMPAC: May 2017 - May 2018



Patents May 2017 - May 2018

Patents issued – 11
Patents filed - 8

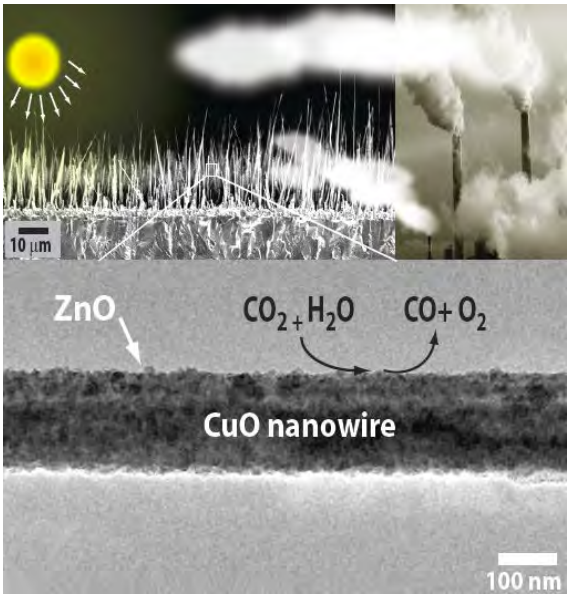
New Faculty

Dr. Parag Banerjee

Professor Banerjee joined the Department of Material Science & Engineering at the University of Central Florida. He received his Bachelors from the Indian Institute of Technology, Roorkee, India in 1998 in metallurgical engineering, a Masters from Washington State University in 2000 and a PhD from the University of Maryland in 2011, all in materials science & engineering. At the University of Maryland, he was the recipient of the first, John and Maureen Hendricks Energy Fellowship, 2010 top invention of the year award and won the best graduate thesis award in materials science & engineering.

From 2000 to 2006, Professor Banerjee was a Process R&D Engineer at Micron Technology Inc. in Boise, working on gate and capacitor dielectric reliability. He developed advanced, front-end-of-line processes for high-k dielectrics using atomic layer deposition (ALD). In 2011, Parag was appointed an Assistant Professor in the Department of Mechanical Engineering and Materials Science at Washington University in St. Louis. There, he set up a vibrant research program garnering strong industry and federal support for studying fundamental and applied topics in ALD.

Professor Banerjee's current work exploits ALD as a key technological platform to understand and control charge transport across materials with applications in electronics, energy and catalysis. He has over 45 publications in prestigious peer-reviewed journals and 8 U.S. and international patents. His work has been supported by the U.S. Department of Energy, National Science Foundation, Army Research Office and EMD Performance Materials – a division of Merck KGaA Darmstadt®.



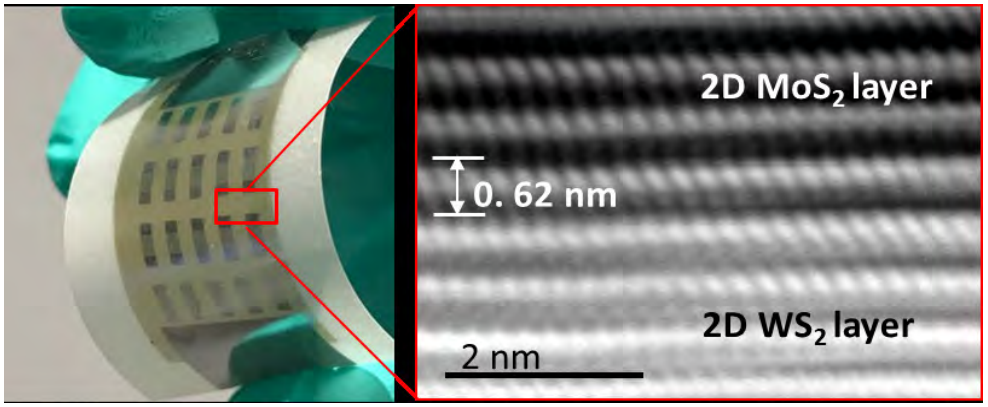
Welcome! Six new additions to MSE

It's our pleasure to welcome Prof (s): Jayan Thomas, Eric Jung, Yang Yang, Swami Rajaraman, Tania Roy, Yajie Dong to Materials Science and Engineering Department as of May 2018. Their tenure home is now MSE. They come from a diverse background of Materials Engineering, Chemistry, and Electrical Engineering with significant expertise in nanoscience and nanotechnology. Our MSE Department and program will greatly benefit from their research expertise and we hope to foster collaborative research.

Yeonwoong (Eric) Jung

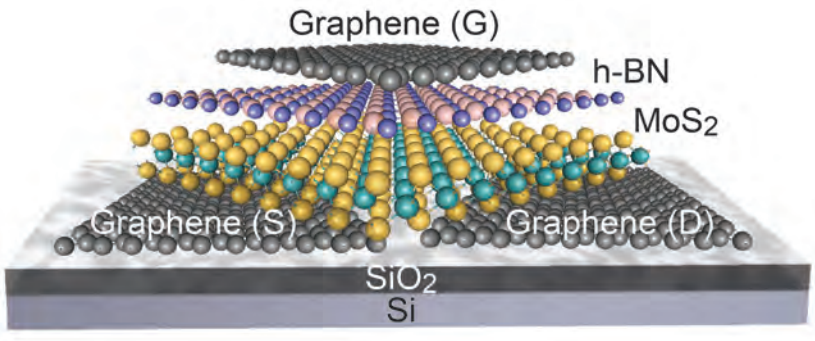
Assistant Professor

Research Interests: His research group focuses on developing novel nanomaterials such as two dimensional (2D) atomic layers with extraordinary material properties and exploring their applications in a wide range of transformative technologies for electronics, energy, and environments.



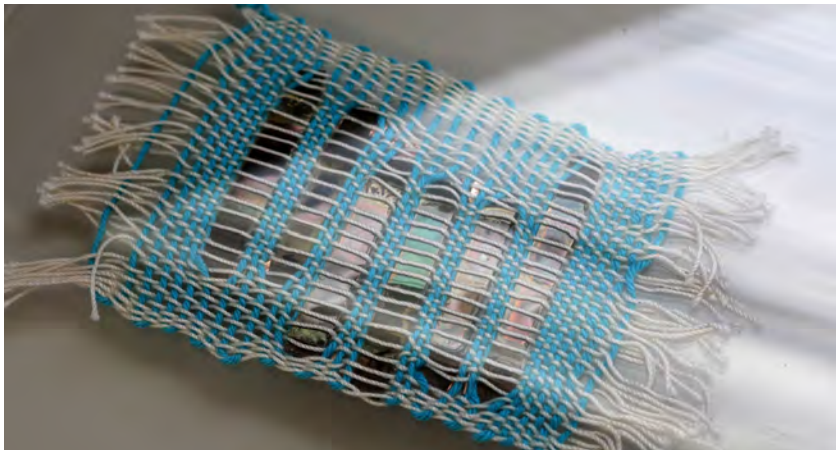
Tania Roy

Assistant Professor
Research Interests: Energy efficient electronic devices with novel functional materials.



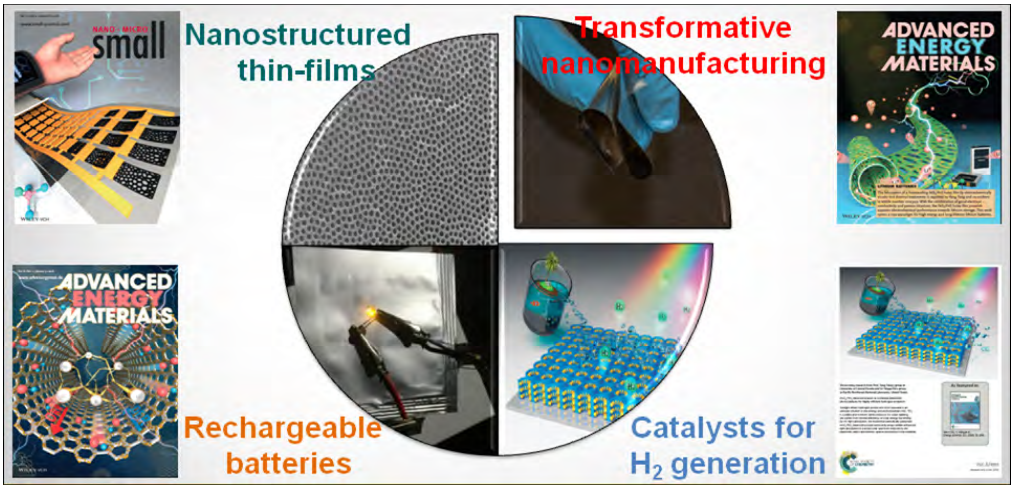
Jayan Thomas

Associate Professor
Research Interests: Dr. Thomas is currently working on the development of energy harvesting and storage devices, wearable devices and photorefractive polymers.



Yang Yang

Assistant Professor
Research Interests: His research group is dedicated to developing transformative thin-film technologies for renewable energy generation and storage, solar energy harvesting, and smart/flexible electronics applications. His current research emphasizes the following projects: a) freestanding thin-film electrodes for rechargeable batteries; b) advanced electrocatalysts for renewable energy generation; d) plasmonic photocatalysts for solar energy harvesting.



Swaminathan Rajaraman

Assistant Professor

Research Interests: Micro/Nanofabrication Technologies for the fabrication of biomedical and agricultural microdevices. 2D and 3D Microelectrode Arrays (MEAs) for in vitro biosensing; applications of Microneedles in biomedical and agricultural applications; Implantable Microelectrode Arrays and the applications of microfluidic and stretchable microelectronics devices.

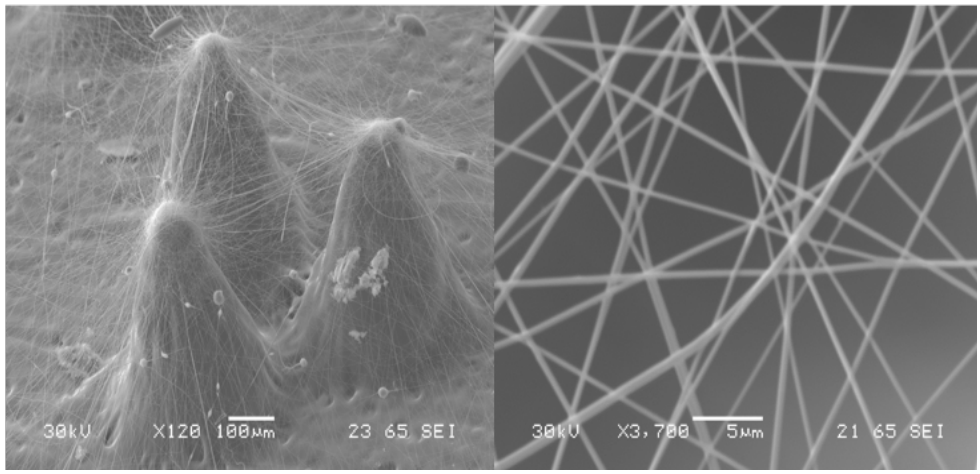


Image from A. Kundu et al., Micromachines 2018; N. Azim et al., Hilton Head MEMS Meeting 2018 A and B.

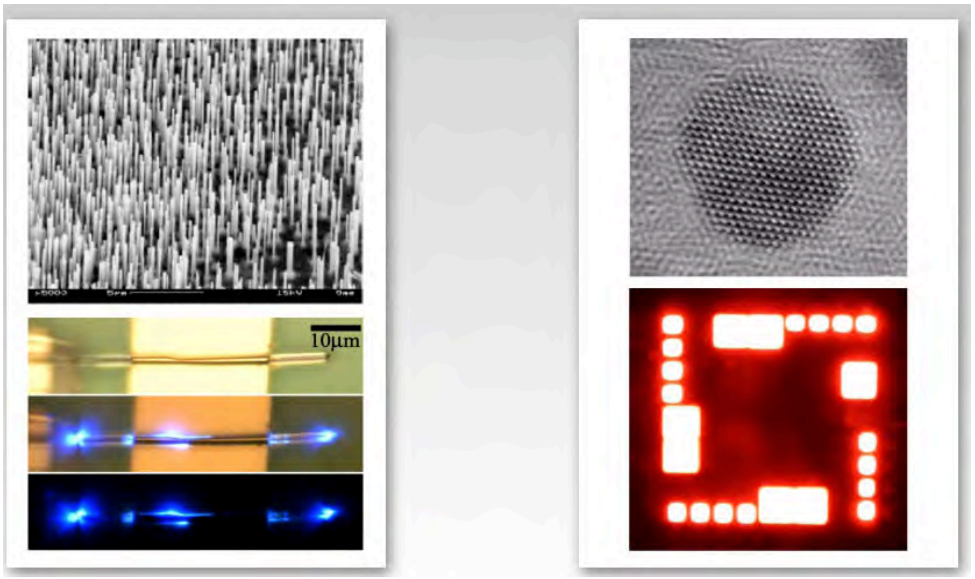
Materials Science and Engineering (MSE) at UCF has grown very quickly from a group of 6 core faculty (2012) to a group of 23 core faculty (2018). MSE is one of the most diverse, interdisciplinary units on campus. Their strong interdisciplinary focus, diversity and the recent outstanding young faculty hires are the strengths that MSE is relying upon to attain its vision of enhanced national visibility and recognition. I am confident that MSE will attain its vision in a short time period.

Dr. Michael Georgiopoulos – Dean, College of Engineering & Computer Science

Yajie Dong

Assistant Professor

Research Interests: Dr. Dong is broadly interested in scientific and technical challenges in luminescent nanomaterials, thin film optoelectronics, nanoelectronics, and energy technology. Current research focuses on quantum dot based light emitting devices (QLEDs) and metal halide perovskite luminescent materials and devices.



Faculty Directory

Linan An, Professor

Research: Dr. An's research lies in the following general areas: processing-structure-property relationships of ceramic materials, microfabrication of ceramics for extreme environmental MEMS, nano- and microstructure design for improving properties of ceramics and their composites and mechanical property characterization with indentation techniques.

Parag Banerjee, Associate Professor

Research: Professor Banerjee's current work exploits ALD as a key technological platform to understand and control charge transport across materials with applications in electronics, energy and catalysis.

Elizabeth Brisbois, Assistant Professor

Research: Dr. Brisbois' translational research is focused on the design and characterization of novel nitric oxide (NO) releasing polymers that can improve the biocompatibility of medical devices (e.g., catheters, extracorporeal life support, insulin infusion sets, wound healing dressings). These NO-releasing polymers are being evaluated for their ability to prevent clotting, antimicrobial activity to reduce biofilm, anti-inflammatory, and wound healing properties. The new polymers and coatings are evaluated for their clinical applications to improve biocompatibility of medical devices using in vitro bioassays and in animal models.

Kevin Coffey, Professor

Research: Dr. Coffey's research interests include both magnetism and the materials science of nano-scale interfaces. Materials systems such as the high magneto-crystalline anisotropy FePt ordered intermetallic phases are of special interest because of a strong relationship between magnetic properties and nanoscale microstructure.

Kaitlyn Crawford, Assistant Professor

Research: Dr. Crawford's group develops soft functional materials that are designed for dynamic use at the biological interface. Research interests related to these efforts include: block copolymers, nanomaterials, interfacial interactions, soft matter synthesis and characterization, self-assembly, wearable sensors, and bionic materials.

Kristopher Davis, Assistant Professor

Research: Dr. Davis's research is focused on the development of new manufacturing processes and characterization techniques to improve the performance and reliability of PV technologies, reduce cost, and gain fundamental insight into the structure-property relationships of PV materials.

Yajie Dong, Assistant Professor

Research: Dr. Dong's group is broadly interested in scientific and technical challenges in luminescent nanomaterials, thin film optoelectronics, nanoelectronics, and energy technology. Current research focuses on quantum dot based light emitting devices (QLEDs) and metal halide perovskite luminescent materials and devices.

Jiyu Fang, Associate Chair and Graduate Program Coordinator

Research: Dr. Fang's research focuses on the interdisciplinary areas of physics, chemistry, materials and biology, with an emphasis on self-organized biological systems and self-assembled nanostructural materials. Technology development such as scanning probe microscopy, liquid crystal optical amplification, and soft lithography also play a major role in his research activities.

James Fenton, Professor and Director of FSEC

Research: Dr. Fenton's research activities in fuel cells, pollution prevention and sustainable energy are helping FSEC expand its nationally acclaimed research and education programs in hydrogen, alternative fuels, solar energy and buildings energy efficiency. Dr. Fenton is also the Director of UCF's Florida Solar Energy Center.

Stephen Florczyk, Assistant Professor

Research: Dr. Florczyk's research is focused on the development and processing of three-dimensional (3D) biomaterial scaffolds. The biomaterial scaffolds are primarily prepared from natural polymers, including chitosan, hyaluronic acid, and alginate, and ceramics. The 3D biomaterial scaffolds developed in Dr. Florczyk's lab are utilized in three research areas: 1. tissue engineering; 2. tumor microenvironment; and 3. cell-material interaction.

Tengfei Jiang, Assistant Professor

Research: Dr. Jiang's group conducts highly interdisciplinary research encompassing fundamental materials science, reliability metrology, advanced interconnect and packaging systems, and nanotechnology. Two research directions are currently being pursued; investigating the fundamental failure physics and mechanisms degrading reliability and the fabrication and characterization of novel nanomaterials and nanostructures.

Yeonwoong (Eric) Jung, Assistant Professor

Research: Dr. Jung's research program explores the extraordinary properties of various emerging nanoscale materials and their translation to transformative technologies through interdisciplinary approaches. A primary focus is on integrating a new class of low-dimensional materials into functional structures and developing a fundamental understanding of their topography-property relationships.

Akihiro Kushima, Assistant Professor

Research: Dr. Kushima's research focuses on understanding the complex nano-scale phenomena through a combination of experiment and atomistic simulation, with particular emphasis on in-situ transmission electron microscopy (TEM) and energy storage devices.

Lorraine Leon, Assistant Professor

Research: Dr. Leon's research is focused on expanding the self-assembly toolbox to include multiple, synergistic molecular interactions using biomolecules, particularly peptides and peptide/polymer conjugates which can incorporate many distinct functionalities arising from individual amino acids. By leveraging multiple orthogonal molecular interactions, we want to recreate the flexibility, adaptability, and multivalency found in natural biomaterials that lead to their dynamic nature.

Kausik Mukhopadhyay, Senior Lecturer

Research: Surface science, coatings, catalysis, biomaterials for wound care, additive manufacturing.

Swaminathan Rajaraman, Assistant Professor

Research: Dr. Rajaraman's current research interests include in-vitro and in-vivo Micro/Nanoelectrode Arrays, micro/nanofabrication, micro/nanofabrication on the novel, biological substrates, microneedles, flexible electronic devices, Micro/Nano Manipulation, micro-TAS/Lab & Organ-on-a-Chip devices, nanosensors and implantable MEMS devices.

Tania Roy, Assistant Professor

Research: Dr. Roy's research interests broadly include engineering novel functional materials to improve electronics for Internet-of-things, and development of energy-efficient devices for electronics and sensors. She is keen on studying the reliability of different materials systems and semiconductor devices.

Patrick Schelling, Professor

Research: Dr. Schelling's research interests include thermal properties of semiconductors. With the increasingly aggressive thermal environments of new technologies, thermal transport is becoming an important issue for device lifetime and functionality. To address fundamental problems in thermal transport, Dr. Schelling uses large-scale atomic simulation.

Faculty Directory

Sudipta Seal, Professor and Department Chair

Research: Manufacturing of functional materials, sensors, micro-nano systems, green synthesis, rare earth materials, nano-bio medicine, nanomaterials for agricultures and energetics, surface science and characterization, flexible materials, etc.

Yong-ho Sohn, Professor

Research: Dr. Sohn's research group focuses on materials development, additive manufacturing, testing and characterization for applications that are categorized as "extreme" environment, e.g., temperature, stress, radiation, and their gradients. Our research aims to provide a fundamental understanding of thermodynamics and kinetics as well as practical solutions.

Jayan Thomas, Professor

Research: Dr. Thomas's research is focused on developing nanoarchitectured energy conversion and storage devices. Recently, we have developed a nanoarchitecturing technique using which polymer nanostructures can be printed efficiently at low cost. This technique is utilized to develop nanostructured polymer solar cells, nanoarchitectured electrodes for Li-ion batteries and supercapacitors, and printed biomolecule based photonic devices.

Raj Vaidyanathan, Professor

Research: Dr. Vaidyanathan has established a world class program in the research and development of shape memory alloys. The program has had tremendous impact and has placed UCF's doctoral students in prominent careers in shape memory alloys, partnered with prestigious partners and has been supported by very competitive awards from funding agencies and major multi-national corporations.

Yang Yang, Assistant Professor

Research: Dr. Yang's group research interests include advanced materials and their applications in renewable energy devices, environmental science, and smart electronics. Our research focuses on design and synthesis of highly ordered porous films with precisely controlled chemical composition and morphology; fundamental investigation of new electrochemical, electronic and optical properties; and exploration of the novel, cutting-edge technologies arising in these advanced materials.

Dan Zhou, Instructor

Teaching MSE courses, Microscopy and surface analytical techniques

Faculty news snippets

Congratulations to **Prof. Yongho Sohn** for his selection to receive the CECS Lockheed Martin Professorship. Dr. Sohn is also a Pegasus Professor and the Fellow of American Society of Materials.

UCF research team with collaborators at Virginia Tech have developed a new "green" approach to making ammonia that may help make feeding the rising world population more sustainable.

"This new approach can facilitate ammonia production using renewable energy, such as electricity generated from solar or wind," said physics **Assistant Professor Xiaofeng Feng** (MSE Program Faculty). "Basically, this new approach can help advance a sustainable development of our human society."

Ammonia, a compound of nitrogen and hydrogen, is essential to all life on the planet and is a vital ingredient in most fertilizers used for food production. Since World War I, the ammonia in fertilizer has been primarily produced using the Haber-Bosch method, which is energy and fossil-fuel intensive. There have been substantial obstacles to improve the process, until now.

The research team's new approach is documented in the **Nature Communications** Journal.

Kaitlyn Crawford's work in design thin, conformable resistive sensors was selected for journal cover arts was selected for Journal Cover Art in the July 2018 edition of the Journal: Extreme Mechanics Letters. The article DOI is: 10.1016/j.eml.2018.04.002.
Dr. Crawford was Invited speaker at the Kavli Foundation Workshop hosed by Rice University; May 2018, and Invited faculty mentor at an NSF funded 'Future Faculty' workshop at U. Delaware; July 2018. Two undergraduate researchers in her research group received the SURF Fellowship (Summer Undergraduate Research Fellowship); Summer 2018.

The World Academy of Ceramics named **Dr. Sudipta Seal** as one of only four Americans and 20 scientists worldwide to be honored for their renowned contributions to the advancement of the field.

Dr. Seal receiving the World Academy of Ceramics award in Perugia, Italy, June 2018.

Dr. Yeonwoong (Eric) Jung's lab was visited by local television station WFTV to showcase his "oil-water separating 2D Mos2 sponges" developed in his group to separate oil from water.
A research article led by Dr. Yeonwoong (Eric) Jung has been selected as one of the top 100 read chemistry papers for Scientific Reports in 2017. The article titled 'Noble metal-coated MoS_2 nanofilms with vertically-aligned 2D layers for visible light-driven photocatalytic degradation of emerging water contaminants' reports the efficient removal of harmful water contaminating organics utilizing novel two-dimensional (2D) materials.

Prof. Yajie Dong was invited to present at the 24th International Display Workshops (IDW'17) at Sendai, Japan and his presentation titled "Luminescent Perovskite-Polymer Composite Films for Display" was selected to win the IDW '17 Best Paper Award.

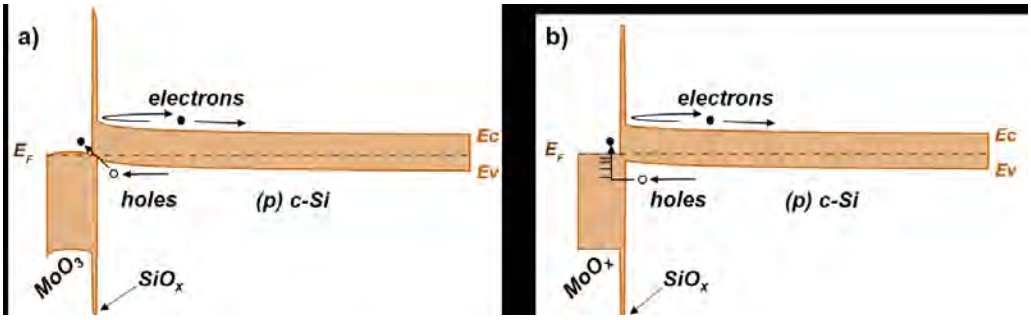
Dr. Kristopher Davis, Assistant Professor in Materials Science and Engineering at UCF, is now serving on the IEEE Electron Device Society's Photovoltaic Devices Committee. In this capacity, Dr. Davis will help shape the IEEE's future direction in the field of photovoltaics, a large and rapidly growing source of energy across the world.

Research Highlights

Dr. Kristopher O. Davis, an Assistant Professor of Materials Science and Engineering at UCF, and the **Davis Research Group** are currently working on three projects aimed at lowering the cost of solar energy by increasing the efficiency of photovoltaic (PV) cells, reducing manufacturing costs, and improving the reliability and durability of PV modules. All three projects are funded through the U.S. Department of Energy's Solar Energy Technologies Office under award numbers DE-EE0007533, DE-EE0008155, and DE-EE8172.

Project 1: Hole-Selective Passivated Contacts using High Work Function Metal Oxides

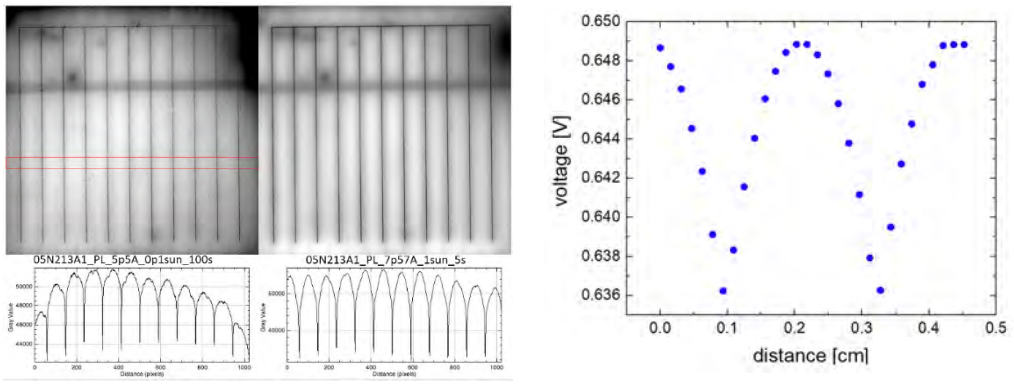
Contact passivation is an area where new materials have the potential to drastically improve the efficiency of silicon PV cells. Metal-silicon interfaces have a high concentration of interface states leading to significant carrier recombination at any silicon surface touching the metal contacts. Contacts can be made smaller to reduce recombination, but this results in an increase in series resistance. In this project, metal oxide heterostructures and thin passivating interlayers are used to limit carrier recombination due to metal contacts without compromising the series resistance. Geoffrey Gregory (Ph.D. student) has recently shown that hole-selective contacts with very low contact resistivity (below 10 $m\Omega\text{-}cm^2$) can be formed using molybdenum oxide and the manipulation of the work function through oxidation treatments can improve the surface passivation and hole-selectivity of these contacts. Additionally, Dr. Haider Ali (postdoctoral researcher) is using transmission electron microscopy and electron energy loss spectroscopy to study interactions between molybdenum oxide films and the metal contact layers to further optimize the performance of these materials.



Band diagram of (a) MoO_3 and (b) MoO_x hole-selective contacts to p-type Si with a SiO_x tunneling layer. Holes transport into the (a) the conduction band of MoO_3 and (b) the O defect levels of MoO_x.

Project 2: Characterization of Contact Degradation in Photovoltaic Cells and Modules

Silicon PV modules have been shown to be very reliable and durable over the years, with typical warranties of 25 years. However, pushing the lifetime beyond this can further lower the cost of solar energy. Currently, the metal contacts that extract current from the active semiconductor in a PV cell and the metal interconnects that connect PV cells together in a PV module are the main weak points where degradation can reduce PV module efficiency over time. The Davis Research Group is using electroluminescence and photoluminescence imaging to isolate exactly what part of the metal contacts and interconnects are the origin of power loss. Nafis Iqbal (Ph.D. student), Geoffrey Gregory (Ph.D. student), and Hardik Patel (B.S. student) are focused on improving the accuracy and the speed of measurements aimed at separating contact resistivity losses from contact recombination in PV cells. Dr. Eric Schneller (postdoctoral researcher) and Dylan Colvin (B.S. student) are developing methods of converting electroluminescence images of PV modules to images of recombination and resistive loss in manner that can trace degradation mechanisms back to the root cause.



(Left) High-resolution photoluminescence images of a PV cell. (Right) Voltage distribution perpendicular to the metal contacts derived from the high-resolution photoluminescence images.

Project 3: Applying Novel Characterization Techniques to PERC Module Degradation

Passivated emitter and rear cells (PERC) are becoming the industry standard, replacing the aluminum back surface field (Al-BSF) PV cell due to the higher conversion efficiencies of PERC compared to Al-BSF. In this project, the Davis Research Group is partnered with Case Western Reserve University (the project lead) to investigate potential degradation pathways introduced by the new surface passivation layers and localized back contacts used in PERC cells. Dr. Eric Schneller (postdoctoral researcher), Jobayer Hossain (Ph.D. student), Rafaela Frota (B.S. student), and Dylan Colvin (B.S. student) are using photoluminescence imaging and high-speed quantum efficiency measurements to quantify power loss in PERC modules and identify the origin of defects (e.g., pn junction, surface passivation layer, anti-reflection coating, contact).

UCF Researchers Receive JDRF Funding to Improve Biocompatibility of Insulin Delivery Systems

The University of Central Florida recently was selected to receive an award from the Juvenile Diabetes Research Foundation (JDRF) totaling $374,000. Many patients with Type 1 diabetes utilize insulin pump systems to administer insulin and maintain tight glycemic control. However, the insulin infusion cannula remains the "Achilles heel" that has limited continuous subcutaneous insulin infusion due to complications that arise related to the body's inflammatory response and risks of infection. The project is led by **Dr. Elizabeth Brisbois,** a member of UCF's Materials Science & Engineering department and the Prosthetic Interfaces Cluster. Her team is developing polymers that release a biomolecule called nitric oxide (NO) that are applied to the insulin infusion cannula to resist infection and inflammation. Dr. Brisbois' team is collaborating with researchers at the University of Georgia to evaluate the antimicrobial and anti-inflammatory effects of these new polymer coatings on the insulin infusion cannula using in vitro bioassays and animal models. This new generation of insulin infusion cannula will possess enhanced biocompatibility and reduce risks of infection and inflammation at the insulin infusion site, which will dramatically improve diabetic patient compliance and care and improve their quality of life.

Dr. Stephen J. Florczyk, Assistant Professor in Materials Science & Engineering, was named the 2017-2018 Mentor of the Year by the UCF Office of Undergraduate Research. He was nominated by his undergraduate research assistants for the award that recognizes outstanding mentoring and support of undergraduate research. Dr. Florczyk received his award following the Showcase of Undergraduate Research Excellence, where three of his undergraduate research assistants presented projects.

AMPAC is an interdisciplinary research and education center with excellent facilities to promote the collaboration research and education in materials science and engineering.

Jiyu Fang – Prof. MSE and Interim Director AMPAC

Collaboration Attracts Funding for Advanced Imaging Device A New Addition to AMPAC-Materials Characterization Facility

Interdisciplinary research team led by **Dr. Sudipta Seal** with Co-PI S. Branting, T. Roy, and Y. Sohn and senior personnel Y. Yang, A. Kumar, and X. Feng win an NSF MRI grant (NSF ECCS: 1726636) to acquire a state of the art ESCALAB 250XI (Thermo Fisher) includes: XPS with parallel quantitative xps imaging with 1µm spatial resolution, Ion Scattering Spectroscopy (ISS), Reflected Electron Energy Loss Spectroscopy (REELS), Ultraviolet Photoelectron Spectroscopy (UPS), Monatomic and Gas Cluster Ion Source, Heating & Cooling in the analysis chamber, High pressure gas cell, Ion source on prep chamber and many more.

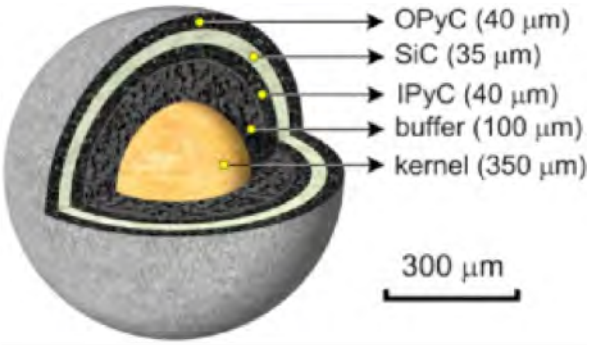
today.ucf.edu/collaboration-attracts-funding-advanced-imaging-device/

"The breadth and the width of what the instrument can do is phenomenal, from electronics to medical to archaeological to manufacturing to entertainment to forensics" – it goes on and on - Seal

A quick peek at the ESCA Lab at MSE-AMPAC MCF/CECS: NSF REU Site students receiving a quick tour, led my Prof. A. Gesquiere and S. Seal (NSF REU Site: EEC-1560007)

Dr. Yongho Sohn
Professor

Dr. Kevin R. Coffey
Professor

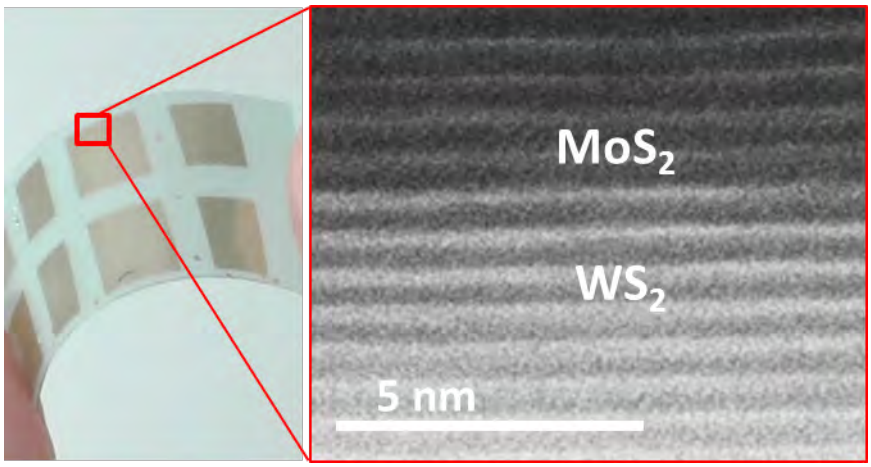


Schematic cutaway drawing of a TRISO fuel particle (Yang and Allen, J. Nucl. Mater.

Dr. Yongho Sohn and **Dr. Kevin R. Coffey** received a $700K, 3-year grant from the U.S. Department of Energy for a research project entitled "Mechanisms of Retention and Transport of Fission Products in Virgin and Irradiated Nuclear Graphite" through Consolidated Innovative Nuclear Research (CINR) and Nuclear Energy University Program (NEUP). In this project, Drs. Sohn and Coffey will examine how the fission products are retained and transported through graphite before and after neutron irradiation in order to help develop TRIstructural-ISOtropic (TRISO) nuclear fuel that, compared to current technology, can double the fuel efficiency, reduce the waste by more than 80%, and most importantly, be self-contained in case of accidents. Mechanistic understanding of atomic configuration and diffusion process will also contribute to the overall appreciation of carbon that can exist in various forms such as graphite, graphine, diamond, fullerene, and nanotubes. This project will be carried out in partnership with Drs. Jacob Eapen and K.L. Murty from North Carolina State University (Raleigh, NC) and in collaboration with Dr. Anne Campbell from Oak Ridge National Laboratory (Oak Ridge, TN), Drs. Abbie Jones, Clint Sharrad, and Barry Marsden from University of Manchester (Manchester, UK).

Dr. Yeonwoong (Eric) Jung

Two-dimensional (2D) semiconductors with near atom thickness present an unusual combination of extremely high mechanical bendability and superior electrical/optical properties, rendering unprecedented opportunities for flexible electronics/optoelectronics. More interestingly, heterogeneously integrating one 2D semiconductor on top of the other achieving vertical stacks of 2D "hetero" structures is envisioned to project even more exciting functionalities impossible with their mono-component counterparts. One of the major hurdles for their technological applications lies in the technical difficulty with precisely integrating them into flexible substrates on a large scale compatible with prevailing microelectronics processes while maintaining their structural integrity. In a recent paper published in Nano Letters, Dr. Yeonwoong (Eric) Jung's research group reports a viable solution to this problem. By exploring the water-assisted debonding nature of gold interfaced with conventional silicon dioxide growth substrates, they demonstrate the direct growth, transfer, and integration of various 2D hetero-semiconductors on mechanically deformable plastics and metal foils. The size of the integrated 2D hetero-semiconductors reported in this study reaches up to a few centimeter squares, significantly advancing over previous studies which remain to be a few micrometer-scale integrations. This study will open a new pathway to explore 2D hetero-semiconductors as novel building-blocks for large-scale emerging electronic/optoelectronic devices of various form factors.



Students in the News

Elizabeth Barrios (advised by Dr. Lei Zhai) presented as an emerging space leader at the 69th International Astronautical Congress in Bremen, Germany.

The College of Engineering and Computer Science selected **Omar Ahmed** (advised by Dr. Tengfei Jiang) to receive the Austin Grogran Scholarship for the academic year 2018-2019.

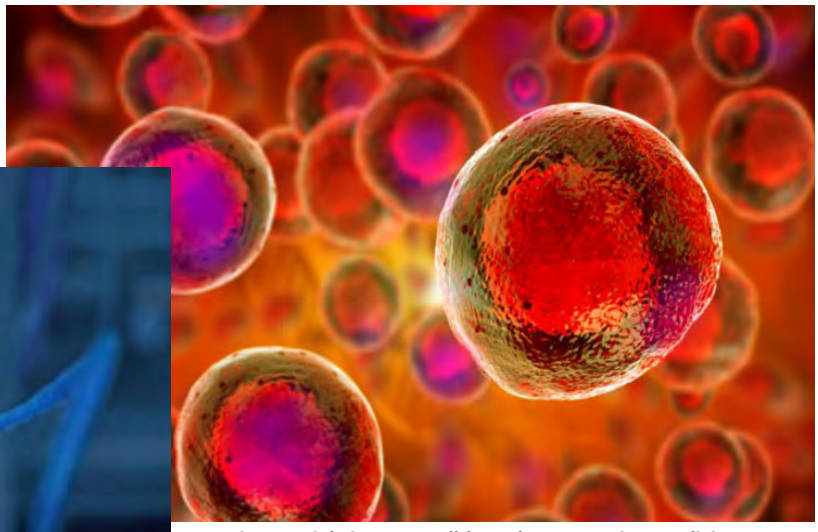
Mikhael Soliman (advisor Dr. Laurene Tetard) was selected to receive the Dissertation Completion Fellowship for Spring 2018.

Elizabeth Barrios, 3rd year PhD student under the guidance of Dr. Lei Zhai, was awarded NASA HQ Sponsorship to attend the 68th International Astronautical Congress in Adelaide, Australia, where she presented on the current status of her work developing a polymer derived ceramic nanocomposite as a ther moelectric material. While at the conference, Elizabeth represented NASA on the International Student Education Board as well as on the Young Professionals International Project Management Committee Workshop.

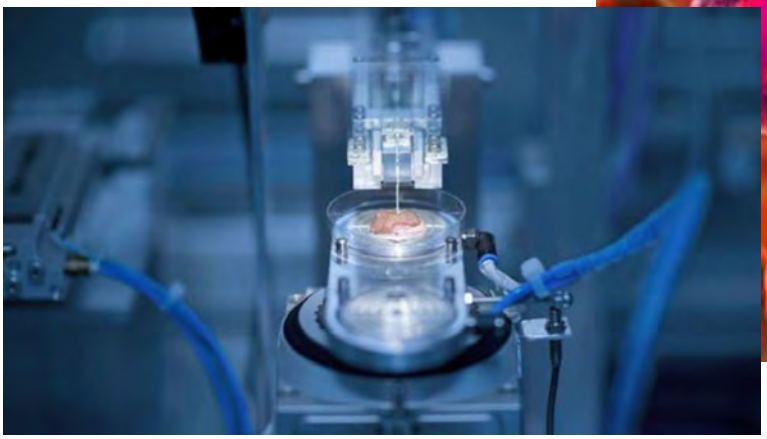
MSE student **Linda Rossmann,** adviser Dr. Seetha Raghavan, has been awarded a Fullbright Scholarship to conduct research in DLR Germany.

Minh-Chau N. Le, a Mechanical Engineering major and Materials Science & Engineering minor student was named an honorable mention for the Goldwater Scholarship. The Goldwater Scholarship is a prestigious scholarship that seeks to identify and support college sophomores and juniors who show exceptional promise of becoming the United States' next generation of research leaders in the natural sciences, engineering, and mathematics.

Minh-Chau is a Provost Scholar, a 2018 Order of Pegasus recipient, and is in both University Honors and Honors in the Major. Her research focus is in the area of bioengineered materials and devices—an exciting field that offers much promise for tackling some of the most pressing societal challenges in health, energy, and structural mechanics. Minh-Chau is specifically interested in developing biomaterials for cancer research that can be used to model tumor progression, screen new cancer drugs, and assess their efficacy in preclinical trials.



Biomaterials in stem cell-based regenerative medicine



The system that can rapidly manufacture two-layer artificial skin models.

Alumni News

Dr. Ankur Gupta (2017- advisor Dr. Sudipta Seal) has been recognized for his services as student board member of the Thermal Spray Society-ASM International. He learned the basics and gained hands-on experience in thermal spray area at Plasma nano-manufacturing laboratory, UCF. Dr. Gupta is currently working in the thermal spray industry. He is applying materials processing and analysis techniques learned in the laboratory.

Dr. Jing Liu (Ph.D. MSE, 2007) is now an Associate Director of Global Transition at Pratt and Whitney (P&W) – United Technologies, East Hartford, CT, USA. Until recently, she had worked at Oerlikon-Metco, NY, USA, for 10 years as a R&D Manager, materials scientist and project manager in Materials Research and Development (R&D) Division. As a materials scientist, she is credited with launching over 15 new products, and was promoted to manage Materials R&D group of Oerlikon-Metco. Her responsibilities as a R&D Manager included leading a group of scientists and engineers for global coordination among internal cross-functional teams, vendors, OEMs, universities and government agencies with a goal of new products development for coatings solutions in next generation gas turbines for both civil and military aviation. With her ample experience and proven leadership, she recently joined Pratt and Whitney as Associate Director of Global Transition to take on grand challenges of planning, managing and completing global transition programs for a wide variety of business unit and commodities to increase manufacturing capability and capacity. She credits, "outstanding technical knowledge gained from UCF classrooms and research laboratories, volunteering experience that harvested her key soft skills through teamwork, communication, and outreach activities, and finally, doctoral supervision of Dr. Yongho Sohn who nurtured her fundamental competency and professional confidence," as the foundation of her soaring career.

Dr. Petya Georgieva Fernlund, 2017 Distinguished CECS Alumna Award PhD, MSE, '06

As manager of Siemens GT Risk Management Organization, Petya Georgieva Fernlund, Ph.D., leads a global team responsible for ensuring the quality of the Gas Turbine engineering products. In her position, she oversees strategy and the portfolio; coordinates on root cause analysis and quality issues resolution; works on risk analysis and management; and supports the professional growth of employees within her organization. Previously, she worked three years as a quality manager, leading a team of managers for different Siemens Gas Turbine high-risk and high value development projects. She was the quality manager for the rapidly developing, fast-to-market program for a particular Siemens gas turbine engine.

While working towards her doctoral degree, Petya was a Research Associate in UCF's Advanced Materials Processing & Analysis Center (AMPAC). In this role, she worked in collaboration (funded projects) with industry and academia (Lockheed Martin, Office of Naval Research, Siemens, Constellation Technology); and conducted research and led the development of advanced materials and processes in the areas of: nanomaterials synthesis and consolidation, thermal spray processing and developing coating and bulk nanocomponents using plasma spray, metal/ceramic nanocomposites, surface engineering of materials, and more.

Dr. Hugues Francois-Saint-Cyr has been working at CAMECA Instruments Inc. since 2005 and has spent the past 8 years in the Atom Probe Tomography (APT) group as an Applications Scientist. Prior to joining the company, he earned a B.S in Chemistry and an M.S in Physics from France. He then continued his education with a Ph.D. in Materials Science from the School of Optics at the University of Central Florida (advisor Dr. Kathleen Richardson) and finished his academic journey at Harvard Medical School. Although he has a passion for materials characterization methods in various fields, he currently focuses on developing tailored training for new and seasoned APT groups, providing technical support, presenting at scientific conferences, opening new application markets and creating scientific marketing in APT and correlative microscopies, all with a common goal: Help the APT scientific community reach new heights, like the UCF Pegasus helps students reach for the stars. From metallurgy to semiconductors, from fiber optics to LED materials, from glass-ceramics to geological sciences, or from biomineral to biomedical applications, APT provides answers in 3 dimensions at the atomic level, making this technology fascinating.

Outreach Activities

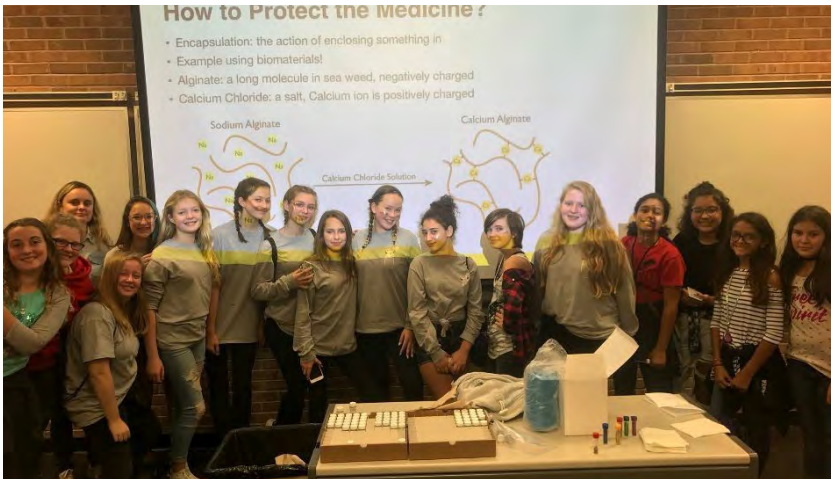
Dr. Crawford Outreach

Student from Trinity High School interned in Dr. Crawford lab for 6 weeks this summer. The student completed her own project on the stability and leaching of conductive ink; June/July 2018.

Dr. Crawford participated in AeroMat 2018 Mini-Camp in Kissimmee, FL by conducting a "Fun with Plastics" demo in May 2018. She participated as a poster judge at the 2018 UCF Graduate Student Research Symposium in April 2018, and at the 2018 Ying Expo for high school and middle school students in Orange County in March 2018.

Dr. Crawford is member of the Florida Prison Education Project. One of two participants from CECS. May 2018 - ongoing.

MSE at ASM Aeromat 2018 Conference



Dr. Lorraine Leon runs a workshop teaching middle school girls how to use biomaterials to encapsulate therapeutics. The workshop is part of "Mystery Design" an event organized by UCF's Society for Women Engineers.

Dr. Lorraine Leon and PhD students Allen Eyler and Sara Tabandeh run a biomaterials station as part of the ASM Mini-Materials Camp at AeroMat 2018. The mini-camp is attended by both high school and middle school students in the Orlando area.

Advisory Board

MSE Hosted Industry Advisory Board meeting in May. This is an opportunity for faculty and students to showcase the work the department is doing and receive feedback from board members in surrounding industry. As MSE continues to grow we are excited to continue to develop a cycle of feedback with our Industry Advisory Board to insure that our graduates are prepared for the current and future industry needs.

ASM Meeting

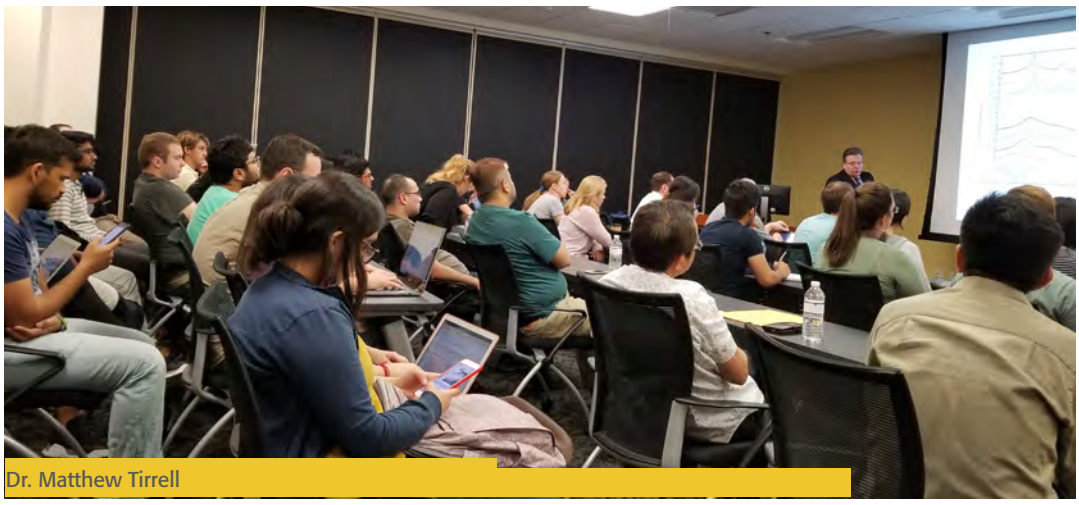
The Central Florida Chapter of ASM International held a meeting on April 19, 2018. The highlight of this meeting was a presentation by Dr. David Mitchell from Siemens. He presented his work on composite materials in a presentation entitled "Ceramic Matrix Composites: It's Black and White." The presentation provided details about the motivation for ceramic matrix composites (CMCs) and contrasted the forming and applications of carbide CMCs (black) and oxide CMCs (white). Dr. Mitchell presented about the differences in the processing of the two classes of CMCs and highlighted applications where each class will excel. He noted how the two CMC classes have almost opposite advantages and disadvantages, leading to selection of one class or the other for the desired application. There were many good questions following the presentation, leading to discussion of CMCs.

MSE Distinguished Seminar Series

Dr. I Cevdet Noyan

Dr. Molly Stevens

Dr. Christopher Schuh



Dr. Matthew Tirrell

In the past year we have welcomed several speakers as part of our MSE Distinguished Seminar Series. We would like to thank the following for accepting the invitation to speak at the University of Central Florida and sharing their research with students and faculty MSE.

Dr. Molly Stevens
Imperial College, London, UK

Bio-Responsive Hybrid Materials for Regenerative Medicine and Biosensing

Dr. Michele Manuel
University of Florida

Design Principles and Tools in High Temperature Magnesium Alloy Design

Dr. David Cahill
University of Illinois at Urbana-Champaign

Ultrafast Heat Transfer in Nanoscale Materials

Dr. Chirstopher Schuh
Massachusetts Institute of Technology

How Grain Boundary Segregation Enables 3D Printing of Bulk Nanostructured Metals

Dr. Arumugam Manthiram
The University of Texas at Austin

Electrical Energy Storage:
Nest Generation Battery Technologies

Dr. Matthew Tirrell
University of Chicago,
Argonne National Laboratory

Polyelectrolytes in Multivalent Ionic Media:
New Physics and New Materials

Dr. I. Cevdet Noyan
Columbia University

Diffraction Analysis of Nanocrystalline Powder Samples

Refereed Journal Articles

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7. Y. Cao, L. An, "*Anomalous piezo-dielectricity of a polymer-derived amorphous silicoaluminum oxycarbide (SiAlCO)*," Ceramics International, 44(2), 1467-1470 (2018).
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9. K. Chen, Y. Jiao, Y. Zhao, Y. Gao, X. Zhang, L. An, "*Non-contact electric field-enhanced abnormal grain growth in (K0.5Ha0.5)NbO3 ceramics*," Ceramics International, 15, 12343-12347 (2017).
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