

CHEMICAL AND BIOLOGICAL ENGINEERING



BREAKING NEW GROUND

An innovative undergraduate lab and faculty hires move CBE forward



Greetings from Madison!

Our newsletter cover features the exciting start to our instructional lab renovation project. Alumna

Beth Berenschot-Koenings (ChE '81) had the honor of taking the first swing as we started the demolition and remodeling of the current summer laboratory space. With architectural planning and fund raising in full swing, we hope to have the new instructional space ready for Summer Lab 2023.

For the past three years, due to COVID-related restrictions, we were unable to offer any international Summer Lab opportunities to our students. However, this year marks a return to Oviedo, Spain, where we have conducted Summer Lab since 1999. For the Madison sessions, much of the experimental work will be conducted in temporary space on the fourth floor as we undergo the renovation. Our historical, multi-floor distillation column has been deconstructed, and a smaller column has been built for the upcoming sessions. Once complete, our new lab space will have multiple large process units in a pilot plant setting to help enhance the student experience. The plans also include state-of-the-art classrooms, a history wall and meeting rooms for the students. Learn more about the lab renovation in this issue.

Please join me in welcoming our two newest faculty members—Whitney Loo

and Rose Cersonsky, who will join us as assistant professors in January 2023. In this issue we also introduce Assistant Professor Siddarth Krishna who joined CBE in January 2022. At our May 20 virtual town hall meeting, you will have an opportunity to meet Siddarth and hear him discuss his groundbreaking catalysis work. Expect to see these town hall e-mail invitations soon.

Our graduate student recruitment weekends hosted 100 guests—59 in-person and 41 virtual attendees. Virtual international visitors logged in from Greece, India, Taiwan, Hong Kong, China, Turkey and Nigeria. In-person international visitors arrived from Saudi Arabia and Ecuador. We look forward to welcoming a great new group of outstanding CBE graduate students in the fall!

In May, we will be honoring 68 newly minted chemical engineering bachelor's degree graduates. Please join me in congratulating our future engineers. I am excited to see them carry on the Wisconsin CBE tradition of making great engineering and societal impacts.

Thank you for your ongoing support and interest in our department. We are always interested in hearing from our alumni. Please drop us a line and let us know what you are up to!

On, Wisconsin!

Eric Shusta

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CBE students introduced grade schoolers to chemical recycling at the the Wisconsin Science Festival.



Former chair Regina Murphy and long-time Summer Lab instructor Rafael Chavez took a swing for lab renovations.



Recent CBE graduate Jazmin Washington received the Erroll Davis Award from former UW System president Tommy Thompson.



Focus on new faculty

Siddarth Krishna continues CBE's cutting-edge catalysis research



For Siddarth Krishna, who started as a CBE assistant professor in January 2022, moving to Madison is a homecoming of sorts. After finishing his bachelor's degree at the University of California at Berkeley, he came to UW-Madison where he studied for five years with now-Professor Emeritus James Dumesic and Richard L. Antoine Professor George Huber, investigating the catalytic production of chemicals from biomass derived from grasses or agricultural waste.

These experiences convinced him that he could have a positive impact on society,

working on scientific questions and getting to teach, mentor and learn from talented students—all of which led him to pursue an academic career.

In 2019, Krishna became a Henson postdoctoral fellow at Purdue University, where he worked on designing zeolite catalysts to eliminate pollutants, like NO_x, from diesel engines using a combination of reaction kinetics and spectroscopy tools.

Returning to Madison, Krishna plans to draw on both his PhD and postdoctoral training, continuing his work in sustainable chemistry and catalyst design. That will include researching ways to produce chemicals from low-carbon feedstocks with lower environmental footprints than oil

and gas and investigating ways to mitigate environmental pollution from sources like automobile engines.

UW-Madison, says Krishna, is one of the best places to conduct world-class catalysis research due to its longstanding traditions and team of highly visible researchers in this area. "It is wonderful to come back to a place that has historically been a leader in catalysis and prides itself on collaborative, impactful research efforts combining complementary expertise from experimental and computational researchers," he says. "This is a special place in which to launch my independent research career."

New class gets students excited about the future of plastics recycling

Like many people, PhD student Dell Zimmerman assumed plastic recycling was an efficient, mature technology.

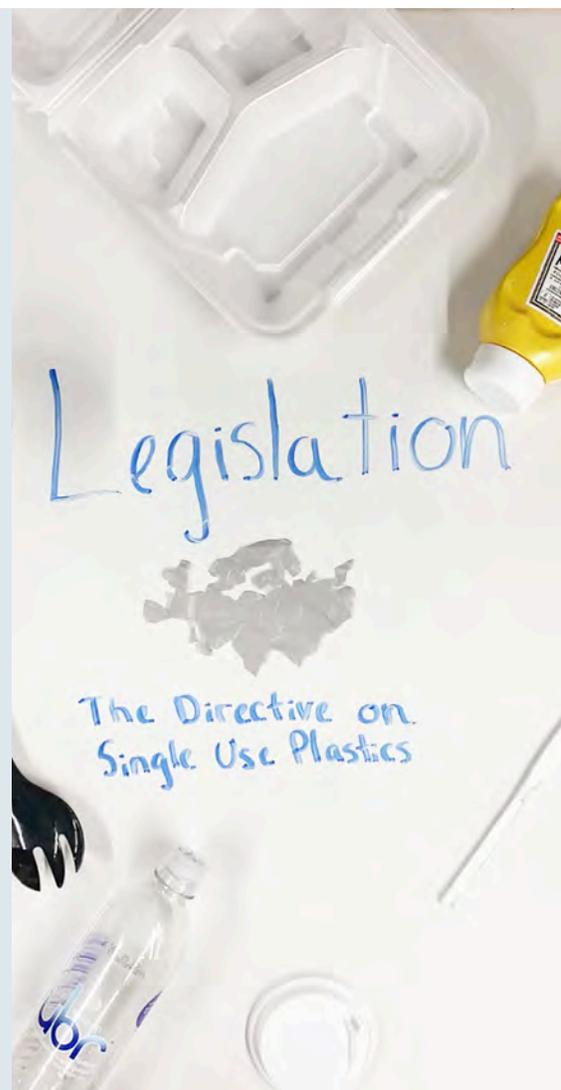
Then he signed up for CBE 562: *Technology for Plastic Recycling*.

The course, offered to undergraduates and graduate students, is designed to engage students with the current issues and emerging solutions in recycling. And Zimmerman was surprised to learn the dirty truth: Most plastic items are not recyclable, despite the triple arrow symbol printed on their bottoms. Less than 10 percent of all plastic produced since the 1950s has actually been reused. "I was very surprised to see that plastic recycling fundamentally hasn't changed in the last 40 years," he says.

That type of reaction is exactly what George Huber, the Richard L. Antoine Professor, was looking for when he designed the course, which is an offshoot of the Chemical Upcycling of Waste Plastics, a multi-university research center funded by the Department of Energy and led by Huber.

The goal of the course is to give students an understanding of the challenges and opportunities in the recycling industry and the ability to look at the industry from a chemical engineer's perspective. Not only do they study current recycling techniques and their limitations, but they also look at a wide array of potential chemical solutions for recovering and reusing plastic polymers in a more sustainable manner. Guest lecturers from across academia and industry also contribute to the class.

In fall 2021, the students' final project was to create a video that distilled complex topics into a two-minute presentation. Classmates voted the submissions by Zimmerman, who presented a low-budget parody of how catalytic pyrolysis can be used to improve plastic recycling, and undergraduate Jazsmin Washington, who created a stop-motion animation about policy differences between nations and states, as the best.





Undergraduate lab renovation kicks off, but still needs alumni support

Last December, CBE faculty, staff and some alumni gathered in the basement of Engineering Hall for a little light demolition. The occasion was the ceremonial brick-breaking to kick off the renovation of B103, the instructional lab that is home to the required transport lab and home to the legendary Summer Lab capstone course.

Several alumni who have already donated to the renovation as well as faculty, staff and supporters of CBE toured the space and took a few whacks at the wall to signify the start of the project, which CBE hopes will be completed in time for the start of Summer Lab in 2023.

The plan is to redesign and modernize the lab, creating a large open space around a clerestory that will flood the basement space with natural light. New lighting, windows and floors will make the space more inviting. Increased storage space, flexible utility dropdowns and moveable benches will make it a state-of-the-art classroom setting.

It will also include rooms radiating from the central lab space that will provide access to specialized equipment and meeting areas. The plan will also add an extra 4,500 square feet of lab space by incorporating the adjacent underused room, B209. The room will house large equipment like distillation and humidification towers, solvent extraction units, packed bed reactors, heat exchangers and other pilot-scale equipment used for Summer Lab and other classes.

While the vision is starting to become reality, the department still needs alumni to support the effort, especially to equip the lab space.

Neenah, Wisconsin-based alum Peter Allen (BSChE '81) says he decided to support the project after retiring from a 38-year career with Kimberly-Clark. While his degree was key in setting him up



Last October, alumni Matt Koenings (BSChE '81), Beth Berenschot-Koenings (BSChE '81) and Don Baldwin (BSChE '57) joined Dean Ian Robertson, Chair Eric Shusta and others to kick off Summer Lab renovations.

for career success, over time he realized it was much more than that. "Being back on campus while my daughters were UW students reminded me how influential my time in Madison was and how important it was to the rest of my life. The rigor, the disciplined thinking I learned, the whole of the experience opened opportunities and made the rest possible," he says.

"I look back with a sincere sense of appreciation. And I feel a sense of responsibility. How do I ensure that others have the same opportunity? How do I assure that the quality of the program is maintained, both in terms of faculty and in terms of facilities? To me, donating to this project was a no-brainer."

Brookfield, Wisconsin-based Kevin Yttre (BSChE '03) agrees. Currently a mergers and acquisitions consultant in the chemical and materials industry, Yttre says his training in CBE and experience in Summer Lab in particular helped make him who he is today. "Summer Lab is a real rite of

passage that bonds UW-Madison alumni," he says. "Once you've gone through it you kind of feel like you could walk through a brick wall."

He hopes his donation to the B103 project will allow future students, including some of his five children, to have a similar experience. "I would not have had the opportunity for that experience if there weren't alumni prior to me who invested in the school," he says. "I doubt I'll ever meet those people, but I'm grateful for the time and investment that they put into the program. And I think being able to support CBE that same way for future generations to have a great experience is something my wife and I are excited to be a part of."

Though the project is officially underway, CBE still hopes to raise \$4 million for the \$13 million project. There are still many opportunities for alumni and friends to participate. For more information, contact Kyle Buchmann, (608) 630-1679, or Kyle.Buchmann@supportuw.org

Pioneering process increases environmental sustainability of manure fertilizers



Wisconsin's 1.2 million cows produce a lot of manure—about 26.5 million tons a year. Much of that manure is spread on agricultural fields; however, it isn't a particularly well balanced fertilizer. For instance, excess phosphorous in manure that isn't taken up by crops can build up in the soil and wash into local waterways.

In those waterways, cyanobacteria, also known as blue-green algae, use the excess phosphorous to multiply rapidly, leading to

algae blooms that suck up all the available oxygen in the water. That can lead to dead fish, bad odors, closed beaches and economic hardship for tourism businesses that rely on clean lakes.

That's why Baldwin-DaPra Professor Victor Zavala, Jay and Cynthia Ihlenfeld Professor Brian Pflieger, along with colleagues from the College of Agricultural and Life Sciences are using a \$2 million grant from National Science Foundation to investigate an on-farm system that will allow producers to convert manure into a well-balanced biofertilizer by treating it with engineered cyanobacteria.

"The fundamental observation is that these cyanobacteria are actually capable of taking up this phosphorus to grow—so, they are natural phosphorus-capture agents," says Zavala. "We propose growing algae on the farms as opposed to letting it grow wild in the lakes. The idea is to build bioreactors that use the manure as a medium for algae growth. Then you'll collect the algae and sell it as a biofertilizer."

The team hopes to develop strains of cyanobacteria that will adjust the ratio of phosphorous and nitrogen in the manure as they gobble it up. After the cyanobacteria die, their biomass can be dried and pelletized to produce a balanced biofertilizer, which farmers could use or sell. Over time, by using the right balance of fertilizers, farmers could reduce the excess phosphorous applications on their fields.

Pretreatment could keep tons of methane out of the atmosphere



Methane is a greenhouse gas many times more potent than carbon dioxide produced by combustion automobiles and burned off in flares found at refineries, coal mines and methane storage facilities. Those flares, however, don't burn very efficiently, releasing a huge amount of methane into the atmosphere.

Recently, a team including Stanford University researcher Matteo Cargnello and Ernest Micek Distinguished Chair, James A. Dumesic Professor, and Vilas Distinguished Achievement Professor Manos Mavrikakis have discovered a relatively simple pretreatment of palladium catalysts that can make

methane combustion more efficient. It could lead to new types of catalytic flares and cleaner-burning car engines that could keep untold tons of heat-trapping methane out of the skies.

Pretreatment is a process in which a catalyst is exposed to other chemicals, like oxygen or hydrogen, to improve its reactivity or purity. The key ingredient in the palladium pretreatment, the researchers were surprised to learn, is steam. Once exposed, the effect on the catalyst is permanent, leading to large increases in combustion efficiency.

The experimental team, however, had difficulty explaining just how the process worked. That's why they turned to Mavrikakis, an expert in computational catalysis, who used advanced computer models of atomic physics to establish the

theoretical underpinnings of the steam effect on the crystalline palladium. The steam forces atoms near defects into strained positions, which speeds the methane reaction.

"Steam pretreatment is unique among the other pretreatments in producing these key atomic-scale structural defects on palladium," Mavrikakis says. "The combination of these two effects can explain the reactivity enhancement measured for steam pretreated catalysts almost exactly as predicted quantitatively."

The researchers believe if they can optimize the reaction, the palladium catalyst could improve methane combustion by two or three orders of magnitude.

Faculty News



Conway Assistant Professor **Reid Van Lehn** received the 2021 Young Investigator Award from the

Computational Molecular Science and Engineering Forum of the AIChE. He was cited for the development and application of computational techniques to understand the interfacial properties of functionalized nanomaterials and their interactions with lipid membranes.



Richard L. Antoine Professor **George Huber**, Professor

Emeritus **James Dumesic** and PhD student Hochan Chang were selected as finalists for the 2021 WARF Innovation Awards for the development of a green synthesis process for bio-based polyurethanes and polyesters. The award honors the most promising technologies developed at UW-Madison.



Jay and Cynthia Ihlenfeld Professor **Brian Pflieger** has received a Friedrich Wilhelm Bessel Research Award from

the Alexander von Humboldt Foundation. The award honors outstanding researchers across the world and includes funds to conduct a research project in Germany.

Alumni News



Paul Dauenhauer (PhDChE '04) was honored with a College of Engineering early career award. A professor at the University of Minnesota, his ingenious

catalytic processes have revolutionized biomass use and led to three startup companies that put his inventions into practice. He was recognized with a MacArthur "Genius" grant in 2020.



The College of Engineering recently honored **Brian Luedtke** (BSChE '85) with a distinguished achievement award. Throughout his

career as a chemical engineer and executive in the pharmaceutical industry, Luedtke has sought to improve life for patients with chronic conditions by supporting innovative technology development, effective partnerships with healthcare providers and sustained community engagement.



Jesse Bond (PhDChE '09), an associate professor at Syracuse University, and **Jean Marcel Gallo**, a former postdoctoral researcher with

James Dumesic, were both chosen for the 2021 class of influential researchers by the journal *Industrial & Engineering Chemistry Research*



Jeff Greeley (PhDChE '04) was recently named the Charles D. and Nancy G. Davidson Professor of Chemical Engineering at Purdue University.



Michael Amiridis (PhDChE '91) was recently selected as the president of the University of South Carolina.

Student News



Alec Linot, a PhD student working in lab of Vilas Distinguished Achievement and Harvey D. Spangler Professor Michael Graham, was selected as a Givens

Associate in summer 2021, a highly competitive program at Argonne National Lab.



Senior **Hawra Aljawad** was one of two UW-Madison finalists for the prestigious Rhodes Scholarship. Aljawad is a volunteer for the Girl Scouts, the Boys & Girls Club

and has worked in several research labs, including the lab of Vilas Distinguished Achievement Professor John Yin.



Aaron Simmons, a PhD student in the lab of Milton J. and A. Maude Shoemaker Professor Sean Palecek, received the best poster award at the ECI Advancing

Manufacture of Cell and Gene Therapies VII Conference in San Diego.



Several CBE teaching assistants were selected by undergraduate voters to receive Ragatz Awards. **Xiaopo Cheng** and **Raka Gosh Dastidar** tied for first place for running discussion sections. **Kevin Sanchez-Rivera** won first place and **Abdulhadi Al-Zahrani** won second place for laboratory sections.

Retirements



Senior Lecturer **Rafael Chavez**, one of the most familiar faces in CBE, retired in 2021. Chavez received his bachelor's degree at the Instituto

Tecnológico de Celaya, master's degree at Instituto Tecnológico de Monterrey and PhD in chemical engineering at the University of Utah. He began his academic career at the Instituto Tecnológico de Celaya and began visiting Madison in 1986 to teach Summer Lab. In 1999, he moved to Madison permanently as a lecturer in CBE. Generations of students know Chavez, who has taught more sessions of Summer Lab than any other instructor, including leading many sessions in Oviedo, Spain, and sessions in Hong Kong.



Faculty Associate **James Miller** retired from CBE earlier this year. Miller earned his PhD at Carnegie Mellon University in 1995 before

working for a decade in industry, developing catalytic gas sensor technologies. He returned to Carnegie Mellon as a research professor and adjunct before joining UW-Madison in 2014 as a research scientist and faculty associate. For the last five years, Miller taught many required undergraduate courses in CBE as well as teaching and running many sessions of Summer Lab.

In Memoriam



Babatunde Ogunnaike (PhDChE '81), a respected researcher, innovator and long-time friend of the department passed away in February 2022.

A native of Nigeria, Ogunnaike earned his bachelor's degree in chemical engineering from the University of Lagos in 1976 before earning a master's degree in statistics and PhD in chemical engineering from UW-Madison.

He spent six years teaching at the University of Lagos before joining the DuPont company in Delaware in 1989, where he worked for 13 years as a researcher. In 1996, he joined the faculty of the University of Delaware as an adjunct professor before becoming full-time faculty in 2002. He became a full professor in 2004 and served as dean of the college of engineering from 2011 until 2018.

Ogunnaike was an expert in process control, modeling and simulation, systems biology and applied statistics. He possessed a robust knowledge of both industrial and academic applications of chemical engineering. He also had a profound impact on chemical engineering overall, serving on a National Academies of Sciences, Engineering, and Medicine committee to set a vision for the next 30 years of chemical engineering research, education and industrial innovation.

Throughout his distinguished career, Ogunnaike remained a dedicated UW-Madison alumnus, serving on the CBE advisory board. "Tunde was a member of our family and noted for his tremendous service to our department and to the field," says R. Byron Bird Department Chair Eric Shusta. "He was always able to contribute to any discussion with a kind confidence that I found inspiring."



CUWP Outreach

Last fall, CBE students in the course *Chemical Engineering in the Community* visited the Madison Children's Museum to present hands-on demonstrations about the science of recycling as part of Wisconsin Science Festival. Not only did visiting students get to learn how plastic is recycled and reused, they also were able to explore Trash Lab, a mobile exhibit from Dane County designed to educate and motivate visitors to create less trash.

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Jazmin Washington named Erroll B. Davis award winner



When she was about five, recent CBE graduate Jazmin Washington of Oak Creek, Wisconsin, was notorious for mixing up slightly disgusting mixes of mustard, barbecue sauce and whatever condiments were in reach, pretending it was a potion

or pain reliever. One day her patient father, turning away another concoction, told her that mixing things together is something people actually do as a job. “He told me they were called chemists, and they make things like medicine.”

That simple conversation set Jazmin on the path to chemical engineering. Now, not only is she a December 2021 graduate, she’s also the winner of a 2021 Alliant Energy/Erroll B. Davis, Jr. Academic Achievement Award. The awards are given each year to recognize the academic and community service of engineering and business students from traditionally underrepresented groups at UW-Madison and UW-Platteville.

Washington started her time at UW-Madison as part of the Women in Science and Engineering program, a residential learning community that provides support and mentorship to women in the sciences and later served as a mentor in that program.

She has also served in several leadership positions in the UW-Madison chapter of the National Society of Black Engineers. That involvement led Grainger Dean of the College of Engineering Ian Robertson to select Washington as the student representative on the college’s strategic planning committee for inclusion, equity and diversity.

“I was the only student representative on that team and we rewrote the college’s five-year plan on diversity, equity and inclusion,” she says. “It was a fun and interesting experience. My biggest takeaway is that nothing can happen overnight, but things can still happen day by day. There are small actions we can take every step of the way to work toward bigger change.”

Washington recently accepted a position in the research and development-focused technical rotation program with the coatings company PPG Industries in Pittsburgh, Pennsylvania.