# NEWS BRIEFS

#### **CHIPS ACT FUNDING COMES TO UCSB**

UC Santa Barbara will play a major part in the effort to bolster semiconductor manufacturing in the United States and develop its competitiveness in the global market. The campus is a member of the California Defense Ready Electronic and Microdevices Superhub (California DREAMS), one of eight Microelectronics Commons regional innovation hubs established by the Department of Defense in October.

The agency's first awards, worth a total of \$238 million, are intended to advance the discovery, innovation, and fabrication of domestic microelectronic technology, such as circuits and chips, with funding from the "Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act." Passed in 2022, the bipartisan federal bill will provide about \$250 billion to invest in semiconductor research and development, build the semiconductor manufacturing sector in the United States, and educate and train the workforce expected to propel the industry forward.

"We are extremely proud to join with other leading research universities and industry partners in Southern California as part of this united effort," said **Umesh Mishra**, dean of the UCSB College of Engineering. "Our involvement is a testament to the university's strong reputation in the semiconductor industry, which was built to a significant extent upon decades of innovation and cutting-edge microelectronics developed on our campus. We look forward to contributing our expertise to the hub."

The hub is a coalition of research and industry organizations having the shared goal of accelerating the development and manufacturing of microelectronics in the U.S. Led by the University of Southern California, the hub also includes UCSB, UCLA, UC San Diego, UC Riverside, UC Irvine, Caltech, Pasadena City College, North Carolina Agricultural and Technical University, Morgan State University, Northrop Grumman, Boeing, Lockheed Martin Aeronautics, Raytheon, Teledyne Technologies, HRL Laboratories, and PDF Solutions.

"We are enthusiastic to be a part of this hub team, and we look forward to the start of the program," said **Jonathan Klamkin**, a professor of electrical and computer engineering and director of the UCSB Nanofabrication Facility, a key component of the DREAMS Hub.

## CLIMATE SCIENCE IS CATCHING UP, SAVING LIVES



Scan the QR code above to watch a viedo about the Nanofabrication Facility at UC Santa Barbara.

A group of climate scientists at UC Santa Barbara and their colleagues are beginning to catch up with, and even get ahead of, climate change. In a commentary for the journal *Earth's Future*, **Chris Funk** and co-authors assert that predicting the droughts that cause severe food insecurity in the Eastern Horn of Africa (Kenya, Somalia, and Ethiopia) is now possible, with months-long lead times that allow for measures to be taken to help millions of the region's farmers and pastoralists prepare for and adapt to the lean seasons.

"We've gotten very good at making these predictions," said Funk, who directs the Climate Hazards Center, a multidisciplinary alliance in the UC Santa Barbara Geography Department.

In the summer of 2020, CHC researchers predicted that climate change, interacting with

naturally occurring La Niña events, would bring devastating sequential drought to the Eastern Horn of Africa. The region normally has two wet seasons per year, in spring and fall, but an unprecedented five rainy seasons in a row failed. Eight months before each of those failures, the CHC anticipated droughts. Fortunately, agencies and other collaborators paid heed to those warnings and took effective actions, Funk said. The forecasts helped to earmark hundreds of millions of dollars within the U.S. Agency for International Development (USAID) to assist millions of people facing starvation.

Ten years priot to that, predictions of sequential droughts for the same region made by researchers who were collaborating with the USAID– supported Famine Early Warning Systems Network went largely unheeded. The result, Funk said: "More than 250,000 Somalis died. It was just horrible."

At that time, however, the group's long-range weather prediction capabilities were still in their infancy, and the forecasts were not yet able to predict rainfall deficits in the region. Now, Funk explained, "Following our [predictive] success in 2016-'17 and extensive outreach efforts, the humanitarian relief community appreciates the value of our early-warning systems."

While investments in early-warning systems and adaptation measures may be costly initially, Funk said, they are relatively inexpensive when compared to post-impact, response-based alternatives such as humanitarian assistance and/or funding safety-net programs. "Flooding still happens, drought still happens, people still get hurt, but we can try to reduce the harm."



Race-ready Gauchos (clockwise from top left): Anirudh Kumar, Cesar Castillo, Roger Torres Aguilar, Matthew Lin, Ryan Nguyen, Tim Schmuelling, Jason Wei, Nicholas Rivelle, Tien Nguyen, Raaghav Thirumaligai, Aran Sandhu, Stephen Wong, Owen Liu, Nikunj Parasar, Dylan Pratt.

### **REVVING UP THE GAUCHO RACE TEAM**

Inactive since 2009, the Gaucho Race team returned to action in 2023, giving a new generation of mostly engineering students at UC Santa Barbara the chance to gain valuable hands-on experience in all phases of designing, engineering, and building a formula-type electric vehicle.

As part of UCSB's official SAE International (formerly the Society of Automotive Engineers) student chapter, the students' main focus this year was simply to participate in the Formula SAE Electric Competition, held each year at Michigan International Speedway.

Re-igniting the race team was the idea of team president **Nick Rivelle**, a former English major-turned engineering student. He started with a small group, which grew thanks to word-of-mouth interest and support from a few faculty advisors, including **Kirk Fields**, who helped students get hands-on experience with the brand-new computerized equipment in the College of Engineering Machine Shop.

The students not only had to work together on the year-long project, but also had to find funding; they managed to raise more than \$30,000. That valuable experience enabled the students to forge connections and build relationships with industry sponsors.

The effort to complete the single-passenger vehicle came down to the wire and was accomplished thanks to several marathon all-night work sessions. It rolled on its own power only on the night before Rivelle set out from Santa Barbara for Michigan, towing the vehicle on a flatbed trailer purchased on CraigsList. In the end, the car was unable to compete, because it failed to meet some of the stringent competition guidelines. But this first year back after a fourteen-year hiatus served to reignite interest among students, who plan to renew their efforts during the current academic year.

The actual machining of the custom parts was done under the supervision of the COE Machine Shop staff, specifically with the help of shop superintendent **Marty Ramirez**, staff members **Andy Weinberg** and **Josh Bowie**, and teaching assistants **Joe Sandoval** and **Braden Beitel**. "We could not have completed the project without them," Rivelle said. Looking ahead, he adds, "We haven't had students who were interested before. Now, it's up to them to keep the momentum going."

To that end, most of the team, including Rivelle, will be returning this year, determined to run their car on the track.

### **NEW CHAIRS FOR COE DEPARTMENTS**

Three new department chairs were named in the UC Santa Barbara College of Engineering last summer. They are: **Divyakant "Divy" Agrawal**, Computer Science; **Michael Gordon**, Chemical Engineering; and **Omar Saleh**, Materials.

Agrawal, a distinguished professor in computer science, came to UCSB in 1987 and has held multiple leadership roles in the department, college, and campus, including as department chair during the dotcom boom and as director of Engineering Computing Infrastructure. He represented UCSB system-wide as chair of the Graduate Council on the Coordinating Committee of Graduate Affairs. A recognized leader in the areas of databases and distributed systems, he is a fellow of several prestigious professional societies.

During his second term as chair, Agrawal intends to respond to the economic dominance of technology companies, which is creating a tremendous demand for computer-science education, both at the undergraduate and graduate levels. He plans to prioritize faculty hiring in strategic areas to meet those demands while continuing to enhance the department's burgeoning research reputation.

Gordon, who came to UCSB in 2007, has held department- and campuslevel leadership positions for the past several years. He has served as the department's Vice Chair for Undergraduate Education since 2018, overseeing the department's program review and successful ABET accreditation renewal. He chaired the UCSB Committee on Admissions, Enrollment and Relations with Schools, and, at the UC level, served for two years on the Board of Admissions & Relations with Schools. He is currently co-chair of UCSB's Western Association of Schools and Colleges accreditation committee, which oversees the accreditation reaffirmation process. His priorities as chair include continuing to hire top-level faculty to meet student needs and reflect new frontiers of research in chemical engineering, maximizing the department's visibility in the field, increasing outreach for department recruitment and support, maximizing inclusivity and diversity in the department, and providing more hands-on learning opportunities and support for undergraduates.

Since joining the UCSB faculty in 2005, Saleh has held multiple key campus-level leadership roles that have prepared him to become the department chair. He served as director of the Biomolecular Science and Engineering (BMSE) Program, successfully completed a program review for BMSE, and spent three years on the Academic Senate's Committee on Academic Personnel, serving as vice-chair and chair for the panel that makes recommendations on faculty appointments, promotions, and non-routine merit advancements. Among his top priorities are the continued strategic hiring of faculty and maximizing the support of graduate students.



New department chairs (from left): Omar Saleh, Divyakant Agrawal, Michael Gordon.

# **CLEANING UP BY REUSING PLASTICS**

Eliminating single-use plastics is a major challenge of our time, and in recent years, UC Santa Barbara chemical engineering professor **Susannah Scott** has been hard at work trying to give plastics a longer life. In a paper published in the journal *Chem*, Scott and colleagues from UCSB, Cornell University, and the University of Illinois, Urbana-Champaign, describe a way to speed up an innovative process they developed previously for turning polyolefins, the most common type of polymer in single-use packaging, into valuable alkylaromatics. Those, in turn, are used to make surfactants, the active components of detergents and other useful chemicals.

"You're getting another use out of the carbon that went into the plastics," said Scott, the Mellichamp Chair in Sustainable Catalytic Processing.

In their previous work, the researchers debuted a catalytic method to break the strong carbon-carbon bonds that make plastic so hard to degrade, then rearranged the molecular chains into alkylaromatic rings. The original process was effective but slow and yielded relatively few alkylaromatic molecules.

"In this paper, we show how to do it much better," Scott said. "It just screams along. It makes the alkylaromatics faster, and we can tune it to make the right-size molecules."

While the method originally took 24 hours to transform plastic into alkylaromatic molecules, the improved process can complete the task within a couple of hours and at moderate temperatures requiring little energy.

The ultimate goal is to bring the process into wide use, incentivizing chemical companies to transform the resulting alkylaromatic molecules into surfactants, which can then be formulated into soaps, washing liquids, cleansers, and other detergents.

To determine if the method is truly sustainable, it will have to undergo a life-cycle assessment, in which the energy spent and the greenhouse gases emitted are calculated at each step. If it passes muster, the method could displace existing fossil-fuel-intensive processes that go into creating surfactants from scratch.



A Million Miles Away tells the compelling life story of UCSB alumnus José Hernandez.



Professor Susannah Scott, Mellichamp Chair in Sustainable Catalytic Processing.

#### GAUCHO ASTRONAUT'S JOURNEY FEATURED IN AMAZON FILM

The spring 2021 issue of *Convergence* magazine included an article describing a planned Netflix film, a biopic about UCSB alumnus **José Hernandez** (MS '86), who started life as a migrant farm worker in California and Mexico and eventually spent fourteen days in space in 2009 as a flight engineer aboard a NASA Space Shuttle mission to the International Space Station. The film, titled *A Million Miles Away* and eventually produced by Amazon, was released in September.

"It feels surreal that I have a movie based on my life story," said Hernandez, who was turned down eleven times before being admitted to NASA's astronaut program. "I hope it becomes an inspirational classic and empowers the viewer to believe that with hard work, preparation, and perseverance, anything is possible."

Hernandez described seeing his life's story depicted in a film as "a very humbling experience," adding, "It was great working with the filmmakers, who did an incredible job of telling my story!"

## TRESA POLLOCK INVENTED THE TRIBEAM. NOW A NEW ONE IS COMING TO UCSB.

In 2020, we told you about a first-of-its-kind tomography instrument called the TriBeam. Developed by UC Santa Barbara materials professor **Tresa Pollock** and collaborators, the TriBeam includes an extremely fast, femtosecond (10<sup>-15</sup>-second) laser, an ion beam, and an electron beam, making it possible to acquire, layer-by-layer, a unique set of information about materials' chemistry and structure. The TriBeam is now being commercially produced by Thermo Fisher Scientific, the world's leading microscope manufacturer, and Pollock and her UCSB colleagues have secured a roughly \$2 million National Science Foundation grant to acquire one of the new commercial instruments.

Pollock, a world-renowned metallurgist and the ALCOA Distinguished Professor of Materials, says that the new instrument, called the Helios G5 PFIB TriBeam Microscope, "will dramatically enhance our ability to address challenging scientific problems in electronic, magnetic, structural, and softmaterial systems; broaden community access to this technique via formation of a national training and data-sharing hub; and increase access of a broad spectrum of researchers to the unique 3D multimodal datasets generated by the TriBeam platform."

The new TriBeam's dual-wavelength laser capability will greatly speed up the acquisition of 3D datasets, enabling advances in the design of bio-derived

thermoelectric gels and in understanding behavior related to friction and wear of fluoropolymer metaloxide composites, while providing new insights on the subcellular structures in heart tissue and cardiomyocytes derived from induced pluripotent stem cells. Importantly, the new terabyte (TBG)-scale datasets, combined with the existing 100-TB datasets, will provide missing 3D data need to train machine-learning algorithms that will change the paradigm for materials discovery.



The original TriBeam developed in Tresa Pollock's lab (left) and its commercially produced progeny.



### AWARDS FOR ADVANCES IN PHOTOVOLTAICS

**Thuc-Quyen Nguyen,** a professor of chemistry and biochemistry at UC Santa Barbara, recently received two major professional honors recognizing her work in developing novel materials to benefit society. One was the de Gennes Prize from the Royal Society of Chemistry, which cited her "seminal contributions to the development of organic semiconducting materials and device physics of organic photovoltaics to mitigate climate change." The award comes with a grant and an invitation to speak at universities across the United Kingdom and Ireland.

Nguyen was also awarded the Wilhelm Exner Medal by the Wilhelm Exner Foundation of the Austrian Trade Association. It recognizes an individual whose discoveries have "directly or indirectly promoted the economy in an outstanding way."

Nguyen's research is centered on organic semiconductor materials, often in pursuit of making organic photovoltaics (OPVs) that are more efficient, last longer, and have a reduced environmental impact. Her solutions include carbon-based materials that are expected to form the basis of completely new technologies and are part of what is sometimes called the Organic Electronics Revolution.

OPVs convert sunlight into electricity, but

most commercial photovoltaics use silicon wafers, made at very high temperatures in cleanroom environments. Nguyen's group makes organic photovoltaics using carbonbased materials processed from chemical solutions at room temperature. OPVs are a thousand times thinner than silicon solar cells and can be made into various sizes, shapes, and colors; they can be semi-transparent, lightweight, and flexible.

"OPVs are ideal solutions to reduce the carbon footprint of skyscrapers and highrise buildings," Nguyen said. "They can be wrapped around the exteriors of buildings or used to coat glass windows and greenhouses to generate energy."

The honors are more than academic for Nguyen, who grew up in Vietnam lacking clean water, electricity, or enough food. She immigrated to the United States with her family at 21, speaking little English and having no money. She hopes that her story can inspire young students, especially those from developing countries. "Awards come with responsibilities," she says. "These honors are not only for me, but also for the many women — especially those in Vietnam and developing countries — whose education or career dreams were shattered by life challenges."

Professor of chemistry and biochemistry Thuc-Quyen Nguyen.