CONTINUUM

UCF Department of Materials Science and Engineering
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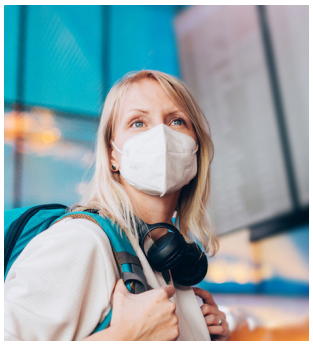

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UCF | Materials Science and Engineering
UNIVERSITY OF CENTRAL FLORIDA

Continuum is an annual publication that highlights the achievements of the students, faculty, staff and alumni from the University of Central Florida's Department of Materials Science and Engineering.

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Letter From the Chair

Dear Friends and Alumni,

Welcome to the fall 2022 semester! I wish you and your family the very best of health. Navigating through challenging times are not easy. I am proud of our faculty, staff and students for adjusting to this new normal and continuing to excel in teaching, research and service while doing so. This new magazine, *Continuum*, captures some of the exciting highlights from our department over this past year.

UCF continues to strive in winning a record number of NSF CAREER awards. I congratulate MSE faculty members Tengfei Jiang, Eric Jung and Mehdi Razavi for winning NSF CAREER awards in semiconductor reliability, flexible electronics and novel biomaterials. I also heartily congratulate faculty members Kris Davis, Tania Roy, Eric Jung, and Swaminathan Rajaraman for earning promotion and tenure.

Research from our faculty and students was accepted to high impact journals and featured on several covers. This work also generated numerous federal and industry grants, including two Multidisciplinary University Research Initiative awards from the Department of Defense.

MSE graduated its first cohort of undergraduates this year and some of our students also received prestigious GEM fellowships. Here's what Associate Professor Parag Banerjee, the undergraduate program coordinator, had to say about this achievement:

"The GEMs fellowship students received a once-in-a-lifetime learning experience in and I was happy to coordinate this internship."

We are delighted that our faculty, students and staff were honored at UCF and won national and international awards. We're also proud to highlight the distinguished alumni of our department who were recently recognized by the UCF College of Engineering and Computer Science for their professional accomplishments.

Through this newsletter, I would also like to reach out to our wonderful alumni and friends and ask you to share your stories and accomplishments with us. Your generous support for the growth of our department will be greatly appreciated.

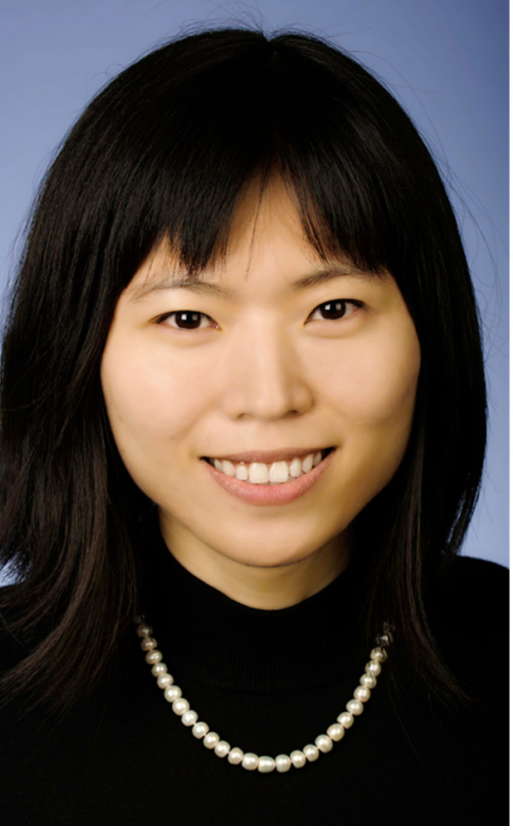
I wish you all a productive year ahead and I hope you enjoy our first issue of *Continuum*.

Stay safe and well. Go Knights!

Sincerely,

Sudipta Seal
Chair, Department of Materials Science and Engineering
College of Engineering and Computer Science
University of Central Florida

To find out how you can support the MSE department, visit https://bit.ly/3TTJIlb.



Promising CAREERs

The MSE Department Broke a Record This Year With Three CAREER Award Recipients in One Award Cycle

The U.S. National Science Foundation has named eight UCF professors 2022 NSF CAREER award recipients. Three of those professors — Tenfang Jiang, Yeonwoong Jung and Mehdi Razavi — are from the Department of Materials Science and Engineering, which sets a record for the department.

All of the recipients are engineers by training who are working on interdisciplinary projects that aim to improve health or to develop new technology that promises to improve our lives. The awardees represent the most promising junior researchers in the nation with the potential to lead in their respective fields, according to criteria outlined by NSF. This brings UCF's total NSF CAREER winners to date to 85.

UCF has seen a rise in winners for the past few years. In 2019, the Office of Research launched a program to help junior faculty prepare their applications. The results — a record 12 winners in 2020. There were five winners in 2021, above the norm for UCF in the past decade. This year's results continue the positive upward trend.

The winners all share three common traits. They are experts in their respective areas. They are curious about the world, and they believe their students are invaluable to their success.

Creating New Microelectronics

The pandemic triggered supply chain issues including a shortage of semiconductor chips which has impacted more than 160 American industries from computer makers, vehicle companies and even dishwasher makers.

Assistant professor Jiang hopes to help give American more options by unlocking the power of materials used in semiconductor chips. Her research looks at materials and their manipulation to advance high performance computing. Traditional microelectronics follow Moore's Law of scaling. Simply put, transistors are made smaller and smaller to increase device density and improve performance. However, at a certain point the benefits of miniaturizing diminishes and cost increases. At the same time there is a growing demand for higher performance computing from individual users that tap into their smart home systems to companies using big data and the cloud for daily business operations.

So how do we improve output and power? Jiang says one promising solution could be three-dimensional integrated circuits (3D IC). This is a new approach that allows for interconnected stacked electronic circuits. Copper is a potential material to use in building the structure, but it has limitations and reliability issues within a device. This is where Jiang comes in. She's looking to find ways to make this technology more efficient and solve the reliability issues.

"The CAREER award will let me focus on addressing the fundamental reliability challenge of 3D interconnect to fill important knowledge gaps," she says. "This research will pave the way for high density 3D heterogeneous integration that can enable a broad range of critical applications such as high-performance computing, autonomous vehicles, mobile connectivity and aerospace and defense applications."

She credits her Ph.D. advisor at the University of Texas at Austin, Paul S. Ho, with her passion and drive.

"He was encouraging of female students in his group, telling us that we could excel when we put our hearts to what we work on," she says.

She also encourages her own students to pursue excellence and says that without them, her work wouldn't be possible.

"Students are indispensable," Jiang says. "They are the ones doing experiments in the lab and running models. Students generate results to make my research ideas possible. I also get inspired when I discuss with my students."

Jiang joined UCF in 2015. She has published more than 21 papers in peer-reviewed publications and has funding from various corporations and funding agencies. She holds multiple degrees including a Ph.D. in materials science and engineering.

Exploring Stretchy Laptops and Smartphones

Imagine a smart phone that bends or stretches and can withstand the extremes of the Mariana Trench on Earth or the cold valleys of the moon.

Assistant professor Jung is studying materials and nanotech that could one day make this possible.

"When the size of materials becomes extremely small — down to the nanoscale (smaller than 1/1,000,000 times of a human hair thickness) they start exhibiting unusually exciting and superior properties which cannot be obtained in any traditional materials," Jung says. "The 2D materials that I'm researching can be stretched more than 10 times compared to silicon (the major driver for modern electronics) while still preserving excellent electrical conductivity and semiconducting properties, which are essential for digital electronics. This research enables us to project creating extremely stretchable electronic devices based on the 2D materials. Think laptops or cell phones that can be twisted, folded, and stretched in all dimensions."

That means potentially packing more computing or optical power and flexibility for use in a broad array of environments.

Jung's curiosity for creating new materials and search for excellence drives his work and why he loves working with his students in the lab.

"[Students] are pivotal in all aspects of my research," he says. "Without them, none of what I have accomplished at UCF would be possible … I'm very proud of them. My graduate students have received more than 30 awards for their research excellence inside and outside UCF. They have also found great jobs in places such as Apple, Intel and Yale University. Seeing how they are growing professionally is always quite rewarding and inspiring for me, and it continuously help me keep my momentum in doing what I'm doing."

Jung joined UCF in 2015 and has published more than 100 journal papers. He has funding from federal agencies including the U.S. National Science Foundation, the U.S. Air Force Office of Scientific Research and from corporations including Samsung. His work led to two patents. Jung holds multiple degrees including a Ph.D. in material sciences and engineering. Before arriving at UCF he worked at Los Alamos National Laboratory and Yale University. In 2022 Jung was named a UCF Reach for the Stars awardee.

Developing Implants of the Future

Assistant professor Razavi's goal is to reduce the pain many patients feel especially when suffer a fracture. Although he's not a medical doctor, much of the work he and his team conduct focuses on using engineering to eventually help improve patient outcomes.

Bone injuries and degeneration caused by aging, cancer, accidents and even sport's injuries often require metal implants to restore a patient's mobility. But those implants often pose problems as the body rejects the foreign objects. One possible solution is the use of bioabsorbable magnesium implants. Currently these implants corrode too quickly, generating harmful hydrogen gas pockets. That's a major challenge, which Razavi will work to overcome with the funding provided by his CAREER grant. The group will focus on improving the corrosion resistance to produce better magnesium-based bone implants.

"I remain optimistic that the basic science we all do today, will lead to new technologies to help patients in the future," he says.

Razavi was deliberate in choosing UCF as his home. After completing postdoctoral work at Stanford University, which was on the heels of work at the Brunel Center for Advanced Solidification Technology — a world renowned casting center in the United Kingdom — he wanted to find a place that would support a collaboration among mechanical engineering, material science, medicine and nanotech. He saw the potential at UCF.

UCF was an ideal incubator of synergies. Home to the Advanced Materials Processing and Analysis Center, the NanoScience Technology Center, the Burnett School of Biomedical Sciences, the College of Medicine and the Biionix Cluster, it was a no brainer for Razavi.

"Together they provide a hub for biomedical innovation that is transforming Orlando into a globe destination for biomedical education, research and healthcare," he says. "All these together create a top working environment which is hardly found at other universities.

Razavi like the other CAREER winners says that students are the heart of his research.

"They are like my second family," he says. "All I have accomplished and will achieve is because of my students. These students work alongside me, and I can't thank them enough for all the things they have done."

Razavi holds multiple degrees including a Ph.D. in biomaterials. He has published more than 80 articles and his work has contributed to securing eight patents. His students are also successful, includine, most recently, Angela Shar was awarded a Goldwater Scholarship. He mentors several students graduate, undergraduate and high school students.

Written by Zenaida Gonzalez Kotala.

To learn more about our faculty's research, visit https://mse.ucf.edu/lab-directory/.

Protecting Health

Three UCF Colleges Receive $4.5M for Infectious Disease, Travel Health Research Initiative

University of Central Florida's Rosen College of Hospitality Management, College of Medicine and College of Engineering and Computer Science have received $4.5 million dollars in funding for a research initiative aimed at mitigating the damage caused to hospitality, travel, and small businesses by health crises, like the COVID-19 pandemic.

The funding for the collaborative research project comes from the UCF Strategic Investment Program, supporting UCF President Alexander N. Cartwright's vision that UCF will become a "University for the Future" as a top public institution and the world's leading public metropolitan research university

The Infectious Disease and Travel Health Initiative has three major areas of focus:

• To provide an advance warning system through its data collection methods.

• To bring travelers and those who serve them closer to science, bridging the gap between basic science and behavioral science.

• To create a resource for small to medium-sized businesses in tourist areas to help them manage future health crisis situations that may arise.

The primary investigator on the initiative, Professor Robertico Croes, focuses his research on tourism economics, human development, poverty, and tourism management with a special interest in small and developing economies.

Croes says the Infectious Disease and Travel Health initiative is critical given travelling's economic impact on the world and its ability to alleviate poverty and elevate human development.

"We began this project in the early days of the pandemic," Croes says. "Health crises like this are not an anomaly, they are becoming more and more frequent. Sometimes they are isolated to one area of the globe, but as we saw with COVID, they can devastate entire segments of the economy and small businesses often can't recover as they don't have the resources that large corporations have in order to mitigate a crisis."

Griffith Parks, a collaborator on the initiative and professor and director of the Burnett School of Biomedical Sciences at UCF's College of Medicine, says he is enthusiastic about the project.

"We are thrilled to have the support from the university on this important and unique initiative," Parks says. "We aspire to build an initiative that will draw in faculty and students from other colleges, not just the three currently involved, such as nursing and health professions, who have an interest in population health, travel and tourism and in

infectious diseases. Most importantly, a goal of the initiative is to have a strong impact on our Central Florida communities by creating connections that will help to improve and support the health of our tourism workforce and industries."

Pandemics can have devastating consequences for regions where tourism and travel are the economic lifeblood. According to Visit Florida it's estimated the local economy in Central Florida took a $40 billion hit from lower rates of travel during the height of the COVID-19 pandemic.

Taj Azarian, an assistant professor at the Burnett School of Biomedical Sciences who investigates the emergence and spread of bacterial infectious diseases is collaborating on the project.

"Florida is a major tourist destination, as well as an international corridor to the United States. Further, its recent history has been marked by several notable public health events, as such, Florida is an ideal location to focus translational infectious disease research." Said Azarian. "Here, or initiative will serve to strengthen business continuity, improve health and safety of travelers, and establish a sentinel network for early detection of emerging threats."

Rosen College Associate Dean and Professor Alan Fyall, a collaborator on the initiative, says the work could have a global impact.

"The pandemic has woken the world up to the fragility and vulnerability of the global tourism industry," Fyall says. "The time is thus ripe to bring together an internationally recognized and highly experienced interdisciplinary team to develop new science-based solutions and strategies to build future economic and social strength for Central Florida and beyond."

The initiative's collaborators also includes Resea Kenneth Alexander, chief of the Division of Infectious Diseases at Nemours Children's Hospital, Florida, who says this is crucial work for future generations.

"It is important that Nemours Children's Hospital joins in this initiative with UCF for two reasons," Alexander says. "First, many of our tourist guests here in Florida are children. Second, many in our tourism labor force are raising families. Therefore, the health of children is central to the success of our tourism industry."

The Infectious Disease and Travel Health Initiative research project received funding in the Academic Excellence Category of the UCF Strategic Investment Program. The funding will help in hiring research faculty who can secure additional funding for the project; establishing new courses and a Travel & Health track of study within the Master of Public Health degree program; and developing partnerships within the hospitality, healthcare, and science industries. Current UCF faculty from several disciplines are engaged with the initiative.

"The interdisciplinary nature of the project and the involvement of engineering and nanoscience will have a tremendous impact on combatting future infectious disease and travel health," says Sudipta Seal, chair of the Materials Science and Engineering Department in the College of Engineering and Computer Science and co-principal investigator on the grant.

Seal's statement was echoed by project collaborator Jane Gibson, a professor of pathology at UCF's College of Medicine.

"We are excited to harness the collective expertise at UCF to support the health and well-being of our tourist industry colleagues, visitors and community," Gibson says.

The Infectious Disease and Travel Health Initiative is ongoing with work on the initiative starting this summer.

Written by Susan Vernon-Devlin.

To learn more about this initiative, visit https://bit.ly/3rTOWb5.

Professor Named Third President of Electrochemical Society

Jim Fenton, the director of the Florida Solar Energy Center and a professor of materials science and engineering, has been elected the third vice president of The Electrochemical Society.

Fenton has been a member of the industry organization for 40 years and previously held the title of ECS Secretary. In his candidacy statement, he said that he hopes to inspire future members of ECS to pursue careers in electrochemical and solid state research.

"To promote awareness of electrochemical and solid state scientific developments at the precollege level, I will encourage divisions, sections, student chapters and corporate members to provide educational tools for K–12 teachers," he said. "By disseminating ECS members' research to the general public, they too can be active in mitigating climate change."

As FSEC director, Fenton leads more than 50 faculty and staff members in the research, development and evaluation of clean energy technologies. He has more than 40 years of experience in electrochemical engineering, particularly in the areas of fuel processing, PEM fuel cells, high temperature corrosion, metal recycling and more.

Within ECS, he has held all positions within its New England Section, served as secretary for four years, chaired the ECS student poster session for four years and has sat on various committees and subcommittees.

A Night Among the Stars

College Honors Distinguished Alumni

The finest stars shined in Orlando on the evening of Oct. 14. They weren't celestial constellations, but rather the shining alumni, industry partners and donors of the UCF College of Engineering and Computer Science.

CECS hosted its annual Alumni Honors event this past month, celebrating its distinguished alumni from across the college, including from the Department of Materials Science and Engineering. The event included a cocktail hour, dinner, a fireside chat with the president of UCF and an awards presentation. A total of 16 awards were handed out, with Othmane Benafan '08 '09MS '12PhD and Sam Salama '03PhD earning the title of Distinguished Alumni from MSE.

A Three-Time Alumnus

Benafan is a well-known in the field of materials science for his work with shape memory alloys. Since 2012, he's worked at the NASA Glenn Research Center, where he leads a team of scientists and engineers to design functional materials for use in lightweight actuators and morphing structures. He holds five patents and has received more than 120 awards for his work. Now he can add one more award to the list.

"It's an honor for me to receive this award from UCF," Benafan says. "I have met many professors and made many friends that I still have relationships with. I look forward to continuing to serve in some capacity and being a part of the Knight's team."

Although Benafan earned all three of his degrees in mechanical engineering, he completed his research under the guidance of Professor Raj Vaidyanathan, an expert in shape memory alloys. Benafan says the opportunity to work with Vaidyanathan made the choice to return to UCF an easy decision.

"It was about the quality of the research, the value of the faculty, and the resources and support given to the student body," Benafan says. "UCF met that criteria and more. But for me, it was also about the opportunity to continue to

to learn about shape memory alloys and working with one of the top professors in the world."

UCF also provided opportunities for MSE alumnus Sam Salama, who says he chose the university for its world-class faculty and research. Salama serves as the chief executive for Hyperion Technologies, a U.S.-based microelectronic systems manufacturer. Prior to joining Hyperion, he worked at Intel as the vide president and general manager.

Like Benafan, Salama is well established in the field of materials science. He holds more than 130 patents in a range of areas, and has been a frequent keynote speaker and thought leader at multiple international forums. He says he is honored to be recognized by UCF for his professional accomplishments.

"I'm truly honored and very humbled by the selection for this award," Salama says. "For all of us, your alma mater holds a very special place in your heart and being awarded by UCF is really going to deepen the love I have for this institution."

Written by Marisa Ramiccio.
Photos by Kimberly J. Lewis.

To learn more about the CECS Alumni Honors recipients, visit https://bit.ly/3yXfuMJ.

Benafan Named 2022 Fellow of ASM International

As an undergraduate student in Professor Raj Vaidyanathan's Structures and Properties of Materials course, Othmane Benafan '08, '09MS, '12PhD became fascinated with the concept of metals with memory. The idea conjured up images of the shape-shifting T-1000 android assassin from Terminator. The intrigued mechanical engineering major had to learn more, so he joined Vaidyanathan's research group.

More than 10 years and three degrees later, Benafan has been recognized for his research on metals with memory, known in the industry as shape memory alloys. ASM International, a global organization for materials scientists and engineers, has named him a member of its 2022 Class of Fellows. This distinction is given to ASM International members who have made outstanding contributions to the field.

"It is a great honor to be elected to the ASM International 2022 Class of Fellows," said Benafan. "It's also motivation to continue my humble contributions to materials science and engineering and further expand my passion for STEAM in our society."

For more than a decade, Benafan has contributed to the field as a materials research engineer at the NASA Glenn Research Center in Cleveland, Ohio. In this role, he leads a team of scientists and engineers in developing a novel classes of shape memory alloys for aviation and space mechanical systems. This includes aircraft control systems with morphing capabilities as well as solar panels that can unfold in space. NASA Glenn recognized his work in 2019 with the Abe Silverstein Medal, which is given to employees with outstanding research that has practical applications in the field. Over the years, Benafan has garnered more than 120 awards for his research.

Benafan's rising star is the result of a lot of hard work that began in his early days as a Knight. He worked at a Disney hotel during the day to make ends meet and took classes at night. But with the support of UCF faculty and staff, he was able to complete his undergraduate degree.

"UCF programs and staff gave me some level of flexibility and cooperative understanding to pursue my education while still making ends meet," he said. "To my fortune, I found the level of education at UCF to be splendid, from the professors to the quality of the labs."

His experience and interest in shape memory alloys led him to continue his education at UCF. His advice for current engineering students is to start planning for a career now. Ask professors for advice, and seek opportunities that can give experience and insight into potential career paths.

"Apply for internships to get some field experience and probe the path. Join a research group and see what goes on in the labs," Benafan said. "Most importantly, follow your passion and not someone else's path."

UCF Researchers Prove COVID Disinfectant Works in Latest Paper

A team of UCF researchers have proven the efficacy of a nanomaterial-based disinfectant they developed to combat the spread of the COVID-19 virus. Through their experiments, they found that the disinfectant was able to kill several serious viruses including SARS and Zika. The results of their findings were recently published in ACS Applied Materials and Interfaces.

"It is always a delight to have our research work featured in a reputed journal," said Udit Kumar, a doctoral student in the Department of Materials Science and Engineering (MSE) and the lead author of the journal article. "Given the theme and possible impact of antiviral research in current times, our article will definitely aid our fight against global pandemics."

The paper outlines the most recent study from a multidisciplinary team of researchers that includes Sudipta Seal, the chair of the MSE department, and Griff Parks, a College of Medicine virologist and director of the Burnett School of Biomedical Sciences. They experimented with the nanomaterial yttrium silicate, which has antiviral properties that are activated by white light, such as sunlight or LED lights. As long as there is a continuous source of light, the antiviral properties regenerate, creating a self-cleaning surface disinfectant.

"Yttrium silicate acts as a silent killer, with antiviral properties constantly recharged by the light," Kumar says. "It is most effective in minimizing surface to the surface spread of many viruses."

Kumar says their test of yttrium silicate in white light disinfected surfaces with high viral loads in approximately 30 minutes. Additionally, the nanomaterial was able to combat the spread of other viruses including parainfluenza, vesicular stomatitis, rhinovirus, Zika and SARS.

"This disinfectant technology is an important achievement for both engineering and health because we all were affected during the pandemic," Seal says. "COVID is still ongoing and who knows what other illnesses are on the horizon."

Other UCF researchers, including College of Medicine postdoctoral researcher Candace Fox '16MS '19PhD, nanotechnology student Balaashwin Babu '20 and materials science and engineering student Erik Marcelo, are co-authors on the paper.

"This publication is the culmination of timely insight by the investigators as to the importance of rapid development of broad-spectrum anti-microbials, as well as hard work in the lab to show the potency of our new materials," Parks says. "This is an outstanding example of the power of cross-discipline research — in this case, materials science and microbiology researchers from CECS and COM."

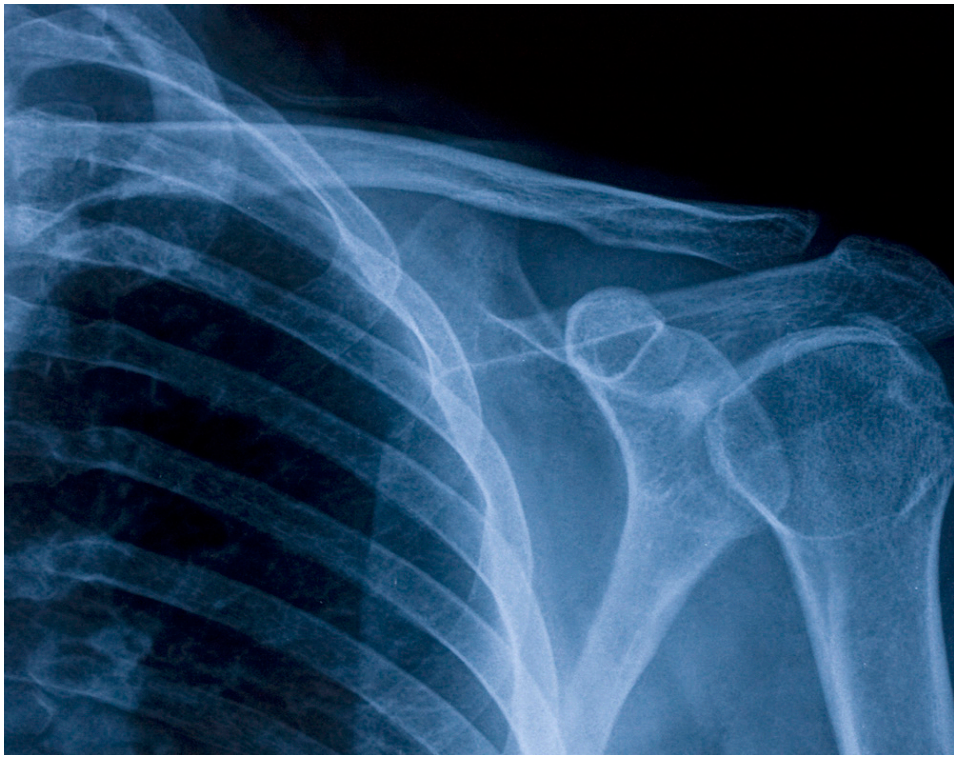
The research is funded by the U.S. National Science Foundation's RAPID program.

Seal joined UCF's Department of Materials Science and Engineering and the Advanced Materials Processing Analysis Center, which is part of UCF's College of Engineering and Computer Science, in 1997. He has an appointment at the College of Medicine and is a member of UCF's prosthetics cluster Biionix. He is the former director of UCF's NanoScience Technology Center and Advanced Materials Processing Analysis Center. He received his doctorate in materials engineering from the University of Wisconsin.

Parks is the College of Medicine's associate dean for Research. He came to UCF in 2014 as director of the Burnett School of Biomedical Sciences after 20 years at the Wake Forest School of Medicine, where he was professor and chairman of the Department of Microbiology and Immunology. He earned his doctorate in biochemistry at the University of Wisconsin and was an American Cancer Society Fellow at Northwestern University.

Written by Marisa Ramiccio.

To read the full journal article, visit https://bit.ly/3VgS3aF.



Strong Defense:

UCF Researchers Design Treatment to Protect Bones During Cancer Therapy

UCF material sciences engineers Melanie Coathup and Sudipta Seal have designed a cerium oxide nanoparticle — an artificial enzyme — that protects bones against damage from radiation. The nanoparticle has also shown abilities to improve bone regeneration, reduce loss of blood cells and help kill cancer cells.

Their study, a collaboration with Oakland University, North Carolina A&T University, the University of Sheffield and University of Huddersfield in the U.K., was published in Bioactive Materials.

Approximately 50% of all cancer patients receive radiation therapy — a treatment that uses electrically charged particles to kill cancer cells. About 40% of patients are cured with this therapy. However, bone damage is a side effect, impacting about 75% of patients receiving radiation.

"Because of its high calcium content, bone absorbs 30-40% more radiation than other tissues and so it is a common site of injury," says Coathup, director UCF's Biionix faculty cluster. "Radiation makes the bone brittle and easily fractured. And due to the damage caused by radiation, many people are then unable to repair their bone fracture. In some people, this leads to having an amputation to resolve the complication."

While radiotherapy beams are directly aimed at the tumor, surrounding healthy tissue also gets damaged and can cause many additional health issues for patients.

"At the moment, there is no real drug or therapy to protect healthy tissue from the damage caused by radiation," Coathup says. "This is not only a problem for cancer patients who undergo radiotherapy but also poses problems for astronauts and future deep space exploration."

The body's natural defense against radiation is a group of enzymes called antioxidants — but this defense system gets easily overwhelmed by radiation and on its own cannot protect the body from damage. Seal, a leading nanotechnologist, designed the cerium oxide nanoparticle — or nanoceria — that mimics the activity of these antioxidants and has a stronger defense mechanism in protecting cells against DNA damage.

"The nanoceria works with a specifically designed regenerative lattice structure responsible for destroying harmful reactive oxygen species, a byproduct of radiation treatment," Seal says.

Working with postdoctoral researcher Fei Wei, Coathup tested the nanozyme in live models receiving radiation therapy.

"Our study showed that exposing rats to radiation at similar levels to those given to cancer patients led to weak and damaged bones," Coathup says. "However, when we treated the animals with the nanozyme, before and during three doses of radiation over three days, we found that the bone was not damaged, and had a strength similar to healthy bone."

The study also showed that the nanozyme treatment helped kill cancer cells, possibly due to an increase in acidity, and protected against the loss of white and red blood cells that usually occurs in cancer patients. A low white and red blood cell count means the patient is more susceptible to opportunistic infection, less able to fight cancer and is more fatigued. Another interesting find is that the nanoparticle also enhanced healthy cells' ability to produce more antioxidants, reduced inflammation (which also leads to bone loss) and promoted bone formation.

Future research will seek to determine appropriate dosage and administration of the nanozyme and further explore how nanozyme helps to kill cancer cells. The researchers will also focus their studies in the context of breast cancer, as women are more susceptible to bone damage than men.

"Cancer patients are already struggling with fighting one disease," Coathup says. "They shouldn't have to be worried about bone fractures and tissue damage. So we're hoping this breakthrough will help survivors go back to living a normal and healthy life."

Written by Christin Senior.

Watch Melanie Coathup discuss the research with the media: https://bit.ly/3et8Qqnk.

A Group of GEMS

MSE Graduate Fellows Gain Hands-On Experience With National Industry Leaders

Seven University of Central Florida graduate students, including two from the Department of Materials Science and Engineering, are currently interning at Adobe and 3M, among other leading employers thanks to fellowships supported by the National Graduate Degrees for Minorities in Engineering Fellowship (GEM) program.

The GEM program began in 1976. The public-private partnership aims to connect students from underrepresented groups with the nation's top employers and universities. Those selected receive a $16,000 fellowship from the GEM Consortium, a paid summer internship, and a tuition remission for a master's or doctoral program of their choice. The national program is highly competitive and enables students to be placed in coveted internships with some of the nation's industry leaders in STEM.

UCF has been a partner university for more than 20 years. The GEM program is one of several supporting students of color at UCF, a Hispanic Serving Institution.

Novia Berriel '21MS

Currently a researcher in associate professor of materials science Parag Banerjee's lab, Novia Berriel will continue her education as a doctoral fellow in materials science. She originally came to UCF because of the so-called "two-body problem" — the need for two professional spouses to find suitable placements in the same area — but has since fallen in love with everything the university has to offer.

"UCF is at the cutting edge of everything," she says. "And being a Hispanic woman, I appreciate that it's an HSI."

Berriel earned her master's in physics at UCF in 2021. Since she began the degree in 2018, she has been working to explore atomic layer deposition of thin films. In this capacity, she's been able to engage with different disciplines by producing the films needed for a variety of devices.

The opportunity "to be interdisciplinary in your everyday life" is one of her favorite aspects of the materials science department at UCF.

"You can collaboratively interface with so many other labs," Berriel says. "I work in Research Building I, which houses faculty and labs from many different departments. So, I've been able to meet experts in different disciplines by just walking around."

As a GEM fellow and intern for Lam Research, she hopes to build expertise in semiconductor development and solar cells, while making the most of the chance to research freely, meet other Fellows and embrace interdisciplinary collaboration.

Andrea Molina Moreno '22

After building a foundation in the different areas of STEM, Andrea Molina Moreno decided to focus on materials engineering.

She says that "it has a uniquely broad scope. You can work with anything you choose, since almost everything is material."

Moreno came upon this decision in the midst of several transitions: immigrating from Caracas, Venezuela, transferring from Simón Bolívar University, and graduating among UCF's first cohort of bachelor's materials science students.

With the GEM fellowship, she will pursue a doctoral degree in materials science. This summer, she is gaining experience in industry by interning at 3M in Minneapolis. As she continues her education, Moreno most looks forward to serving as a role model for fellow Hispanic female engineers.

What has motivated her so far is the desire to "gather as much knowledge as she possibly can." She shares that "I've been studying for so much of my life, and it's what I really enjoy doing — learning more and more."

Written by Alexandra Angeloff.

To read the full article, visit https://bit.ly/3VkycrO.

SENIOR LEADERS

First Student Team From MSE Participates in College's Senior Design Showcase

The Department of Materials Science and Engineering marks a milestone this year with its first entry in the Senior Design Showcase. A team of four students, guided by Assistant Professor Tengfei Jiang, made department history when they presented their project, titled "Alloy Design for Solder Joints in Advanced Semiconductor Devices."

"Being the first in anything can be exciting, it can also be scary," said team leader Nicolas Ayers. "I feel a lot of pressure to set the bar high. A lot of work has gone into creating this new undergraduate program and I feel a responsibility to show everyone what all their hard work has accomplished."

The Senior Design Showcase will give Ayers and his teammates — Natalie Crutchfield, Andrea Molina Moreno and Devin Lyons — a chance to show of what they've accomplished over the past year. The team has collected data on the properties of bismuth-doped solder alloys, a less toxic version of the lead-based solder alloys used to join together metal parts in electronics.

"Because of the toxicity of lead there has been a recent push to use lead-free solders in electronic devices," Ayers said. "Of the available lead-free solders, Tin-Silver-Copper (Sn-Ag-Cu or SAC) has been the most popular."

SAC alloys aren't the most reliable though. Ayers says that as our electronic devices become bigger and consumer more power, solder joints made with SAC alloys can experience significant thermo-mechanical stress. One solution to this problem is to add in bismuth, which can increase the strength and reliability to SAC alloys.

The data that the students collected on bismuth-doped solder alloys will be used by their sponsor, Juniper Networks, to run computer simulations that can predict the life expectancy of these materials.

The work that the team has done not only impacts their sponsor, but paves a path for future materials science and engineering students who participate in the Senior Design Showcase. MSE Professor and department chair Sudipta Seal said he's proud of this group and of future teams to come.

"I'm very proud of our creative MSE undergraduates who utilize their materials knowledge and skills to design functional engineering products from space to microelectronics applications."

As the first leader of the pioneering team, Ayers advises future MSE Senior Design teams to take advantage of the connections they've made with their professors as well as the resources and facilities made available to them.

"Also keep in mind that it is your project, you have a lot of control over the scope and direction of the project," Ayers said. "Seize the opportunity to apply what you have learned in your undergrad and design something truly impressive."

Written by Marisa Ramiccio.

Watch the Senior Design team's project video: https://bit.ly/3Ct25gi.

AI-Based Screening Method Could Boost Speed of New Drug Discovery

Developing life-saving medicines can take billions of dollars and decades of time, but University of Central Florida researchers are aiming to speed up this process with a new artificial intelligence-based drug screening process they've developed.

Using a method that models drug and target protein interactions using natural language processing techniques, the researchers achieved up to 97% accuracy in identifying promising drug candidates. The results were published recently in the journal Briefings in Bioinformatics.

The technique represents drug–protein interactions through words for each protein binding site and uses deep learning to extract the features that govern the complex interactions between the two.

"With AI becoming more available, this has become something that AI can tackle," says study co-author Ozlem Garibay, an assistant professor in UCF's Department of Industrial Engineering and Management Systems. "You can try out so many variations of proteins and drug interactions and find out which are more likely to bind or not."

The model they've developed, known as AttentionSiteDTI, is the first to be interpretable using the language of protein binding sites.

The work is important because it will help drug designers identify critical protein binding sites along with their functional properties, which is key to determining if a drug will be effective.

The researchers made the achievement by devising a self-attention mechanism that makes the model learn which parts of the protein interact with the drug compounds, while achieving state-of-the-art prediction performance.

The mechanism's self-attention ability works by selectively focusing on the most relevant parts of the protein.

The researchers validated their model using in-lab experiments that measured binding interactions between compounds and proteins and then compared the results with the ones their model computationally predicted. As drugs to treat COVID are still of interest, the experiments also included testing and validating drug compounds that would bind to a spike protein of the SARS-CoV2 virus.

Garibay says the high agreement between the lab results and the computational predictions illustrates the potential of AttentionSiteDTI to pre-screen potentially effective drug compounds and accelerate the exploration of new medicines and the repurposing of existing ones.

"This high impact research was only possible due to interdisciplinary collaboration between materials engineering and AI/ML and Computer Scientists to address COVID related discovery" says Sudipta Seal, study co-author and chair of UCF's Department of Materials Science and Engineering.

Mehdi Yazdani-Jahromi, a doctoral student in UCF's College of Engineering and Computer Science and the study's lead author, says the work is introducing a new direction in drug pre-screening.

"This enables researchers to use AI to identify drugs more accurately to respond quickly to new diseases, Yazdani-Jahromi says. "This method also allows the researchers to identify the best binding site of a virus's protein to focus on in drug design."

"The next step of our research is going to be designing novel drugs using the power of AI," he says. "This naturally can be the next step to be prepared for a pandemic."

The research was funded by UCF's internal AI and big data seed funding program.

Co-authors of the study also included Niloofar Yousefi, a postdoctoral research associate in UCF's Complex Adaptive Systems Laboratory in UCF's College of Engineering and Computer Science; Aida Tayebi, a doctoral student in UCF's Department of Industrial Engineering and Management Systems; Elayaraja Kolanthai, a postdoctoral research associate in UCF's Department of Materials Science and Engineering; and Craig Neal, a postdoctoral research associate in UCF's Department of Materials Science and Engineering.

Garibay received her doctorate in computer science from UCF and joined UCF's Department of Industrial Engineering and Management Systems, part of the College of Engineering and Computer Science, in 2020. Previously, she worked for 16 years in information technology for UCF's Office of Research.

Written by Robert Wells.

To read the full journal article, visit https://bit.ly/3CS8fb8.

Emerging Technologies

MSE Researchers Are Part of New Multi-Million Dollar Awards from Department of Defense

Three University of Central Florida researchers, including two from MSE, are part of recently announced multi-million-dollar research projects aimed at facilitating the growth of newly emerging technologies for the U.S. Department of Defense.

The awards, which are part of the DOD's Multidisciplinary University Research Initiative, will support projects that range from advancing hypersonic propulsion to improving semiconductor performance and will fund the work for the next five years.

The awardees from MSE are:

Assistant Professor Tania Roy

Project: REDESIGN: Radiation Effects preDiction through Experimentally validated Simulation of Gallium Nitride
Amount: $7.5 million total project award, with UCF receiving $700,000

The work will focus on understanding defects caused by ionizing radiation in gallium nitride semiconductors, which are used in high-power and 5G network devices.

Ionizing radiation comes from the sun or other celestial bodies and can affect devices in space and on the Earth through solar flares.

"It is important to understand how radiation will affect the devices and what can be done at the roots to make these devices immune to radiation," Roy says.

Her team will use standard and novel techniques to understand the nature of the defects. This includes further developing sophisticated techniques, such as inelastic electron tunneling spectroscopy in a magnetic field.

Pennsylvania State University is the lead institution for the project, and it also includes researchers with Carnegie Mellon University and the University of Iowa. The work is sponsored by the U.S. Air Force Office of Scientific Research.

Professor Kevin Coffey

Project: Comprehensive Minimally/ Noninvasive Multifaceted Assessment of Nano/ Microelectronic Devices (CoMMAND)
Amount: $7.5 million total project award, with UCF receiving $561,000

This work will examine advanced metrology, or measuring, techniques for microelectronics. As semiconductor electronics continue to advance, novel characterization and metrology techniques are needed to ensure reliability and design consistency, Coffey says.

His research team will be using experimental techniques developed from current and prior projects.

"I am very pleased that this MURI was selected for funding and pleased to be part of this strong group of collaborators," Coffey says. "The project's longer term of five years is very welcome as it provides the opportunity for significant scientific discovery."

The State University of New York at Buffalo is leading the research, and the project also includes researchers with Columbia University; Boston University; the University of Maryland, College Park; and the University of Arizona. The work is sponsored by the Air Force Office of Scientific Research.

About the 2022 MURI Awards

For the competitive, 2022 DOD MURI Awards, the Army Research Office, the Air Force Office of Scientific Research, and the Office of Naval Research solicited proposals in more than 25 topic areas of strategic importance.

From a merit-based review of approximately 340 proposals received, a panel of experts narrowed the proposals to a subset, from which the 28 final awards were selected. The grants, which total $195 million, will be provided to teams located across 63 U.S. academic institutions for five years each, subject to satisfactory research progress and the availability of funds.

Written by Robert Wells.

To read the full article, visit
https://bit.ly/3CV4thj

MSE BY THE NUMBERS

The UCF Department of Materials Science and Engineering has seen tremendous growth over the past several years. From faculty research to student growth, take note of these impressive numbers.

3.8M

External research funding
2021-22

3.4M

Research expenditures
2021-22

4.2M

Three-year external funding average

110

Number of journal articles produced by MSE faculty
2021-22

10

Number of conference papers produced by MSE faculty
2021-22

92

Number of talks given by MSE faculty
2021-22

33

Number of invited talks given by MSE faculty
2021-22

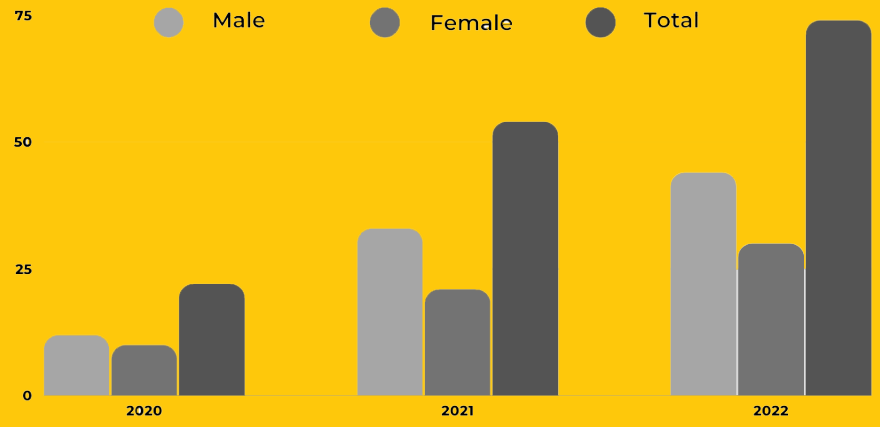
9

Number of patents issued to MSE faculty
2021-22

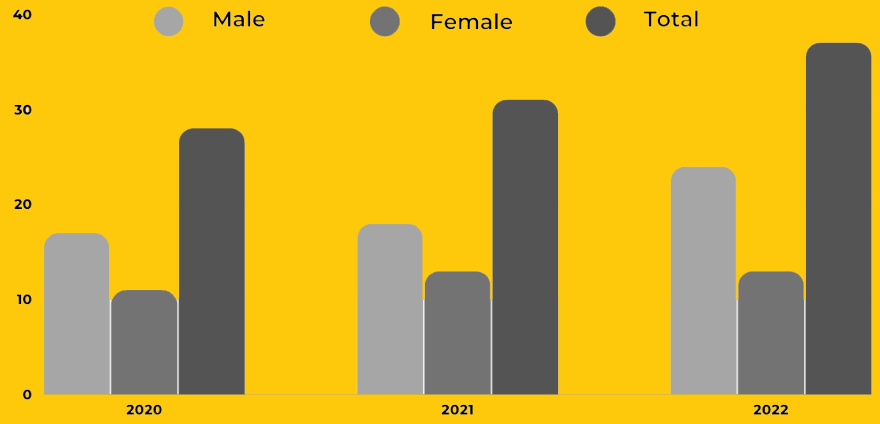
20

Number of core faculty and adjuncts
2021-22

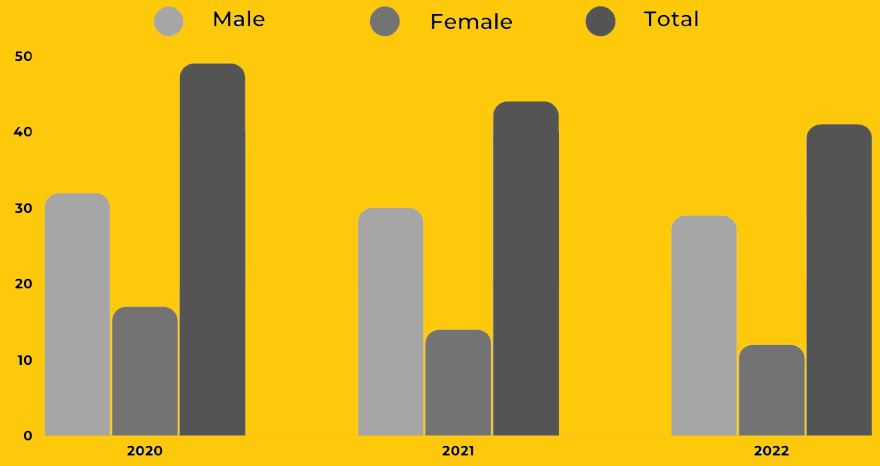
Undergraduate Enrollment



Master's Degree Enrollment



Doctoral Degree Enrollment



To learn more about the department, visit mse.ucf.edu.

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