CONTINUUM

UCF Department of Materials Science and Engineering
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UCF

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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 Colleagues,

It's been another exciting and successful year for the UCF Department of Materials Science and Engineering. This semester, we hired five amazing new faculty members who bring expertise in electronics, nanomedicine and hypersonics to our esteemed group of professors. We've hired a total of 10 new faculty members within the past two academic years, and we plan to expand that number in the coming semesters.

I'm excited to see the innovative research ideas these new faculty will bring to fruition, and judging by the research output from our faculty this year, their discoveries are sure to be groundbreaking.

Assistant Professor Kris Davis and his team of researchers were awarded $1.5 million from the U.S. Department of Energy to improve the efficienct of solar cells while, more recently, Assistant Professor Leland Nordin received $1 million from the U.S. Army to develop a semiconductor light source that help the military communicate.

On our cover, you'll see Associate Professor Yang Yang in his lab with one of his students. This year, he has developed technology that can transform carbon dioxide into fuel. His device could be used by industrial factories and chemical plants and was inspired by the lotus flower. Yang is also collaborating with researchers from the UCF Department of Civil, Environmental and Construction Engineering to create clearner drinking water with the aid of gold.

It isn't just our faculty that's soaring to new heights. Alumnus David Reid '12PhD, the founder of the Helicon Chemical Company, was awarded awarded a $1.9 million Tactical Funding Increase Contract from the U.S. Air Force to accelerate its enhanced-performance solid rocket propellant research and production. Doctoral student Novia Berriel '21MS was also recognized by the Society of Vacuum Coaters, which awarded her with a $2,500 scholarship. Berriel is also a previous recipient of the UCF GEMS Fellowship, whicg connects underrepresented students with the nation's largest employers. I'm sure you'll see much more from Berriel and Reid in the future.

I'm also proud to announce that Professor Jiyu Fang has been recognized for his longtime contributions to the field through the International Association for Advanced Materials Scientist Medal, a prestigious achievement for academics and professionals in the field. Assistant Professor Kaitlyn Crawford was also honored for her work by the American Chemical Society, which invited her to present at the Early Investigator Sympsoium this fall.

You can learn about all of these people and their wonderful accomplishments in this issue of *Continuum*. If you want to explore the department further, visit our website at mse.ucf.edu or follow us on social media at @ucfmse.

Go Knights! Charge On!

Sincerely,

Sudipta Seal
Chair, Department of Materials Science and Engineering

To find out how you can support the MSE department, visit **bit.ly/givetomse.**

Making an Impact

Five Academics and Practitioners Join MSE Department

The UCF Department of Materials Science and Engineering is making an impact in areas such as hypersonic technology, nanomedicine, bioengineering, and electronics — and has hired a new group of faculty who will enhance its reputation in these fields.Five new faculty members have joined the department this fall, with more to come in the spring. Overall, the department has brought in a total of 10 new faculty members over the past two academic years, reflecting the College of Engineering and Computer Science's goals of providing quality education and producing innovative research.

Needa Brown, Assistant Professor

Brown comes to UCF from Northeastern University, where she served as an assistant professor of physics, the assistant director of the Cancer Nanomedicine Co-ops for Undergraduate Research Experience (CaNCURE), and the founder and director of the master's degree in nanomedicine. Her research focuses on the development of nanomaterials to provide solutions for cancer and infectious diseases.

Sidong Lei, Assistant Professor

Lei joins UCF from Georgia State University, where he taught physics. His research lab, known as the Functional Materials Studio, develops new electronic, optoelectronic and quantum devices for applications in biomedicine, microelectronics and sensing systems. Lei earned his doctoral degree from Rice University and completed a postdoctoral research position at the University of California, Los Angeles.

David Mitchell, Associate Professor

Mitchell joins UCF from the Oak Ridge National Laboratory, where he worked as a senior research and development materials scientist. During his tenure at ORNL, he built new research laboratories, advanced manufacturing capabilities and assembled a team to create the next generation of composite materials used in aerospace, hypersonic, nuclear and advanced energy applications. He earned his doctoral degree in materials science and engineering from the University of Florida, and completed his research at ORNL.

Aleksandra Petelski, Assistant Professor

Petelski is the co-founder of Parallel Squared Technology Institute, a nonprofit research organization dedicated to scaling up proteomics, or the study of proteins, for biological research. At UCF, she aims to exploit the heterogeneity of single cell proteomes towards building better materials for biomedical applications. She earned her doctoral degree in bioengineering from Northeastern and her master's and bachelor's degrees from the Stevens Institute of Technology.

Rachna Rachna, Lecturer

Rachna's research focuses on the innovative green synthesis of nanomaterials and their applications in the degradation of organic contaminants. She earned her doctoral degree in 2021 from the National Institute of Technology in India.

To learn more about our faculty, visit **mse.ucf.edu.**

Optimized Oxides

UCF Researcher's Nanoparticles Serve as Pivotal Delivery Component of Promising Pediatric Cancer

The fight against cancer is an all-hands-on-deck battle.

UCF researcher Sudipta Seal joined the fight by collaborating with Johns Hopkins Kimmel Cancer Center to provide a key component for a targeted medicine that combats the most common kind of pediatric brain tumor.

Seal, who is a Pegasus Pofessor and chair of the Materials Science and Engineering Department within the College of Engineering and Computer Science, along with his postdoctoral researcher Elayaraja Kolanthai, created a solution containing therapeutic cerium oxide nanoparticles that acts as a protective vehicle to deliver a combination of cancer therapies through the body and to a patient's brain. Their work was recently published in the journal *Cell Reports*.

A Targeted Approach

The intravenous mixture of therapies attacks medulloblastomas — or tumors — on all fronts. Ranjan Perera, director of the Center for RNA Biology at Johns Hopkins All Children's Hospital in St. Petersburg, Florida, and his team developed the medicine that targets a specific part of RNA that "reprograms" a region of our DNA to hinder cancer causing genes.

A specific, long non-coding RNA, lncRNA, was identified as a potential bullseye target that accumulates and promotes cancerous growth. Johns Hopkins assembled a sequence of nucleotides – the building blocks of RNA – that can bind to the specific parts of the cancer-promoting portion of the RNA and destroy it.

Perera and his team paired the genetic treatment with cisplatin, a common intravenous chemotherapy medication that disrupts cancer cells and prevents them from replication.

The treatment was tested in mice and results showed that it inhibits tumor growth by 40-50%. The intravenous method may have an advantage as an alternative therapy to craniospinal irradiation as it may have less long-term side effects and risk of relapse.

The hope is once this specific genetic expression is identified and this treatment is administered, the malignant tumor growth can be halted and even eliminated in human patients.

Safe Delivery

Protecting the combination of promising treatments, bolstering therapeutic value and ensuring they reach their target is precisely what the cerium oxide was intended to do, Seal says.

"We can attach various drugs to the nanoparticles and deliver them to a specific site for medical intervention," he says. "The medication on its own already has its own applications, so when you combine them, their role in intervention becomes quite significant. We are quite excited about this." Seal and Perera previously had worked together and were familiar with each other's work. After a few conversations between the two, a collaboration on this pediatric cancer research seemed like a good fit.

"This medication can be very difficult to deliver to sites," Seal says. "Dr. Perera and I knew each other and so there was mutual interest between us both. I spoke with Dr. Perera, and he said that he had microorganisms to deliver, and that we've been studying oxides for a long time. They're very well known in medicine, and here we are at UCF we're well known for our oxide vector delivery."

Seal's cerium oxide has been used in a variety of biomedical and therapeutic applications even before it was used in the Johns Hopkins study. The cerium oxide nanoparticles previously were shown to aid in healing diabetic wounds and to maintain bone strength during cancer treatments.

What makes these specific nanoparticles so useful is that because they are oxides, they can bond with such a varied spectrum of other compounds at the molecular level, Seal says.

"Oxides are omnipresent in nature, and so they can be fairly compatible with many things," he says. "It's almost like a LEGO block. You've got many anchors to attach to on it and many different kinds to attach to."

For this instance, the cerium oxide ensures the genetic therapy and chemotherapy successfully travels to the site of the brain tumor rather than taking any pit stops along the way, Seal says.

"It has the power to be like a GPS system," he says. "You can program it to go to a specific address, or maybe it'll make a stop or bypass a stop. That is the power of what we can do with nanotechnology."

Studying and tweaking the particles (which are less than 10 nanometers in length) in water allows them to be highly customizable and to fit like a block or travel to the correct site.

Seal is greatly encouraged by the promise of the study and is excited to continue pursuing other ways to utilize his cerium oxide.

He invites other researchers to collaborate and see if he and his nanoparticles make a good fit.

"We're open to opportunities," Seal says. "I think this nano oxide vector can really help, and it opens a whole door of other biomedical opportunities that needs to be explored. We can modulate our nano vector in a way that it can sense and intervene in many ways. We're happy to see if any other drugs can be attached to our molecules.

The research was funded by the National Institutes of Health, National Cancer Institute and various other sources.

The researchers plan to study the therapy in humans to further test its safety and efficacy in hopes of triumphing over pediatric cancer and providing relief for children with cancer.

Researcher's Credentials

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 Biionix faculty cluster initiative. He is the former director of UCF's NanoScience Technology Center and Advanced Materials Processing Analysis Center. He received his doctorate in materials engineering with a minor in biochemistry from the University of Wisconsin and was a postdoctoral fellow at the Lawrence Berkeley National Laboratory at the University of California Berkeley.

Kolanthani is a postdoctoral scholar for the Nano BioMaterials Group, managed by Seal. He earned his doctoral degree in biomaterial science at Anna University in India. His research focuses on the development of nanoparticles, antimicrobial nanoparticle coatings, composites for tissue engineering and drug delivery applications.

By Eddy Duryea '13

To learn more about Seal's research, visit bit.ly/SealLab.

UCF Researchers Develop Life-Saving, Spongelike 'Bandage'

Without medical invention, injuries sustained from serious accidents may result in fatal hemorrhaging.

UCF researchers aim to prevent this through a new hemostatic spongelike bandage with antimicrobial efficacy that they recently developed and detailed in the journal *Biomaterials Science.*

"What happens in the field or during an accident is due to heavy bleeding, patients can die," says Kausik Mukhopadhyay, assistant professor of materials science and engineering. "These fatalities usually occur in the first 30 minutes to one hour. Our whole idea was to develop a very simple solution that could have the hemostatic efficacy within that time. If you can save the patient, then the doctors and the nurses can then save the patient."

Mukhopadhyay and his team developed SilFoam, which is more of a foam than a traditional bandage wrap. SilFoam is a liquid gel comprised of siloxanes that rapidly expand into a spongy foam within the wound in under one minute. The sponge applies pressure to restrict the hemorrhage at the delivery site while also serving as an antibacterial agent because of the silver oxide in it.

"Anytime you have a profuse bleeding or bleeding, you want to press on top and stop the bleeding," he says. "So, what we did here is actually the same thing. Instead of putting the hand, we injected it, and it creates a voluminous expansion."

INSPIRING INNOVATION

UCF Ranks 21st in U.S. Public Universities for Patents

UCF continues to be a top university in the world for producing patents, securing 57 patents in calendar year 2023 and ranking 53rd among public and private universities in the world and 21st among public universities in the nation.

The worldwide rankings, released from the National Academy of Inventors, placeS UCF in a tie with Yale University (57) and ahead of U.S. institutions such as Vanderbilt (56), Princeton (44) and Florida State University (38).

This is the 11th year that UCF has ranked in the top 100 universities in the world for patents.

"Innovation is at the heart of our mission at UCF, and these latest patent rankings reaffirm our commitment to pushing boundaries and making impactful advancements," says Winston V. Schoenfeld, UCF's interim vice president for research and innovation. "The diverse range of inventions reflects the dedication and ingenuity of our researchers across the research enterprise, and their efforts continue to position UCF as a leader in innovation, both nationally and globally."

The patents were secured by UCF's Office of Technology Transfer, which brings discoveries to the marketplace and connects UCF researchers with companies and entrepreneurs to transform innovative ideas into successful products.

Here are a few of the UCF materials scienc and engineering inventions that led to patents in 2023:

Coating for Capturing and Killing Viruses on Surfaces
Lead researcher: Pegasus Professor Suditpa Seal

This technology is a nano-coating designed to capture, hold and kill viruses on a surface, such as on personal protective equipment and clothing, using natural light sources to protect against infections.

The COVID-killing coating is made with a nanomaterial that activates under white light, such as sunlight or LED light. As long as the nanomaterial is exposed to a continuous light source, it can regenerate its antiviral properties, creating a self-cleaning effect.

The efficacy of the disinfectant was shown through a study that was published in ACS Applied Materials and Interfaces this past year. The study found that the coating can not only destroy the COVID-19 virus, but it can also combat the spread of Zika virus, SARS, parainfluenza, rhinovirus and vesicular stomatitis.

Production of Nanoporous Films
Lead researcher: Associate Professor Yang Yang

UCF researchers have created a method for making metal composite films for use in energy applications, such as for fuel cells, hydrogen production, photocatalysts, sensing and energy storage, and electrodes in supercapacitors. The method improves performance and versatility and does not require use of costly precious metals, such as gold. Instead, the UCF technology uses low-cost, earth-abundant resources such as iron, cobalt and nickel. The nanoporous thin films are designed to help meet today's challenges in renewable energy production and conversion applications.

Method of Forming High-Throughput 3d Printed Microelectrode Array
Lead researcher: Associate Professor Swaminathan Rajaraman

This invention is a 3D printed mini-lab that controls liquids and gases very precisely. The device has small channels and chambers that guide liquids, like samples or chemicals, to a central area where there are special electrodes. These electrodes can send and record electrical signals from tiny groups of cells called spheroids. Scientists can use this to see how cells react to different conditions and substances. The innovation offers an easy way to study biological cells, tissues and electrophysiological responses. The technology can help lead to advancements in disease modeling, toxicity assessments and drug discovery.

Written by Robert Wells

To learn more about our research, visit **mse.ucf.edu.**

Accessible Energy

UCF Researchers Lead $1.5M Project to Improve Efficiency of Solar Cells

A team of researchers from the University of Central Florida and the University of Delaware's Institute of Energy Conversion has received a $1.5 million grant from the U.S. Department of Energy Solar Technologies Office to develop a novel metallization process that could improve the efficiency and lower the cost of solar cells, making solar energy more accessible to consumers.

The metallization process produces the metal contacts that are placed on the surface of silicon solar cells to harvest electrical currents. Silver is typically used to manufacture the contacts due to its ability to withstand high temperatures without oxidizing, but it's very expensive to use.

"Silver constitutes some of the highest costs to producing photovoltaic cells, and the photovoltaics industry is expected to consume 20% of the annual global silver supply by 2027," says Kristopher Davis, the project's principal investigator and a UCF associate professor of materials science and engineering. "Copper is less expensive and also has a low electrical resistivity and is therefore a great potential alternative metal, but it has many challenges."

One of those challenges is the fact that copper can oxidize in high temperatures, negatively impacting its conductivity. To solve this problem, the researchers will use lasers to heat the copper nanoparticles and reduce the possibility of oxidation.

"This approach has the potential to increase the efficiency of heterojunction solar cells and dramatically reduce their manufacturing costs," Davis says. "This will hopefully help accelerate the adoption of solar energy by lowering the cost barriers that exist for some consumers."

UCF researchers on the team also include Aravinda Kar, a professor in CREOL, The College of Optics and Photonics and Ranganathan Kumar, a professor of mechanical and aerospace engineering and the associate dean of research and administration for the College of Engineering and Computer Science.

The UCF team will collaborate with their counterparts at the Institute of Energy Conversion, led by research scientist Ujjwal Das.

The project is one of 19 selected for funding from President Biden's Investing in America agenda, and one of eight projects that aim to reduce costs and increase efficiency of panel recycling processes through Biden's Bipartisan Infrastructure Law.

About the Researchers

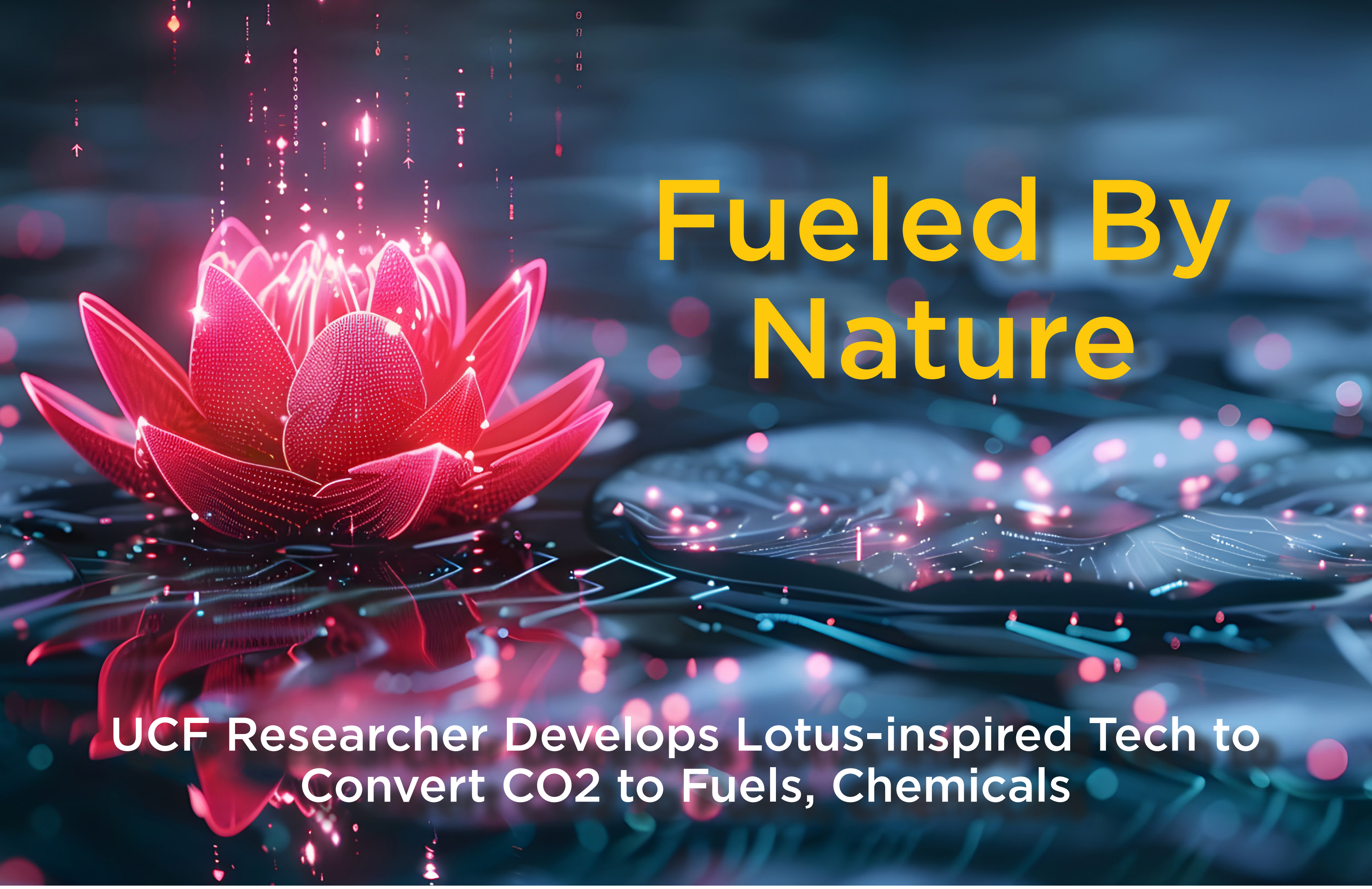
Davis joined UCF in 2017 as an assistant professor of materials science and engineering. He is a three-time graduate of UCF, having earned his Ph.D. and M.S. in optics and photonics and his B.S. in electrical engineering. He has joint appointments with the College of Optics and Photonics and the Florida Solar Energy Center and is a member of the Resilient, Intelligent, and Sustainable Energy Systems (RISES) faculty cluster initiative.

Kumar joined UCF in 2003 as the chair of the Department of Mechanical and Aerospace Engineering and now serves as the associate dean for research and administration for the College of Engineering and Computer Science. He received his Ph.D. in theoretical and applied mechanics from the University of Illinois at Urbana-Champaign. He is a fellow of the American Society of Mechanical Engineering, and his research has been funded by NASA, the National Science Foundation and the Air Force Research Laboratory.

Kar is a professor in CREOL, The College of Optics and Photonics, and he received his Ph.D. from the University of Illinois at Urbana-Champaign. His research areas include laser-assisted manufacturing and materials processing.

Written by Marisa Ramiccio

To learn more about Davis' research, visit bit.ly/DavisLab.



Fueled By Nature

UCF Researcher Develops Lotus-inspired Tech to Convert CO2 to Fuels, Chemicals

In an effort to reduce the environmental impact of carbon dioxide emissions, a UCF researcher has developed a new technology that captures carbon dioxide and outputs useful fuels and chemicals.

Yang Yang, an associate professor in UCF's NanoScience Technology Center, created an innovative device that captures carbon dioxide with a microsurface comprised of a tin oxide film and fluorine layer. The device then extracts gaseous carbon dioxide via a bubbling electrode and selectively converts the gases into carbon monoxide and formic acid, which are important raw materials for manufacturing chemicals.

This technology, detailed in a recent study in the Journal of the American Chemical Society, aims to reduce humanity's carbon footprint sustainably while addressing the need to produce alternative energy.

"We want to create a better technology to make our world better and cleaner," says Yang, who also is a member of UCF's Renewable Energy and Chemical Transformation (REACT) Cluster. "Too much carbon dioxide will have a greenhouse effect on the Earth and will heat it up very quickly. It's the motivation for why we want to develop this new material to grab and convert it into chemicals we can use."

This carbon dioxide capture technology could be located at power plants, industrial facilities, or chemical production plants where carbon dioxide is captured from emissions and converted into useful products.

Design Blossomed from Nature

The inspiration for the device and mitigating our impact on the environment came directly from nature itself, Yang says.

"We as scientists always learn from nature," he says. "We want to see how the animals and the trees work. For this work, we learned from the lotus. We know that the lotus has a really hydrophobic surface, which means when you drop water on the surface, the water will go quickly away from the surface. We also know that green plants absorb carbon dioxide and convert it to oxygen through photosynthesis."

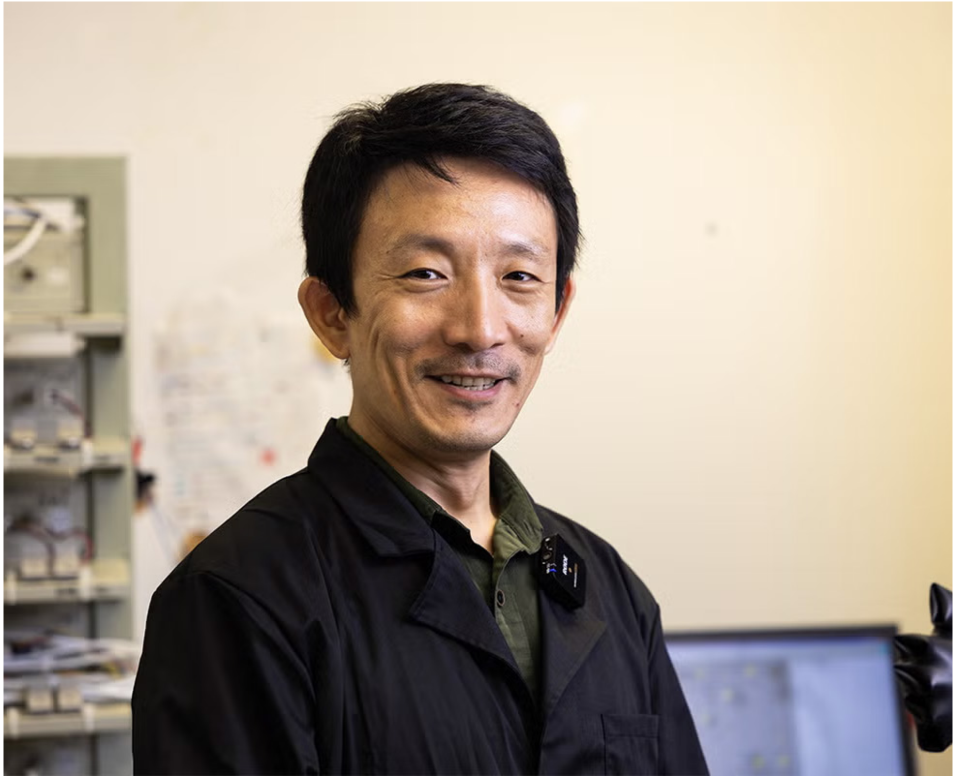
The lotus helped Yang conceive of carbon dioxide capture technology that mimics the lotus surface, in which water trickling down a device's fabricated hydrophobic surface would be separated from the carbon dioxide conversion reactoin.

It's necessary to carefully manage the amount of water on the surface of materials that may flood the device or disrupt carbon dioxide conversion, Yang says.

Once captured, the carbon dioxide gas is then routed through an electrode and converted through a more customizable process than naturally occurring photosynthesis.

The electrocatalytic carbon dioxide reduction reaction converts carbon dioxide gas into carbon-containing chemicals, such as methanol, methane, ethylene, ethanol, acetate, and propanol, depending on the specific reaction pathways on the catalysts.

"We want to create a better material which can quickly grab carbon dioxide molecules from the air and convert them into chemicals," Yang says. "We just reduce the



concentration of carbon dioxide in the air and convert it in the liquid and gas phase so we can directly use those converted chemicals and fields for other applications."

One of the most challenging components of the research was reducing the amount of water spread out on the surface of the catalytic materials when exposing the components of gaseous carbon dioxide in the liquid electrolyte, he says.

"If you have too much water surrounding your materials, you may produce hydrogen instead of converting carbon dioxide to chemicals," Yang says. "That will decrease the energy efficiency of the overall process. The materials we use can repel the water from the surface, so we can avoid the formation of hydrogen, and we can greatly enhance the carbon dioxide reduction efficiency. So that means eventually we can use almost all of the electricity for our reaction."

Scaling Up

There are many existing efforts around the world to reduce, capture or convert carbon dioxide including planting trees and developing large-scale carbon dioxide capture technologies.

Yang says he hopes his carbon dioxide capture and conversion device may serve as a viable alternative option to other more time-consuming or costly methods.

Harnessing environmentally sustainable electricity is another step in implementing the carbon dioxide conversion technology into reality, Yang says.

"In our process, we can use intermittent electricity, like the electricity coming from the solar panel or from the wind farm," he says.

The technology is built off Yang's previous energy efforts at UCF nearly three years ago in developing new materials for fuel cells that used fluorine-enhanced carbon.

The research serves as an important first step and a is fundamental study that may pave the way for more large-scale carbon dioxide capture methods, Yang says.

"For this, we validated our concept from the fundamental point of view," he says. "We tested the performance in our reactors, but in the future, we want to develop a bigger prototype that can show people how quickly we can convert and reduce the carbon dioxide concentration and generate chemicals or fuels very quickly from our large-scale prototype."

Written by Eddy Duryea '13

To view the video on this research, visit bit.ly/lotustech.

Gold May Be Key Element for Cleaner Drinking Water

Gold may be a coveted precious metal, but it could also be the key to cleaner drinking water.

A team of UCF researchers, including materials science and engineering Associate Professor Yang Yang, is exploring the use of the metal to develop a novel method to rid drinking water of harmful algal blooms, or HABs, which occur when colonies of algae grow out of control and produce toxic or harmful effects on people, fish, birds and other living creatures.

UCF received $75,000 from the U.S. Environmental Protection Agency for the two-year project that aims to develop a gold-decorated nickel metal-organic framework (MOF) that removes microcystins — toxins produced by harmful algae blooms — from the water.

The gold will be coated in an MOF, which will help it react to the sunlight. That reaction, known as photocatalysis, will result in the oxidation of the microcystins, removing them from the water.

Microcystins are the most common cyanotoxins linked to harmful algal blooms in freshwater environments. They're known to cause liver damage, kidney failure, gastroenteritis and allergic reactions in humans. With the UCF team's novel solution, water treatment facilities can produce cleaner, safer drinking water.

"Clean drinking water isn't just a necessity, it's a fundamental right, especially for Floridians who rely on our abundant lakes and waterways," says project collaborator Woo Hyoung Lee.

Preparing for Launch

Company Founded by UCF Alumnus Earns Prestigious Air Force Contract to Propel Innovation

Helicon Chemical Company, a company using UCF's Business Incubation Program and founded by David Reid '12PhD, was awarded a $1.9 million Tactical Funding Increase Contract in May from the U.S. Air Force to accelerate its enhanced-performance solid rocket propellant research and production.

Helicon is the second company to have been awarded a Tactical Funding Increase Contract through UCF's Business Incubator's guidance and services. The first company was Red Six Aerospace Inc., which received a contract in 2022 for developing an augmented reality system.

Reid says he is proud to continue developing his propellant technologies and collaborate again with the U.S. Air Force.

"This marks a significant step in making the Helicon technology available for government and commercial use," he says. "Helicon is extending on previous work with the Air Force to use our technology to improve the performance of solid rocket motors for various systems. The underlying nanotechnology has broader uses for commercial space, improved high temperature performance for semiconductors, and improved performance for solar energy cells."

The Tactical Funding Increase was awarded by AFWERX, a collaborative innovation arm of the Air Force Research Laboratory and Department of the Air Force.

The award is designed to help bring innovative technologies — like Helicon's rocket propellants — into use by the Air Force and other Department of Defense customers on an accelerated timeline, Reid says.

"The program is specifically designed to assist companies in bringing a key technology across what is often referred to as the 'Valley of Death,' the place where promising technologies tend to have issues moving from the research to the production domains so that the technology can actually get into the hands of our soldiers, sailors, airmen, and marines," he says.

Reid founded Helicon during his final year of graduate studies at UCF under the mentorship of Department of Materials Science and Engineering Chair Sudipta Seal. He later transitioned to chief technology officer from CEO in 2022.

"Helicon is a UCF incubator company that continues to work directly with UCF students and staff to advance and expand the use of its technology," Reid says.

Helping Reid and the rest of the Helicon team navigate the challenges of growing their business has been so gratifying, says Carol Ann Logue, director of programs and operations for the Innovation Districts and Incubation Program.

"It certainly speaks to the quality of work coming out of UCF," she says. "They're still with us and they're still in the process of growing."

The business incubation program is entering its 24th year of operation and manages nine incubation facilities in Central Florida and adjacent counties. The program offers specialized assistance to nurture and grow emerging companies, Logue says.

"In addition to supporting many entrepreneurs from the region, we support the commercialization of innovations developed by faculty and graduate students," she says. "We're helping the university fulfill its commitment to positively impact growth in diversified industries and advancing learning objectives. For example, UCF students often are working part-time for these companies, getting hands on experience in their degree field and getting exposure to that world of business dynamics."

Logue estimates that there are around 130-150 clients at any given time who have applied and been accepted after meeting the program's specific criteria. They are in the Incubation Program an average of 2-6 years while receiving comprehensive support in establishing and growing their business, Logue says.

"We do have very specific criteria for assessing companies that come to us," she says. "They must solve a problem that exists or a problem that is visibly growing and they can't be student-run companies. We do have companies that were started by UCF students who then graduated and continued to grow the company. Helicon is a great example of that."

Reid used specialized facilities, benefitted from mentorship and gained valuable insights from marketing experts from the UCF Business Incubation Program, Logue says.

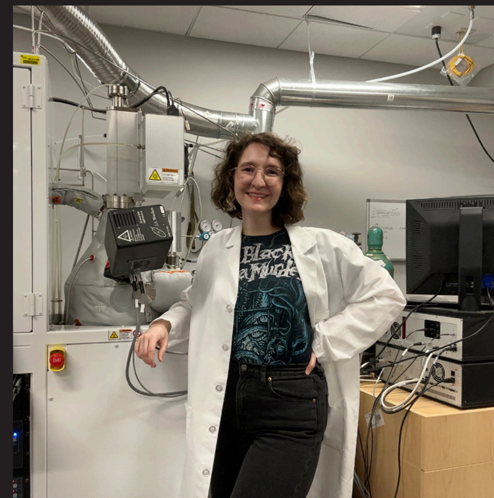
"David has participated in a lot of our programs," she says. "He came to us with his Ph.D. in one hand and a small business grant in the other hoping to commercialize his research. Helicon is a great example of a company who took advantage of the assistance we provide with business management and the critical operational aspect that can sometimes be daunting."

Helicon's procurement of this highly regarded contract is impressive, and it shows that the company's technology is crucial to the field of defense innovation, Logue says.

"The fact that they got this award speaks to how important this innovation is to the needs of the Air Force," she says. "There is a continuous call to move critical solutions much quicker into use for national security."

Written by Eddy Duryea '13

To learn more about the UCF Business Incubation Program, visit incubator.ucf.edu.



Doctoral Student Awarded Industry Foundation Scholarship

Materials science Ph.D. student Novia Berriel '21MS was awarded a $2,500 scholarship from the Society of Vacuum Coaters (SVC) Foundation in recognition of her outstanding academic performance and research efforts.

The SVC Foundation provides scholarships for exceptional students who have demonstrated an interest in studying vacuum coating technology

Vacuum coating, or thin-film disposition, provides protection from damage caused by corrosion, water, heat and other factors. The coatings are applied on everything from tools and lenses to semiconductors and displays. As a member of the Banerjee Lab, led by Associate Professor Parag Banerjee, Berriel uses thin films to create nano-scale electronics.

She is the third student from the department to receive the prestigious scholarship, joining past recipients Corbin Felt, an alumnus of Banerjee's group, and Jannatul Mousumi, an alumna from Kristopher Davis' research group.

Berriel holds bachelor's degrees in both applied physics and electrical engineering. She earned her master's in physics from UCF in 2021.

"I always struggled to find the niche I wanted between application and theory," she says. "I went to materials science for my Ph.D., and I think this field is the niche I was looking for."

Standout Scientist

Fang Receives Scientist Medal for His Contributions to the Field

Professor Jiyu Fang has been awarded the International Association of Advanced Materials (IAAM) Scientist Medal for his contributions to the field of materials science and engineering. This award is given to researchers who have made an impact through their work over the past decade, and is one of the most prestigious honors bestowed from IAAM.

The organization awards one Scientist Medal per year but recognizes other researchers, industry professionals, policymakers and students through a variety of other awards at the Assembly of Advanced Materials Congress.

"I am honored to receive the 2024 IAAM Scientist Medal in recognition of my contribution to biomaterials and biosensors," Fang says. "In 2022, I was elected as a Fellow of the IAAM and this award deepens my service to this organization."

Scientist medal awardees are also invited to present a distinguished lecture at the Assembly of Advanced Materials Congress, which was hosted in Orlando this year. Fang's lecture, titled "Engineering of Liquid Crystal Emulsions for Biosensing Applications," highlighted his efforts to develop liquid crystal-based sensors for biomedical applications. These sensors can be used for rapid, sensitive and label-free detection of important biological species and their interactions in biological fluids.

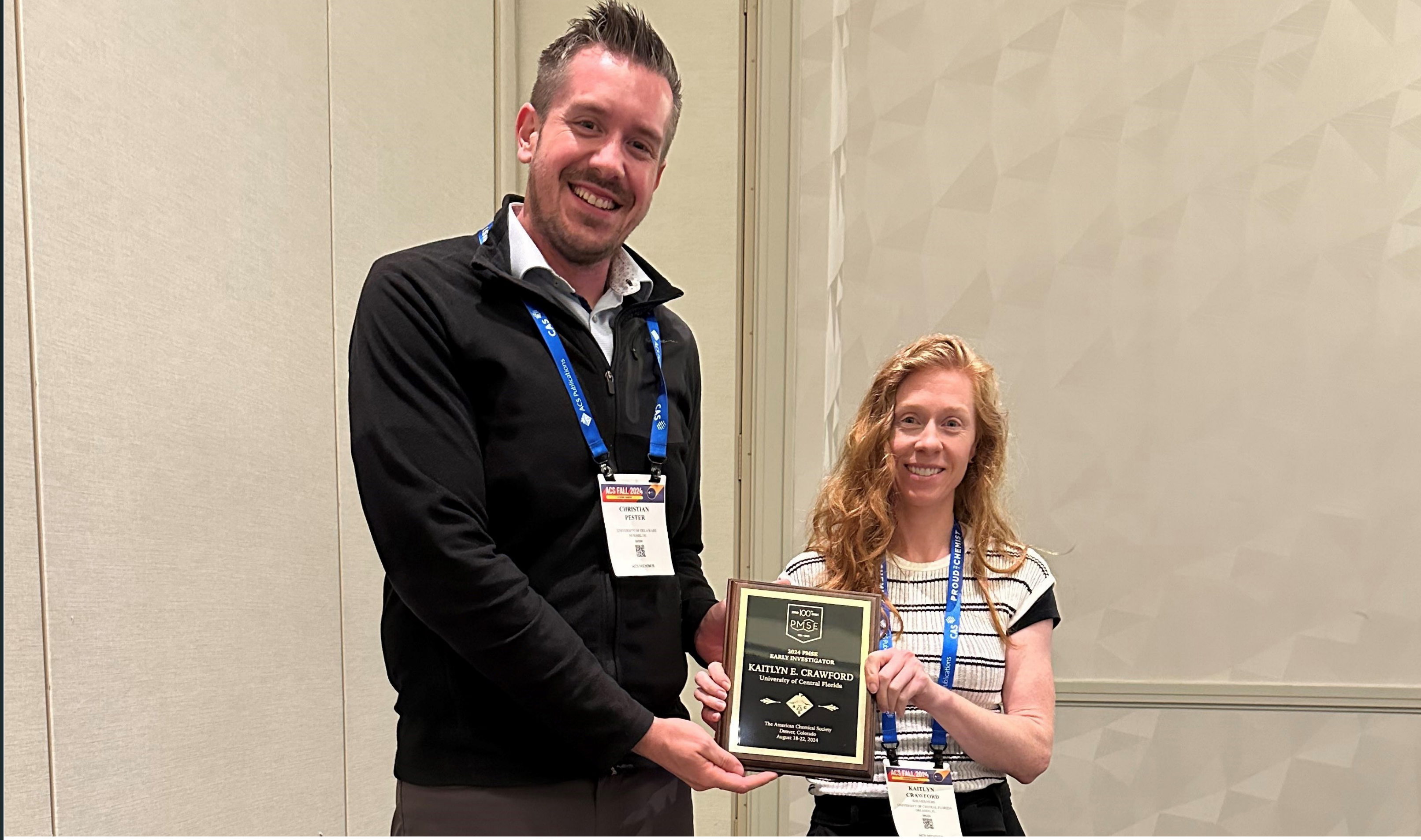
Fang has been conducting this research since he joined the University of Central Florida as an associate professor in 2003. Since then, he has conducted various research projects that span the interdisciplinary areas of physics, chemistry, materials science and biology. His research interests include biomaterials and the development of technology, particular in the design of highly efficient photo-induced electron transfer supermolecule systems, drug delivery vehicles and atomic force microscopy-based nanoindentations. Over the course of his career, he has published over 150 peer-reviewed journal publications.

Fang earned his doctoral degree in bioengineering from Southeast University in China. He completed his master's and bachelor's degrees in physics at the Chinese Academy of Science and Nanjing Normal University, respectively. He completed a postdoctoral appointment in the Department of Chemistry and Biochemistry at the University of California, Los Angeles. Prior to joining UCF, he served as a researcher at the U.S. Naval Research Laboratory's Center for Biomolecular Science and Engineering in Washington D.C.

In addition to teaching and researching in the Department of Materials Science and Engineering, Fang also serves as the associate chair and the graduate program director. He is also the director of the Advanced Materials Processing and Analysis Center at UCF.

Written by Marisa Ramiccio

To learn more about Fang, visit bit.ly/FangMSE.



Investigative Impact

Crawford Named Early Investigator Symposium Honoree

Assistant Professor Kaitlyn Crawford has been named a 2024 Early Investigator Symposium Honoree by the American Chemical Society's Division of Polymeric Materials: Science and Engineering (PMSE). As a recipient of this distinction, Crawford gave a lecture during the fall meeting of the American Chemical Society.

Crawford is one of 24 professionals and academics to be recognized with the PMSE award this year, and the first faculty member from UCF to ever be selected. The honor is bestowed upon emerging leaders in the field of polymer materials science and engineering who have made significant contributions early in their career.

"It's a humbling honor to be selected to present at the PMSE Early Investigator Symposium during the fall ACS Conference in Denver," Crawford says. "The recognition is an opportunity to form new collaborations in the scientific community and motivation to continue pursuing critical research topics in polymer materials science and engineering."

During the conference, Crawford presented a lecture titled "Modulation Material Properties of Branched Polysaccharide Hydrogel Films," which covers the methods and challenges for improving the mechanical properties of natural polymers by forming chemical and physical crosslinks. Hydrogels are polymers that can readily absorb water and are used in a number of practical applications such as batteries, drug delivery and filtration systems.

Crawford's research focuses on identifying new materials, particularly polymers, for environmentally sustainable sensing applications.

Since 2009, she has garnered several awards for her research and for teaching. In addition to teaching and conducting research for the Department of Materials Science and Engineering, she is also affiliated with the Department of Chemistry, the NanoScience Technology Center and the Biionix Cluster.

She earned her doctoral degree in chemistry from the University of Maryland, College Park, her master's degree in chemistry from North Carolina State University and bachelor's degrees in psychology and chemistry from the University of North Carolina at Charlotte.

Written by Marisa Ramiccio.

To learn more about Crawford, visit bit.ly/KCMSE.

Let There Be Light

U.S. Army Awards $1M Grant to University for Development of Semiconductor Light Source

Disinfecting a room with just the click of a button would be a dream come true for medical professionals, scientists and even homeowners. But that technology isn't just a fantasy: it's currently being developed by UCF researcher Leland Nordin.

Nordin, an assistant professor of materials science and engineering, is leading a project to develop a compact semiconductor light source for defense and civilian applications such as room disinfection. The work is funded through a new, $1 million grant from the U.S. Army Combat Capabilities Development Command Army Research Laboratory.

The laser device would operate at the ultraviolet C (UVC) wavelength, which is the shortest of all forms of UV light.

"UVC is part of the UV spectrum," Nordin says. "When we talk about UV, we talk about what hurts us from the sun — UVA and UVB. UVC has the shortest wavelength and the highest energy. The reason why it's useful is because, unlike longer wavelengths, it doesn't penetrate the skin deeply, but it does provide disinfection and virus protection."

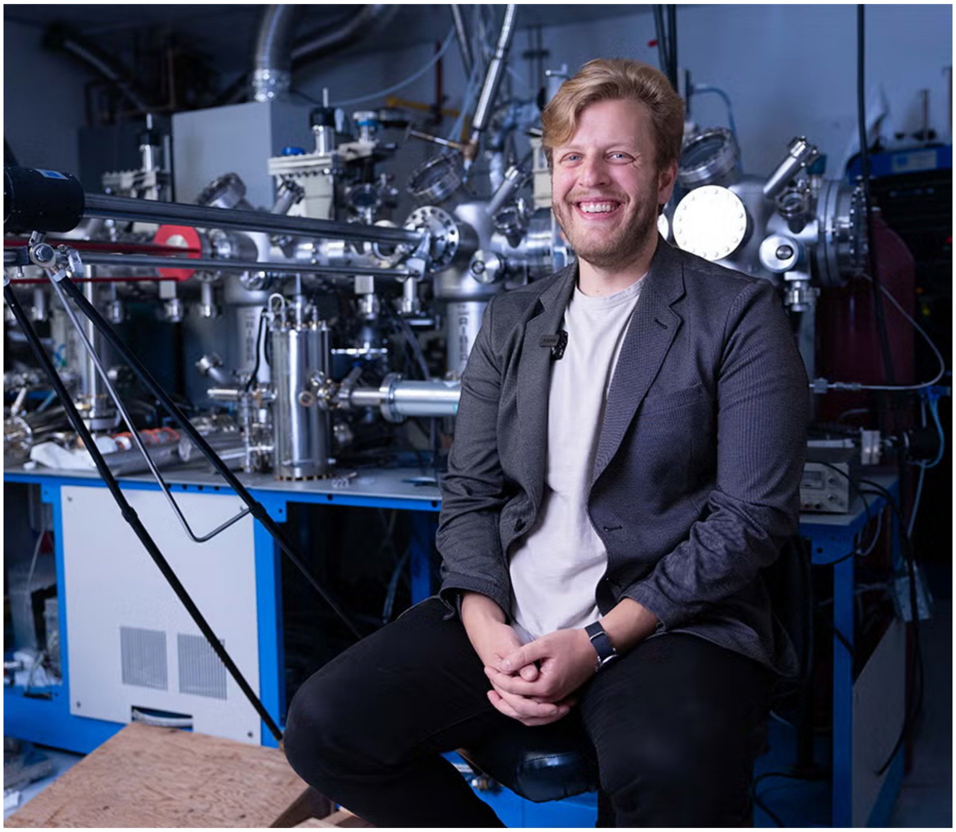
The drawback to UVC semiconductor lasers is their short lifespan. They can last one hour at best, making their use impractical and costly. Nordin plans to develop a UVC laser that can last for at least 10,000 hours by overcoming the electromigration of defects, which can cut the life of a laser short.

"What that means is that while making lasers through crystal growth, defects can occur," Nordin says. "There can be an atom missing or an extra atom generated."

To optimize the laser's performance, Nordin will employ a suite of novel growth approaches, including the use of digital alloys. These superlattice structures can be easily scaled, offer superior transport properties, and have high thermal conductivity, among other benefits. The end result is a more powerful UVC laser with fewer defects and a longer lifespan.

The Army could use these UVC laser for non-line-of-sight communication and the detection of chemical or biological weapons and explosives. There also are other applications for these lasers. Hospitals could use them to remove viruses from surfaces simultaneously, while wastewater treatment plants could use them to sterilize water. Homeowners could someday benefit from this technology as well.

"Imagine this technology being connected with smart home technology," Nordin says. "You could click a button and while you're out, the technology could disinfect the room for you."



Nordin's co-PI on the project is UCF materials science researcher Leo Schowalter, who co-created the first UVC laser with Nobel Prize winner Hiroshi Amano at Nagoya University in 2019. They look forward to building a bigger semiconductor ecosystem in Florida and are eager to collaborate with faculty from the University of Florida who are already working on semiconductors with researchers from the Florida Semiconductor Institute. Nordin says this project provides a chance to develop the semiconductor workforce in Florida, and to foster the spirit of collaboration that UCF is known for.

"UCF supports industry partnerships, and this pairs well with those efforts," Nordin says. It demonstrates the level of partnership that UCF is so eager and interested to do."

Researchers' Credentials:

Nordin is an assistant professor in the Departments of Materials Science and Engineering and holds a joint appointment with CREOL, the College of Optics and Photonics. His cutting-edge research focuses on next-generation semiconductor materials and devices, covering design, growth, fabrication and characterization. Prior to UCF, Nordin was a postdoctoral research fellow at Stanford University's Geballe Lab for Advanced Materials. He earned his doctoral and master's degrees in electrical and computer engineering from the University of Texas at Austin.

Schowalter is the chief technology officer for Lit Thinking and a research adjunct professor at UCF. After receiving his doctoral degree in physics from the University of Illinois Urbana-Champaign, Schowalter worked at the GE Global Research Center and at Rensselaer Polytechnic Institute. In 1997, he co-founded Crystal IS, a manufacturer of high-performance LEDs for disinfection and instrumentation applications. Schowalter is also a designated professor at Nagoya University.

Written by Marisa Ramiccio

To view the video on this research, visit bit.ly/lelandmag.

Seal Presented with Lifetime Achievement Award

The Sustainable Nanotechnology Organization (SNO) has awarded the Lifetime Achievement Award to Pegasus Professor Sudipta Seal. The award is presented to those who have made significant achievements in the field of sustainable nanotechnology and contributed greatly to SNO.

Seal was presented with the award at the 13th annual SNO conference in Rhode Island.

"I am deeply honored to receive this award from SNO," Seal says. "It is a testament not only to my dedication but also to the relentless efforts of my research group over the years, and the unwavering support of my family. This achievement belongs to all of us."

Upon receiving the award, Seal also gave the plenary lecture titled "The Journey of a Nano Rare Earth Oxide: From Metallurgy to Medicine." Through his research, Seal has developed surface-engineered nanoscale transition metal and rare earth oxide ceramics for catalysis, energetics and nano-biomedicine. He has developed scalable methods for template-free nano oxide particles, and engineered nanoceria with switchable valence states with regeneration capability.

Some his more recent research projects include a collaboration with the Johns Hopkins Kimmel Cancer Center to develop a nanoparticle vehicle to deliver cancer therapy to the brain, and an effort to create a virus-killing disinfectant with other UCF researchers and alumni.

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.

4.6M
External research funding
2023-24

4.2M
External research funding
2022-23

29
Number of core faculty
2023-24

104
Number of papers and books produced by MSE faculty
2023-24

22
Number of conference papers produced by MSE faculty
2023-24

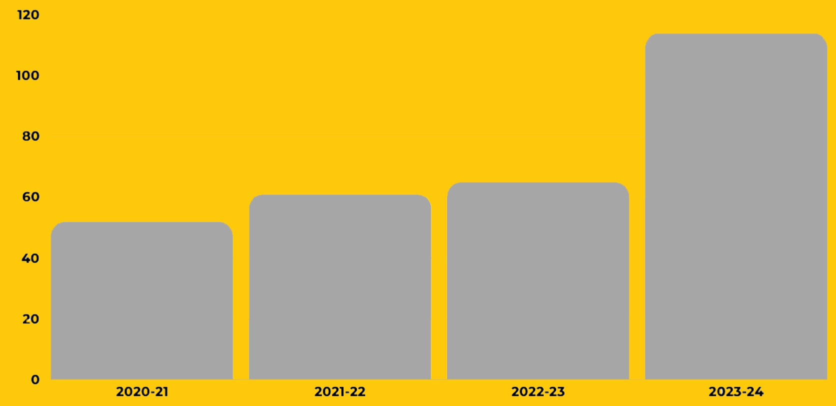
101
Number of talks given by MSE faculty
2023-24

48
Number of invited talks given by MSE faculty
2023-24

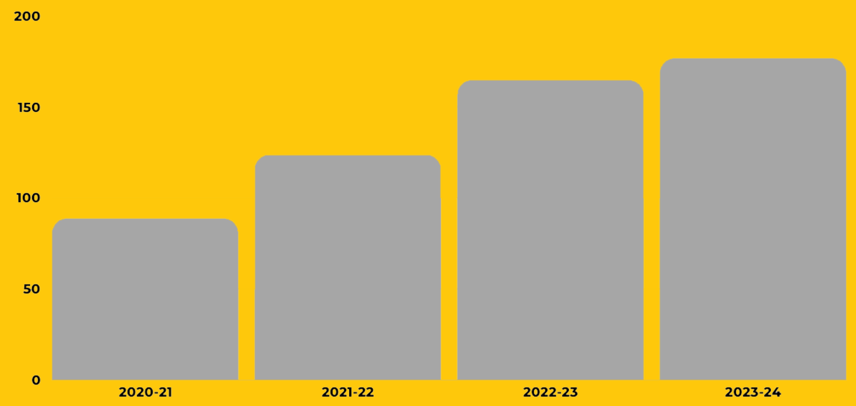
9
Number of patents issued to MSE faculty
2023-24

12
Number of patents applied by MSE Faculty
2023-24

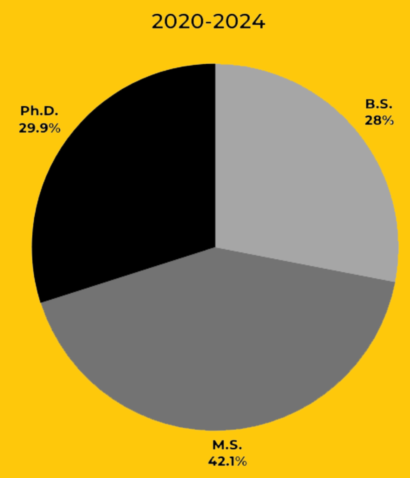
Growth of Pending MSE Students



Growth of Undergraduate MSE Students



Total Number of Graduates By Program



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

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UNDERGRADUATE PROGRAMS

Bachelor of Science in Materials Science and Engineering

Minor in Materials Science and Engineering

GRADUATE PROGRAM

Master of Science in Materials Science and Engineering

DOCTORAL PROGRAM

Ph.D. in Materials Science and Engineering

MSE students and faculty were invited to participate in the Academy of Science, Engineering and Medicine of Florida's annual meeting in November.