

CHEMICAL AND BIOLOGICAL ENGINEERING



UNIVERSITY OF WISCONSIN-MADISON



UPHOLDING CBE
EXCELLENCE FOR
THE NEXT 115 YEARS
AND BEYOND

CHAIR'S MESSAGE



Greetings from Madison!

As you page through this newsletter, we're entering the last weeks of spring semester, students are busily studying for their final exams and faculty members are wrapping up their classes. We're all looking forward to the months ahead, when skies will be sunny and many CBE students will go through the traditional rite of passage that is the summer lab course. Be sure to glance at some of the wonderful photos of summer lab T-shirts from years gone by in the pages of this newsletter.

Looking back on the past semester, we're proud to share several important milestones from the CBE department.

First, it's our pleasure to announce endowment of the R. Byron Bird Department Chair in Chemical and Biological Engineering. In honor of Bob Bird's extraordinary contributions to the department—as a scholar, an educator, a humanist and a leader—several CBE alumni, provided initial leadership gifts to launch fund-raising for the named chair position. A portion of the gifts was also matched by UW-Madison alumni John and Tasha Morgirdge. You can read more about the effort inside this issue, and if you have any questions, contact Kyle Buchmann (kyle.buchmann@supportuw.org).

Such generous support from our alumni has helped the department maintain its long tradition of excellence, and we are truly grateful. You can read about additional donations for student scholarships and named professorships within this issue. These gifts help keep CBE one of the preeminent chemical and biological engineering departments in the nation.

CBE has a long history of partnering with industry and corporations to advance our field and our world. In this issue, you can read about how the Bemis Company Foundation helped establish a named professorship, as well as about a unique project led by one of our students, aimed at helping the dairy industry turn an expensive waste product into a potential source of revenue.

Our students and faculty continue to make us proud earning national recognition for their accomplishments. Read about some of those honors in this newsletter: James Dumesic and George Huber were named among the top 1 percent most-cited researchers in 2018, Michael Graham was named as the Vannevar Bush Faculty Fellow, a prestigious award from the Department of Defense, and Manos Mavrikakis was the recipient of the ACS Gabor Somorjai Award for Creative Research in Catalysis.

These awards are especially meaningful, because they highlight our faculty's exceptional research as well as their strong commitment to teaching and service, something that has long been a priority for the department.

We're pleased to welcome two new faces to our staff! Our new payroll and benefits specialist is Theresa Neisus. Kate Fanis joins the department as associate student services coordinator. Kate previously spent three years as the graduate coordinator in the department of Spanish and Portuguese.

On a sad note, we recently lost Professor Glen Sather, at age 91. Professor Sather was a gifted educator and a member of member of our faculty for more than 30 years. His dedication to his students was an inspiration to me when I was just beginning my academic career at Wisconsin. See his obituary on page nine.

Please don't hesitate to get in touch, whether to schedule a visit, or just to say, "Hi!"

ON, WISCONSIN!

Regina M. Murphy, PhD

R. Byron Bird Department Chair
Smith-Bascom Professor
regina.murphy@wisc.edu • (608) 262-1587



SUPPORT CBE

allwaysforward.org/giveto/cbe



ENGINEERING
FORWARD

Or contact:

Kyle Buchmann

(608) 308-5389

Kyle.Buchmann@supportuw.org



ACCELERATED MASTER'S PROGRAMS

An engineering master's degree from UW-Madison gives you the credentials to get ahead. Find a program that fits your goals and lifestyle.

- 21 flexible online and accelerated programs
- Degrees in multiple disciplines
- World-renowned faculty
- Individual attention
- Innovative partners
- Dedicated fellow students
- Rigorous courses that address real-world problems
- Ideas, inspiration and tools to apply immediately on the job

Earn the recognition you deserve, and prepare yourself today to meet tomorrow's engineering challenges: advanceyourcareer.wisc.edu/engineering

HISTORIC ENDOWED CHAIR SUPPORTS CBE EXCELLENCE

Our department has a long tradition of supporting faculty through endowed faculty positions.

Endowed professorships help the department recruit top talent while keeping student-to-professor ratios small—and those are among the reasons why UW-Madison CBE has consistently been among the world's best chemical engineering programs.

An endowed chair position, however, is a historic first. And CBE is the first of three departments in the College of Engineering to establish an endowed support fund for its leadership.

"It is a real luxury to know that you have a steady source of income, so you can plan for future investments in the department," says Regina Murphy, the first person to hold the Robert Byron Bird Department Chair in Chemical and Biological Engineering.

College of Engineering Dean Ian Robertson awarded Murphy the named chair position at a ceremony in February 2019. That event was doubly festive, as the endowed chair's eponymous honoree, Bob Bird, celebrated his 95th birthday just three days prior on Feb. 5.

In the next few years, Murphy plans to use the support to help create startup packages for new faculty. The department is in a highly



Dean Ian Robertson, Bill and Karen Monfre, Dorothy O'Brien and Richard Antoine, and Katie and Todd Pulvino (back row, standing) Professor Manos Mavrikakis, Bob Bird, and chair Regina Murphy (front row, seated). Photos: Andy Manis.

active recruiting phase, and funds from the endowment can go toward new research instrumentation and graduate student support for the first few years of an assistant professor's time at UW-Madison as he or she begins to establish a research program.

Moving forward, the named chair position could help augment the department's computational resources or support textbook writing. Because the endowment will generate almost \$200,000 in flexible funding per year, Murphy, as well as department chairs far into the future, will have reliable funding to keep CBE among the best departments in the nation.

It's fitting that the department's ongoing source of support bears Bob Bird's name; an educator and researcher whose legendary scholarly contributions helped lay the foundations for modern chemical engineering, Bob helped establish CBE as the powerhouse that it is today.

Outside of the classroom, he is also a linguist, a musician, a composer, a historian, a limerick writer and a puzzle creator.

During his time on campus, Bird shaped generations of chemical engineers.

"As a proud student of Professor Bird, I understand firsthand the transformational impact

of his role in my education and career," says alumnus Richard Antoine (BS '69), who enjoyed a distinguished 39-year career with Procter & Gamble before launching AO Consulting.

Bird's legacy will continue through the Robert Byron Bird Department Chair.

"We are inspired by Bob's legacy and we aspire to carry on his values and traditions long into the future," says Murphy. "This belongs not to me, but the entire department and the entire community of students, faculty and alumni."

Now, the department has achieved its ambitious goal of a minimum of \$4 million for the R. Byron Bird Department Chair endowment.

The effort had a head start thanks to generous initial gifts from Antoine and his wife Dorothy O'Brien (BS SOHE '70), John Kuetemeyer (BSChE '61), Bill Monfre (BSChE '85) and Karen Monfre (BBA '86), as well as Todd Pulvino (BSME '84) and Katie (Grogan) Pulvino. The department is still seeking additional support to further enhance the endowment.

To be a part of this special opportunity to honor Bird, contact Kyle Buchmann, kyle.buchmann@supportuw.org.



Regina Murphy and Bob Bird.

LEVERAGING AI TO MONITOR EXPOSURE TO AIR CONTAMINANTS



“We want people to have more information about what they’re exposed to in their daily lives, especially within cities.”

— Victor Zavala

People in cities encounter all manner of airborne contaminants during their daily lives. New chemical sensors could help scientists understand the hazards in pollution.

Monitoring air contaminant exposure is vital in ongoing efforts to detect the presence of dangerous chemicals and understand how urban pollution affects human health.

A team of researchers at UW-Madison and Cornell University is developing liquid crystal-based sensors that can quickly and accurately detect trace amounts of air contaminants—everything from carbon monoxide to chemical weapons such as sarin. A \$1.9 million grant from the National Science Foundation is funding their efforts.

Liquid crystals, like those used in electronics displays, are states of matter where the molecules can either move and flow like a liquid or adopt an organized arrangement. That switch from the free-flowing to organized phase often alters how liquid crystals interact with light. It’s what produces the vibrant images on LCD screens, which use electricity to switch liquid crystals between phases pixel-by-pixel.

“The versatility of liquid crystal sensors is quite remarkable,” says Victor Zavala, the Baldovin-DaPra Associate Professor. “We want people to have more information about what they’re exposed to in their daily lives, especially within cities. Right now, we measure only a few contaminants and at a few locations, but that doesn’t tell the whole story.”

Liquid crystal technology is already under exploration for low cost, portable, personal sensors. However, existing liquid-crystal-based chemical sensors are limited in response times; detectable changes become visible to human eyes only after several minutes.

That’s too long, given that most of our exposures to airborne contaminants occur briefly—for example, if we walk through a poorly ventilated tunnel or catch a blast of exhaust from a construction site.

The researchers have developed a sensor that can detect specific sarin concentrations within a few seconds. To speed up their sensors, the scientists turned to artificial intelligence: Deep neural networks are computer programs that learn to recognize patterns without input from humans.

When Zavala and colleagues allowed deep neural networks to take a look at snapshots of the new sensors, those algorithms spotted changes in patterns inside the liquid crystals after only three seconds—correctly identifying exposure to the sarin-like chemical with 99-percent accuracy.

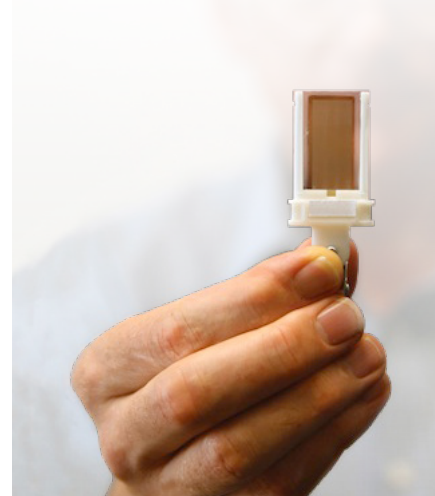
And though the deep neural networks excelled at identification, the researchers weren’t satisfied to blindly trust the machines.

So, drawing on the expertise of colleagues Reid Van Lehn and Manos Mavrikakis, the

team is starting to run molecular simulations and computationally modeled interactions linking the abstract “thoughts” of deep neural networks to actual physical mechanisms occurring within the liquid crystal sensors.

“We’re scientists; we want to know what is actually happening,” says Zavala. “Deep neural networks tell us that there is something hiding in there, and our job is to try to find it and understand it.”

Liquid crystal sensors can detect dangerous chemicals in seconds. Photo: Renee Meiller.



COULD YESTERDAY'S EARTH CONTAIN CLUES FOR MAKING TOMORROW'S MEDICINES?



Several billion years ago, as the recently formed planet Earth cooled down from a long and brutal period of heavy meteor bombardment, pools of primordial muck began to swirl with the chemical precursors to life.

Today, engineers are devising chemical reactions that mimic early Earth to not only learn about how life arose so many years ago, but also to unlock new capabilities for modern medicine.

"If you can get chemistries that encode information, then maybe you can design new drugs," says Professor John Yin.

Yin and colleagues recently did just that—describing initial steps toward achieving chemistries that encode information in a variety of conditions that might mimic the environment of prehistoric Earth.

They published the findings in the journal *Origins of Life and Evolution of Biospheres*.

"I view this as systems chemistry," says Yin. "How do we take store-bought chemicals and combine them in such a way that they display emergent properties like the ability to store information or copy themselves?"

The compounds the researchers combined were molecules called amino acids, which are the molecular building blocks for the proteins that perform much of the structural and chemical work inside living cells. There are

20 different amino acids that combine to form the essential proteins for life, but Yin and colleagues focused on just two: alanine and glycine, which are among the simplest examples of these molecules.

Also in the mix was an energy molecule called triphosphate, believed to be available on early earth.

The researchers "cooked" together the mixture over a range of different temperatures and variously acidic conditions. In mixtures without the energy molecule, amino acids only joined together under the most hot and harsh conditions. When triphosphate was present, however, short chains of alanine and glycine formed at more moderate temperatures.

"Triphosphate facilitates reactions in conditions where most life is found to occur," says Yin.

Intriguingly, the alanine and glycine did not combine at random. Instead, the amino acids linked up into chains with specific sequences, depending on temperature and pH.

"What we have shown is that you are a product of your environment," says Yin.

Key to the study was the ability to determine the composition of different amino acid chains with sophisticated analytical

chemistry. For the molecular characterizations, Yin collaborated with Lingjun Li, a professor of pharmacy and chemistry.

"People have been cooking amino acids since 1940 or so," says Yin. "But now we can identify what's actually in there."

And what they identified hints at the first glimmers of information storage that arose so many billions of years ago.

The scientists speculate that, with increased "cooking" time, even greater complexity might appear. Their reactions only proceeded for 24 hours—a mere blink of an eye compared to the history of the planet. Additionally, the scientists plan to add a greater variety of molecules into the mixture.

Eventually, they hope to create mixtures where complicated molecules spontaneously

"If you can get chemistries that encode information, then maybe you can design new drugs."

— John Yin

come together from simpler components and create self-driving chemical reactions that interact and feed off of each other.

Those reactions could contain the keys to creating new drugs or synthesizing existing compounds more efficiently.

"We'll figure out how to close the loop," says Yin.

The researchers have a patent in progress with the Wisconsin Alumni Research Foundation.

A SWEET IDEA

Converting dairy leftovers into profitable products

A strategy for transforming waste from the Greek yogurt-making process into a high-value sweetener product might pave the way for millions of extra dollars per year for dairy producers.

"We think this technology could definitely reduce the environmental impact of the dairy industry while generating extra revenue," says Mark Lindsay, a PhD student and the project's lead researcher. A grant from Dairy Management Inc., the marketing branch of the dairy industry, supports the project.

But Greek yogurt has a whey problem. Unlike the remnants of cheesemaking, which can be readily dried into high-value whey powders, the liquid left over from Greek yogurt production is too low in protein and too highly acidic for cost-effective processing.

That means a massive amount of liquid, called Greek yogurt acid whey, goes down the drain: U.S. Greek yogurt producers must dispose of roughly 2 million tons of the fluid annually.

"There aren't good solutions for using or disposing of Greek yogurt acid whey," says Lindsay. "Most of it goes to wastewater treatment plants, but that's expensive and not great environmentally."

Greek yogurt acid whey is mostly water, but it contains some sugars, salts and minerals. At 4 percent by volume, the most abundant component in whey besides water is lactose, which is the sugar responsible for some people's intolerance to dairy.

In addition to causing allergies, lactose is far less sweet than table sugar, and it's considered a low-value product for the chemical industry.

But in fact, says Lindsay, lactose itself can be further broken down into two smaller sugars, glucose and galactose.

"There are a lot of ways to make high-value products from lactose if you split it in half," he says.

Once split in half chemically, the two components can form the basis for a sweetener that could stand in for high-fructose corn syrup. That means Greek yogurt producers could flavor their products with a natural syrup, made in-house, while also diverting whey waste away from the drain.

It's a sweet deal—especially as increasing numbers of health-conscious consumers seek products with no added high-fructose corn syrup.

"The people we've contacted in the dairy industry say this could be very good," says Lindsay. "And, the economics suggest that it could be very beneficial."

The researchers' economic analysis, done in collaboration with postdoctoral researcher Kefeng Huang, indicate that a large Greek yogurt facility could milk the process for almost \$3 million per year, after taxes.

And the initial costs for constructing a Greek yogurt acid whey processing facility should run around \$7 million, according to their estimates. That means a producer would be able to recoup its investment within a few years.

Currently, Lindsay and colleagues are working to optimize the process with solid catalysts; up until this point they've used liquid sulfuric acid to promote lactose-splitting, and solid catalysts can be more practical at an industrial scale.

In the future, the scientists hope to investigate strategies for splitting the lactose in whole, unprocessed milk, which is a much more difficult problem due to the large amounts of fats and proteins in fresh-from-the-cow dairy. If successful, their efforts could dramatically reduce the cost of lactose-free milk.

A native Wisconsinite, Lindsay was quick to appreciate the project's potential to benefit farmers in his home state. His research is somewhat unique compared to that of his lab colleagues, however—his advisor, Richard L. Antoine Professor George Huber, is world-renowned for studies of biofuels and breaking down plant materials into useful products.

"I'm the only grad student from Wisconsin in my lab, and I ended up with the dairy project," he says.



Christos Maravelias, the Vilas Distinguished Achievement Professor and Paul A. Elfers Professor, advises Huang. Professor Scott Rankin of the Department of Food Science also collaborates on the project. The researchers have filed patent applications with assistance from the Wisconsin Alumni Research Foundation.

LEADING THE DRIVE TOWARD A RENEWABLE FUTURE

Fossil fuels seep their way into almost every aspect of American life.

Transportation, heating and the plastics and chemicals we use every day all rely on petroleum products, but our insatiable appetite for fossil fuels will have catastrophic consequences for the health of the planet if left unchecked.

That's why engineers at UW-Madison have been leading the charge to find viable alternatives for petroleum products from plant-based sources.

Currently, biofuels can't compete, cost-wise, with petroleum products. That's in part because the fossil fuel industry has a nearly century-long head start in optimizing its refineries to extract profitable products from every last drop of crude oil.

Another barrier is the cost associated with growing, transporting and breaking down the plants that serve as feedstocks into usable chemicals.

"Everything that we can do to reduce feedstock cost on the supply side will help," says Vilas Distinguished Achievement Professor and Paul A. Elfers Professor Christos Maravelias.

Maravelias is one of several world experts at UW-Madison who are lending their insight to big picture problems.

Other biofuels researchers from CBE include James Dumesic, who pioneered several technologies for breaking down the cell walls of plants; Jennifer Reed, who uses computer modeling to tease out strategies for forcing bacteria to produce biofuels; Brian Pfleger, an expert in genetically modifying microbes for fuel production; and Reid van Lehn, who reveals new insight about biofuel chemistry using advanced simulation techniques.

All are members of the Great Lakes Bioenergy Research Center (GLBRC), which is headquartered at UW-Madison. With \$125 million of new support over the next five years from the U.S. Department of Energy, GLBRC will explore cutting-edge questions as it continues to work toward bringing plant-based fuels and products to the market.

And numerous other scientists—graduate students, postdoctoral scholars and nearly 70 faculty members in total—contribute their expertise to the center as well.

years, a main research priority for the center has been strategies to create fuels from plant materials that aren't used for human food, otherwise known as cellulosic feedstocks.

Now, the scientists are shifting their focus to chemicals other than ethanol.

"It's not only about fuels," says Maravelias.

A particularly fertile ground for innovation has been the realm of replacement chemicals—compounds that could someday swap in for products that we currently derive from petroleum.

It's important to find those chemicals, because revenue from side-products of oil refineries (petroleum compounds like solvents and plastic precursors that don't end up in our tanks) help keep gasoline prices substantially lower than those of biofuels.

Maravelias and colleagues have published multiple manuscripts identifying categories of chemicals that might be ripe for replacement.

Another major question concerns the crops that eventually become feedstock. Currently, plants destined to be converted to biofuels displace potential food crops from valuable farmland. Finding ways to grow biofuel feedstocks on parcels known as marginal lands—areas with

little agricultural value because the land is unsuitable for growing food crops—is a major priority of the center.

"If we want to think about bigger, higher-level policy questions, we need to consider the selection of types and locations of lands, the selection of promising target fuels and chemicals, as well as incentives for farmers," says Maravelias. "That's why we're marrying plant and ecological system modeling with biorefinery models."



Plant feedstocks being broken down into useful products at the GLBRC.

Photo: Matt Wisniewski.

Engineers at UW-Madison have been leading the charge to find viable alternatives for petroleum products from plant-based sources.

UW-Madison is home to scientists working on almost every aspect of biofuels, from plant genetics to the big-picture questions such as where to locate biorefineries in relation to feedstock sources and urban centers.

"Our role is to guide future efforts by identifying the most important bottlenecks," says Maravelias. "Some technologies are closer than others."

One technology that the researchers aren't focusing on is the first-generation biofuels, namely, corn-derived ethanol. For the past 10

WITH GRATITUDE FOR OPPORTUNITIES, FAMILY PROVIDES GRADUATE STUDENT SUPPORT

A new scholarship fund, celebrating the lives of Keun Young Kim (MS '56 PhD '59 ChemE) and Sanok P. Kim (MA '58), will support graduate students in chemical engineering for generations to come.

Both Keun and Sanok have always been deeply appreciative of the University of Wisconsin–Madison for the opportunities they received. It was their wish to give back to the university that had given them generous scholarships and made it possible for them to pursue their graduate educations.

“My sister and I felt it would be a great way to give back to UW-Madison while honoring our parents by establishing these scholarships for future students in perpetuity,” says the Kims’ oldest child, Kenneth Kim, a physician and entrepreneur.

In 1954, Keun escaped war-torn Korea, landed in America with \$50 in his pocket,

and made his way to Madison. UW-Madison offered him a full scholarship and teaching award, which allowed him to pursue his master’s and doctoral degrees in chemical engineering.

Sanok also came to America to escape the war in Korea and to pursue her education. She received her bachelor’s degree in romance languages with high honors from Clark University in Worcester, Massachusetts. She was then offered a full scholarship and teaching assistantship in romance languages at UW-Madison, where she received her MA degree in 1958.

“My parents always were so grateful for the opportunities they received in America, and specifically to the University of Wisconsin for providing them with great educations that allowed them to establish successful careers in this country,” says Pauline Kim, a professor of law at Washington University in St. Louis.

Keun went on to have an illustrious 41-year career at Monsanto in St. Louis, where he reached the level of fellow and contributed to research that led to the filing of numerous patents. Sanok worked for 29 years at Washington University’s Olin Library, beginning as a part-time cataloger and rising to become a librarian supervisor responsible for technical training for new staff.

The Keun Y. and Sanok P. Kim Graduate Scholar in Chemical and Biological Engineering Fund will provide scholarships to outstanding graduate students in CBE.

“Awards like this are essential components of our success at recruiting the top graduate students in the nation and in the world to the University of Wisconsin. The impact of the Kims’ gift will strengthen the department for years to come,” says Chair Regina Murphy.

NAMED PROFESSORSHIPS STRENGTHEN CBE



Victor Zavala (left), the Baldwin-DaPra Associate Professor, with Dan Baldovin.



George Huber (center), the Richard L. Antoine Professor, with Richard Antoine and Dorothy O'Brien.



Eric Shusta (center), the Howard Curler Distinguished Chair, with Department Chair Regina Murphy and Dean Ian Robertson

Our outstanding faculty are some of the best in the nation, and their contributions to chemical and biological engineering research and education have long earned UW-Madison CBE its premier reputation.

Attracting and retaining top talent is essential to maintain the department’s status as a powerhouse in chemical and biological engineering, and named professorships are a vital way to support our exceptional faculty.

Before 2016, the College of Engineering had a total of 19 named professorships, but since the announcement of the All Ways Forward campaign, that number has grown to 87. Generous gifts from CBE

alumni and friends have provided our faculty the support they need to advance cutting-edge research and move our field forward.

During fall 2018, CBE celebrated three new endowed positions. George Huber was named the Richard L. Antoine Professor, Victor Zavala was named the Baldwin-DaPra Associate Professor, and Professor Eric Shusta was named the Howard Curler Distinguished Chair.

We’re profoundly grateful to the families for their generosity, as well as to the Bemis corporation, which endowed the Howard Curler Distinguished Chair position in honor of Curler’s outstanding tenure as CEO.

FACULTY NEWS



Clarivate Analytics named **James Dumesic**, the Ernest Micek Distinguished Chair, and **George Huber**, the Harvey D. Spangler Professor, to its 2018 honor roll of highly cited researchers for the chemistry field. The distinction honors researchers who author papers that rank in the top 1 percent by citation count of their discipline. Dumesic's research has accumulated more than 59,000 citations on Google Scholar, and Huber's work has been cited more than 29,800 times. Both Huber and Dumesic have appeared on the highly cited researchers list many times before, in recognition of their pioneering work in biofuels and catalysis.



Professor **Sean Palecek** was named director of research innovation for the newly created forward BIO initiative. Established with a \$750,000 grant from the Wisconsin Economic Development Corp., the Forward BIO Initiative is a collaborative effort to make Wisconsin a recognized center of excellence for biomanufacturing.



Michael Graham, the Vilas Distinguished Achievement Professor and Harvey D. Spangler Professor, authored a new textbook, which was published by Cambridge University Press. The manuscript, titled *Microhydrodynamics, Brownian Motion and Complex Fluids* provides a foundation

for understanding flowing complex fluids. Unlike other volumes, Graham's book brings together fluid dynamics, continuum mechanics, statistical mechanics, polymer and colloid physics and various branches of applied mathematics in a self-contained and integrated treatment that allows the reader to see them in context to deepen understanding.



The American Chemical Society awarded the 2019 Ipatieff Prize to **Ive Hermans**, the John and Dorothy Vozza Professor of chemistry and an affiliate of chemical and biological engineering. Hermans received the award in recognition of his innovative research on catalytic oxidations, and the contributions he has made to industrial chemistry. In particular, his work helped contribute to sustainable production pathways for important chemicals like alkenes, epoxides, and alcohols.



The American Chemical Society honored **Manos Mavrikakis**, the Vilas Distinguished Achievement Professor and Paul A. Elfers, with the Gabor A. Somorjai Award for Creative Research in Catalysis. The recognition highlighted Mavrikakis' innovative research program, which combines molecular modeling, microkinetics, and experiments to reveal what happens inside catalyst active sites during chemical reactions and to discover better catalysts.

Remembering a devoted CBE professor



Glenn Arthur Sather passed away on Monday, Jan. 28, 2019, at the age of 91. Sather was a professor of chemical engineering who was known for offering his students extensive individual attention and guidance during his 32 years with the department. Throughout his career, Sather received several awards for teaching, both at UW-Madison and as a visiting professor at Dupont Corp. in Wilmington, Delaware, during his later years. Prior to joining the UW-Madison faculty, Sather received both his bachelor's and PhD degrees from the University of Minnesota. His education was briefly interrupted during the Korean War, during which time he spent two years in the military. Sather served in the U.S. Army at Fort Knox, Kentucky, and with the Counter Intelligence Corps at Fort Holabird, Maryland, before being stationed for one year in Pusan, South Korea. Throughout his life, Sather was an avid traveler and photographer, visiting seven continents and documenting his adventures with detailed travelogues. He is survived by Eleanor, his wife of 66 years, his son Andrew, daughter-in-law Kit Emory, and several nieces and nephews.

STUDENT NEWS



◀ We welcomed 29 newly minted chemical engineers to the CBE family during the December 2018 commencement ceremony.

GOOD IDEAS

At NSF, Kuech learns and leads

Washington, D.C., as the stereotype holds, is a town full of cynical stuffed-shirt bureaucrats.

But Professor Tom Kuech, who recently returned to Madison after a three-year stint living and working in the nation's capital on an intergovernmental personnel act assignment with the National Science Foundation, found that nothing could be further from the truth.

"The people were some of the most dedicated and interesting people I've met," says Kuech.

At the NSF, Kuech acted as a program director for the agency's advanced manufacturing division—a bit of a departure from the solid-state materials synthesis and characterization research he does at UW-Madison.

"I learned a lot," says Kuech. "It was great to be there because I was in a place where everyone wants to bring you their best ideas."

Those ideas ran the gamut from nanocomposites to lubrication to advanced electronic materials. But Kuech wasn't merely evaluating individual proposals for their merit. His central charge was finding new support mechanisms for research designed to solve big societal problems.

"Many of the more challenging questions can't be answered by one person alone," says Kuech. "We tried to develop programs that enabled multiple people to come together and propose something."

One of the programs Kuech worked on was called Leading Engineering for America's Prosperity, Health, and Infrastructure, or LEAP HI. The new initiative challenges engineers to collaborate on a fundamental



research problem with the potential to make a big difference for America's economic competitiveness, essential infrastructure, or the quality of life for its citizens.

Key to the NSF mission is supporting so-called basic science research, the curiosity-driven, fundamental inquiries that might not be associated with immediately obvious applications.

Such basic science research, however, has paved the way for many of the innovations that we now take for granted.

the city without a personal vehicle—relying primarily on walking, public transportation, and very occasionally, the car-sharing service ZipCar to get around.

His apartment, located in the city's trendy Logan Circle neighborhood, was merely blocks away from world-class restaurants like the French bistro Le Diplomate, and performance venues such as the historic Lincoln Theater.

While at the NSF, Kuech maintained frequent contact with the graduate students and staff scientists working in his lab in Madison, helping them continue to make progress in his absence. Now that he's returned, he's excited to explore new avenues of research—inspired, in part, by his time at the NSF.

"Many of the more challenging questions can't be answered by one person alone. We tried to develop programs that enabled multiple people to come together and propose something."

— Tom Kuech

Cell phones, for example, are now elegantly compiled of myriad far-flung components that sprang from basic research into advanced materials.

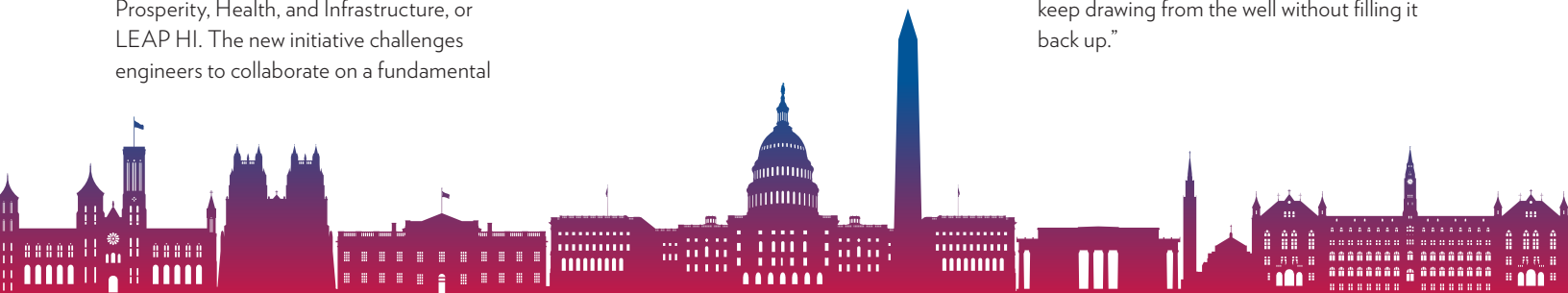
"New devices and new materials were usually driven by curiosity," says Kuech. "Eventually, it's very difficult not to find a use for new devices or new materials."

In addition to enjoying the stimulating work and collegial environment at the NSF, Kuech made the most of his time living in Washington, D.C. He mostly navigated

He's particularly excited for some upcoming large-scale projects with the Materials Research Science and Engineering Center, as well as a project that rethinks how advanced solar cells are manufactured. The potentially paradigm-shifting project could have huge implications for the future of energy generation.

And Kuech will continue to tackle fundamental questions.

"Research that is directed toward a specific need usually means all the discoveries have already been made," says Kuech. "Basic science fills the well of knowledge. You can't keep drawing from the well without filling it back up."



REMEMBERING A GOLD STAR CBE ALUM

Relatives of fallen military personnel who passed away during active duty have been known as “gold star families” ever since World War I.

The designation harkens back to a time when the families of service members placed blue stars in their windows while their relatives were deployed. Families whose loved ones passed away replaced the blue with a star of gold.

That was the case for the family of brothers Phillip and Charles Howard Bixby, who both lost their lives during the conflict.

Both Bixby brothers had UW-Madison ties.

Charles Howard received his degree in chemical engineering in 1941, while the more agriculturally minded Philip attended the farm and industry short course, finishing in 1939. Charles Howard and Philip were raised on a farm in Appleton, Wisconsin—and growing up, the two couldn’t have been more different. Philip was always serious and pragmatic by nature, and he had a passion for farming.

Charles Howard, by contrast, was a jokester with a winning sense of humor who befriended almost everyone he met. Endowed with a

natural aptitude for science and math, Charles Howard pursued his chemical engineering degree while Philip had his eyes on taking over the family business of farming alfalfa and cabbage.

Both brothers served in the Reserve Officers’ Training Corps while they attended UW-Madison. Phillip went on to enlist in the army, becoming a tank commander first lieutenant of the 67th Armored Regiment in the 2nd Armored Division in the European Theater. Charles Howard joined Navy, became an ensign, and served as a pilot in the South Pacific.

During the war, Charles Howard kept in contact with his sister, Janet, back at home, sending a steady stream of often humorous letters.

Sadly, those letters stopped arriving in 1943 when Charles Howard went missing in action after a 1943 plane crash off the coast of Australia. Merely two years later, Philip was felled by an enemy sniper in April of 1945.

On Dec. 7, 1945, Alice Bixby, Charles Howard and Phillip’s mother, received two gold star certificates honoring her two fallen sons. Philip was survived by his wife and high-school sweetheart, Rosemary, as well as their two children.

More than 1,000 UW-Madison alumni have passed away while serving their country, and the Wisconsin Union tells their stories through the Gold Star Honor Roll, a tribute unveiled in November 2017 that includes a kiosk outside of Memorial Union’s Main Lounge and a website sharing fallen heroes’ stories.



UNCOMMON THREADS: CLASSIC SUMMER LAB T-SHIRTS



For longer than a century, CBE seniors have completed the Operations and Process Laboratory capstone course CBE 424, affectionately known as “Summer Lab.” Since 1914, with a brief interruption during WWII, the five-week long “boot camp” course has been a rite of passage for chemical engineers on their way to earning their degrees, pushing students outside their comfort zones and providing undergraduates unique opportunities to solve open-ended challenges with hands-on experiments.

Throughout the years, summer lab participants have created camaraderie within their cohorts by designing custom T-shirts to commemorate their experience. Recently, our alumni shared a treasure trove of classic summer lab shirts. We’d love to hear from you if you still have your shirt, or if you spot the design from your time in the summer lab trenches!



SPOTLIGHT ON YOUNG CBE TALENT



Senior **Coty Weathersby** was one of the 2018 winners of the Alliant Energy/Erroll B. Davis Jr. Academic Achievement Award. Originally from Milwaukee, Weathersby participated in UW-Madison's Engineering Summer Program for high school students. Later, as a LEED Scholar, she led an outreach visit to her alma mater, Rufus King High School. A founding member of the Wisconsin

chapter of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers, she coordinates outreach days through the Madison-area Boys and Girls Club.

Kevin Barnett, the co-founder and CEO of Pyran LLC, received a \$225,000 Small Business Innovation Research grant from the National Science Foundation. Pyran has developed a renewable process to manufacture 1,5-pentanediol, a key chemical used to make paints and plastics. Pyran's patented process uses renewable wood and crop waste resources to make 1,5-pentanediol at less than half the price compared to competing oil-based products. Pyran's technology was developed over the course of three years under the supervision of George Huber, the Richard L. Antoine Professor. The grant will fund research to test and scale up Pyran's catalyst technologies.

