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Chemical and
Biological Engineering
UNIVERSITY OF WISCONSIN–MADISON

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On These Foundations / Spring 2015

New $3M distinguished chair honors an influential CBE alumnus

A new professorship will allow UW-Madison to hire a senior faculty member to build on its widely recognized leadership in chemical and biological engineering.

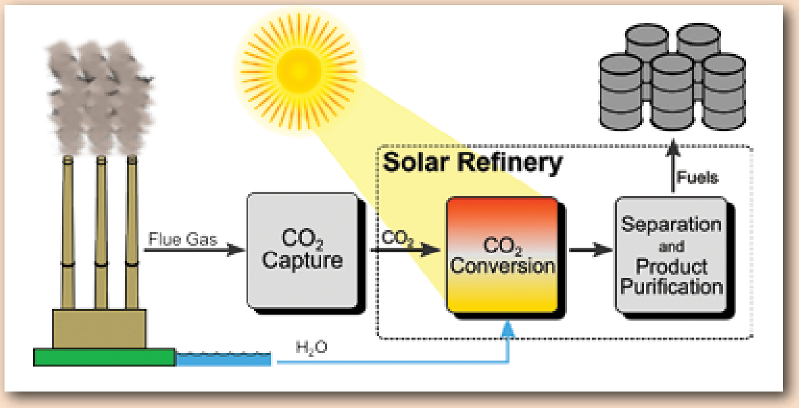
Supported by a $3 million commitment from the Wisconsin Alumni Research Foundation (WARF), the Ernest Micek Distinguished Chair in Chemical and Biological Engineering will honor a UW-Madison graduate with a long record of service to UW-Madison. Ernie Micek, a native of Arcadia, Wisconsin, earned his UW-Madison bachelor's degree in chemical engineering in 1959, then went on to work at Cargill Corporation, starting as a shift supervisor and then working his way up to CEO, a capacity he served in from 1995 to 1999.

During his time at Cargill, Ernie played a major role in dramatically expanding and refocusing the company's operations, turning it from a producer of raw commodities into a global supplier and distributor of processed food products. As part of the executive team that built up Cargill into one of the world's most respected companies, Ernie also became an influential voice in international trade and other affairs, serving on many trade committees and voicing support for federal research funding. After retiring from Cargill in 2000, he continued to work in the private sector as president of Perth Corporation from 2002 to 2007, in addition to serving on the boards of other companies.

(Continued on page 3)

Ernest Micek and his wife, Sally

Calculating the future of solar fuels



Converting the sun's energy into liquid fuels requires a sophisticated, interrelated series of choices. But what makes a "solar refinery" so tricky to map out is that, as one decides how to spark a solar-powered reaction that turns carbon dioxide and water into hydrocarbon fuels, so many steps could potentially involve newly developed and experimental technologies.

New methods for capturing carbon dioxide from a coal-fired power plant, the ever-expanding array of materials used for catalysis, the diversity of approaches to capturing and converting the energy in sunlight—all of these are variables researchers and industry must weigh as they ask how to design economically viable and energy-efficient solar refineries. And many of them will be using a powerful new tool developed at UW-Madison.

In a new paper in the journal *Energy and Environmental Science*, a team led by Chemical and Biological Engineering Professors Christos Maravelias and George Huber crafts a framework intended to help plot the future of solar fuels. The framework essentially calculates the financial and energy costs, as well as the

(Continued on page 3)

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In the year 1900, Magnus Swenson, a visionary chemical engineer and member of the University of Wisconsin Board of Regents, presented a public lecture advocating the establishment of a department of chemical engineering at the university. Swenson ventured, "Let the University of Wisconsin take hold of this matter in earnest and I predict for the Department of Chemical Engineering a career that will reflect credit to the University and redound to the prosperity of the State." Five years later under the leadership of Charles Burgess, the department was established. The subsequent 110 years would prove Swenson correct.

But even a 110-year history of excellence and leadership in the field won't guarantee future success. Continuing reductions in state support of the university and in the funding of engineering research pose an ongoing challenge. In this climate, even the strongest units, like the Department of Chemical and Biological Engineering, face difficulties in meeting our mission of education and research excellence. Faculty retention and recruitment of the very best students, in particular, are continuing concerns at all premier institutions.

And so, with the support of the College of Engineering and the university, we are responding aggressively to these challenges. First and foremost, we are actively recruiting several new faculty to enhance and complement existing areas of research strength and to assure a well-rounded instructional program. I am delighted to report that Victor Zavala, a computational mathematician at Argonne National Laboratory and PhD graduate of Larry Biegler's (PhD '81) process systems engineering group at Carnegie Mellon University, recently accepted our offer as assistant professor and will join us in time for the fall semester. Watch for more information on Victor's contributions in mathematical modeling and optimization of energy systems in the next issue of this newsletter.

We also are proactively seeking to retain the outstanding faculty we currently have. This year for instance, we won competitive, campus-wide Vilas Distinguished Achievement Professorships, which provide $75,000 in research support from the endowed Vilas Trust, for *both* Manos Mavrikakis and David Lynn *(see p. 7)*, and this after both Sean Palecek and Mike Graham received this distinction last year, and Nick Abbott received the campus-wide Hilldale Professorship.

We are also actively seeking endowment support for departmental professorships. The newly established Richard Soit Chair will be awarded to Victor Zavala, and proved to be a valuable recruiting tool, while the Smith-Bascom Chair will be used for retention purposes to support a current faculty member, yet to be selected. The WARF board recently established the $3 million Ernest Micek Distinguished Chair in Chemical and Biological Engineering in honor of one of our accomplished alumni who has provided many years of service on university boards and committees *(see p. 1)*. The Micek Chair will allow us to recruit an outstanding senior faculty member to the department.

Harry and Bonnie Spiegelberg also have pledged an estate gift to support a named professorship in the future.

In addition, two departmental alumni have recently pledged to create new professorships, taking advantage of an unprecedented, university-wide matching gift opportunity made possible by a $100 million gift from John and Tashia Morgridge. One of these matching pledges, from Jay and Cindy Ihlenfeld, is described more fully on page 5. If you (or you and a group of friends!) are in a position to make a major gift to the department, please contact us soon to take advantage of this opportunity to have your contribution doubled!

We also continue to seek fellowship and scholarship funding to help recruit outstanding graduate and undergraduate students respectively. Two other alumni recently pledged to establish new graduate fellowships, which will enhance the department's ability to recruit the best and brightest graduate students. These graduate students will help faculty pursue cutting-edge research, while providing hands-on learning opportunities for undergraduates. On pages 7 and 8 you can read about the work of some of our creative and hard-working students who have received such support.

In closing, I would like to congratulate Manos Mavrikakis on his recent election as a fellow of the American Association for the Advancement of Science. It is recognitions like this—and the important research on which they are based—that demonstrate that our efforts to recruit and retain top talent are paying off, and will serve us well going forward even in this tough budgetary climate. Magnus Swenson is on a roll.

go.wisc.edu/givetocbe

Investing in faculty excellence is a college priority— and one way we can attract and reward star faculty is through endowed professorships. Currently, approximately one-quarter of our engineering faculty members hold a professorship or chair—and our goal is to greatly increase the number of endowed professorships for both junior and senior hires.

A gift to the university will enable us to realize that goal: Alumni John and Tashia Morgridge made a landmark $100 million gift to UW-Madison in support of faculty excellence—and that gift provides a dollar-for-dollar match to other donors who make a gift to endow a professorship ($1 million), a chair ($2 million) or a distinguished chair ($3 million).

If you are considering any contribution, whether a professorship, an estate gift, matching gift, endowment or an immediate gift, please contact:

Ann Leahy, Director of Development
(608) 265-6114
ann.leahy@supportuw.org

Thank you for your support of the UW-Madison Department of Chemical and Biological Engineering.

New $3M distinguished *(Continued from front page)*

Throughout his career and into his retirement, Ernie made significant contributions to UW-Madison, supporting multiple scholarships and serving on the WARF board as well as the CBE visiting committee. At WARF alone, Ernie contributed 17 years of service, at different times serving on WARF's investment committee, the start-up equity committee, and the patent and licensing committee, and chaired the audit and personnel committee.

Ernie was a founding member, and for a time chair, of the board of the Morgridge Institute for Research. Ernie received the 1991 Distinguished Service Citation from the UW-Madison College of Engineering, and has received honorary doctorates from UW-Madison and the South Dakota School of Mines and Technology.

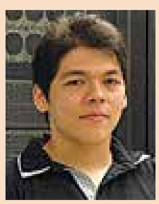
"Ernie's many successes testify to the value of a great UW education," says Carl Gulbrandsen, managing director of the Wisconsin Alumni Research Foundation (WARF). "He harnessed his chemical engineering degree and went on to transform an industry. As a member of the boards of trustees for WARF and the Morgridge Institute for Research, he's graced our organizations with his vision, private-sector expertise and friendship."

"Ernie has been a longtime friend and contributor to the Department of Chemical and Biological Engineering," says Milton J. and A. Maude Shoemaker and Beckwith-Bascom Professor and Chair of Chemical and Biological Engineering Thomas Kuech. "His advice and help to the department over the many years have been instrumental in advancing the department. This gift in Ernie's name continues his legacy of support and helping to move the department into the future."

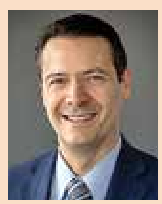
The future of solar fuels *(Continued from front page)*

productivity, of a solar refinery based the many variables that a user can plug in. Renewable-energy researchers at UW-Madison have long emphasized the importance of viewing energy production as a holistic process, and they think the paper will help many different people involved in solar fuels keep the bigger picture in mind. The research was funded by the U.S. Department of Energy.

"The idea is that people who are working on parts of the technology can get a sense of what the milestones are that they might need to reach in the overall scope," says Jeff Herron, a postdoc in Christos' group. Herron is the lead author of the paper, which also includes contributions from PhD student Aniruddha Upadhye in George's group and postdoc Jiyong Kim in Christos' group. "People tend to be narrowly focused on their particular role within a bigger picture."



Herron



Maravelias

It's important for everyone involved to keep this in mind—from catalysis experts to financial decision-makers—because even a big improvement in one particular step of the process might yield only a tiny improvement in the efficiency of the process as a whole. "People think that if they work on a given section of the refinery, then everything else is done, but it's not quite that way," Christos says.

The framework is designed to remain relevant as solar-fuel producers and researchers experiment with new technologies—even ones that haven't been anticipated yet. "The nice thing about it being general is that if a researcher develops a different technology—and there are many different ways to generate solar fuels—or if someone wants a little more detail, our framework would still be applicable," Christos says.

Along with the economic realities of bringing renewable fuels to market, the framework also aims to help producers avoid the perverse situation of wasting too much energy to create a fuel, which will ultimately be used as a source of energy. Capturing CO_2 from power plants already requires burning fossil fuels, and other stages of the process, such as separating the final product from leftover CO_2, are also expensive in terms of energy use.

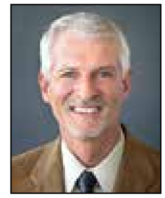
Christos also thinks the framework can play a role in the wider debate about which renewable-energy technologies are ultimately the best for society to pursue on a large scale. When, say, comparing solar fuels to biofuels, things can get complicated pretty quickly—one could argue that plants are already harnessing the sun's energy without the need to build a lot of new infrastructure, but one could also argue that solar-power technology converts that energy more efficiently than plants.

The versatile, process-oriented analyses UW-Madison engineers offer could bring a great deal of empirical clarity to that conversation. In fact, Jeff points out that the framework could easily be adapted to help analyze and plan any number of other processes, not just solar refineries.

The other striking thing about the paper is that it does not come off as a boosterish argument for solar fuels. Instead, the researchers want to give their colleagues in the field a realistic sense of the challenges and opportunities ahead.

"If you read the paper, it maybe comes off as a little bit negative about the technology and its prospects, but I don't think the message is to be negative," Jeff says. "It's more about setting goals for people to aspire to."

Elfers Professorship fuels collaboration and education



Rawlings

Jim Rawlings and Manos Mavrikakis each hold a Paul A. Elfers Professorship, and over the years it's proven crucial to both of these researchers' distinguished careers. Jim has held his Elfers Professorship for nearly 20 years—almost as long as he's been with the department—and over the years that professorship has enabled Jim to create many key initiatives in research and teaching.

That's especially true in the field of control, to which Elfers himself, a 1925 Wisconsin chemical engineering graduate, contributed a great deal in his career with the Iowa-based industrial controls company Fisher Governor Company, before passing away in 1995.

Jim has used the professorship's flexible funds to expand the department's deep commitment to international collaboration. Over the years he's brought an array of guests, including Ravindra Gundi of the Indian Institute of Technology Bombay and David Mayne of Imperial College London, to Madison, where they partnered with Jim's group on research projects and taught graduate and undergraduate courses.

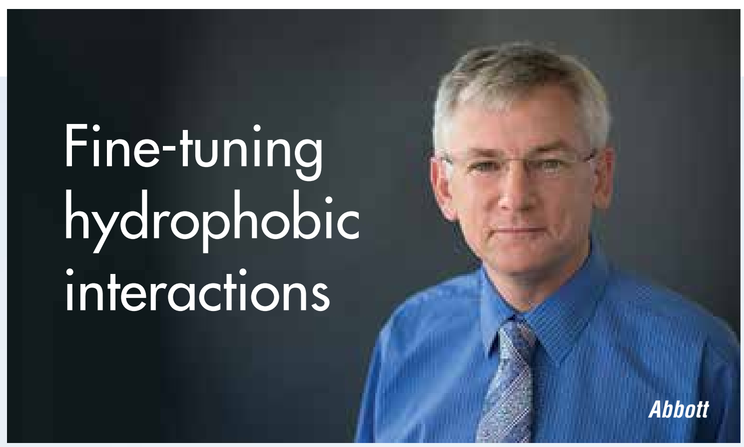
During Mayne's two visits in the late 1990s, he and Jim began work on a graduate-level textbook, *Model Predictive Control,* which was published in 2009 by Nob Hill Publishing. Jim is currently using the textbook in his graduate control course, CBE 770.

Textbooks like this are crucial in making sure that the latest research translates into cutting-edge graduate instruction, but traditional research grants don't support the work of writing them. Plus, graduate-level texts have a shorter shelf life and smaller market than undergraduate-level works, which means they're a riskier undertaking. But this textbook proved to be a high-profile contribution, and one fitting for a Paul A. Elfers professor to make. "The Elfers Professorship was instrumental in our getting that book written," says Jim, who also is the W. Harmon Ray Professor. "Otherwise, that would have been an overload I probably couldn't have managed very easily. The nice thing is that it's a control theory book, and Paul Elfers' career was in the control field."

In addition to training that field's next generation of researchers, the professorship has helped Jim push model predictive control into new approaches. Jim's group is currently working on distributed model predictive control, in which several different agents work cooperatively to solve a large control problem, and economic model predictive control, in which MPC methods are applied with a profit or cost-savings target in mind.

At first, pursuing these directions in research was a bit of a leap: Without some preliminary results, it's hard to get traditional research funding. The Elfers Professorship funded the groundwork needed to put together solid proposals for federal grants.

"We get to take on high-risk research projects that we won't already have funding for because they're too speculative," Jim says.



Fine-tuning hydrophobic interactions

Abbott

Hydrophobic interactions, the forces that cause oil molecules to clump in water, drive many self-assembly processes, such as protein folding, formation of micelles and membranes, and molecular recognition.

A study published January 15, 2015 in the journal *Nature* by John T. and Magdalen L. Sobota and Hilldale Professor Nick Abbott, with his graduate students Derek Ma and Claribel Acevedo-Vélez, postdoc Chenxuan Wang, and Chemistry Professor Sam Gellman, sheds new light on how the surrounding chemical environment affects hydrophobic interactions in biologically and technologically important contexts.

Protein surfaces are mosaics of polar and charged groups together with non-polar groups, which frequently occur in patches that are crucial for binding and recognizing other molecules, and for assembling proteins into larger structures. Though simulation studies have suggested that nearby ionic species affect hydrophobic interactions, often in non-intuitive ways, quantifying this effect experimentally has remained a challenge. Nick and his collaborators have now demonstrated experimentally that hydrophobicity is not an intrinsic property of any given non-polar domain, but can be strongly modulated by immobilized functional groups located as far away as one nanometer.

"We show that if you have two nonpolar groups, and they are going to interact through water, the way they interact depends on their neighbors," Nick says. "It's like a pair of friends having a conversation. The way in which they interact will depend on who is standing close enough to hear."

By coating the gold tip of an atomic force microscope with a non-polar monolayer of molecules, Nick's research team was able to measure the water-mediated adhesive force between the AFM tip and various

Jay and Cindy Ihlenfeld's long involvement with their respective alma maters—the College of Engineering and Wisconsin School of Business—has given them a unique perspective on the strengths and needs that UW-Madison alumni and other donors can address.

The Ihlenfelds, who have served on several advisory boards at UW-Madison throughout their careers, hope to both motivate and focus their fellow alums with their latest donations for faculty support at UW-Madison. Their recent gifts include a $500,000 pledge, which will be matched with funds from the historic $100 million gift from alumni John and Tashia Morgridge, to support a new professorship in the College of Engineering *(see Chair's message, p.2)*.

While it will be available to faculty across the college, the Ihlenfelds have stipulated that the first recipient must be in CBE, from which Jay earned his PhD in 1978 before going on to a long and successful career at 3M. The Ihlenfelds are simultaneously establishing a professorship along the same lines in the Wisconsin School of Business, where Cindy earned her bachelor's

Leading the way with faculty support

degree in 1975 before earning her MBA from the University of Minnesota and pursuing a varied career in private industry and the arts.

"We've been giving money to the UW for a fairly long period of time and have always looked at unique opportunities to support things," Jay says. "We have a flavor for what some of the needs are and what makes these particular parts of UW-Madison unique among their peers around the country."

The Jay & Cynthia Ihlenfeld Professorship will specifically aim to honor and support faculty who show a dedication to advancing educational innovation in the College of Engineering. Jay says the increasing prominence of instructional methods like blended learning help the college support a student body that is more diverse, in racial and cultural terms but also in terms of financial backgrounds, and that benefits from diverse learning styles.

"What's important is, can we tailor teaching methodologies to the ways that different kinds of students learn?" Jay says. "It's also very important that we have an ability to turn our research advances into advances in the way that we teach."

Experiences both recent and not-so-recent have given Jay a lot of confidence in the college's and the department's ability to evolve on the education front. "It all goes back to Bird, Stewart and Lightfoot, and people like Dale Rudd," he says.

"It was made very clear to me as a graduate student that the department has done an incredible job in taking advances in chemical engineering research and translating that into teaching and course content. That in turn is what builds the reputation of a school for excellence."

self-assembled monolayers of molecules on a surface. When amino groups were immobilized among non-polar groups in a monolayer, and were then charged to form ammonium groups by lowering the pH of the surrounding solution, the hydrophobic interaction doubled in strength.

"We show that if you have two nonpolar groups, and they are going to interact through water, the way they interact depends on their neighbors."—Nick Abbott

By contrast, when guanidinium groups were incorporated into the monolayer, the hydrophobic interaction was essentially eliminated.

The finding has important implications for understanding how molecules self-assemble into larger structures and how proteins fold, as well as for manipulating and designing protein–protein interactions. Ammonium and guanidinium are biologically relevant because they form the positively charged moieties of the amino acids lysine and arginine, respectively. Even more importantly from a biological perspective, the researchers found that these observations hold not only for interactions involving the extended hydrophobic surfaces of self-assembled monolayers, but also for interactions between the hydrophobic AFM tip and hydrophobic patches defined by single molecules of helical beta-peptides that contain ammonium (lysine) or guanidinium (arginine) groups about one nanometer away from a patch.

Gellman

Looking forward, the Abbott group's experimental framework for characterizing hydrophobic interactions is versatile enough to probe how these adhesive forces are modulated by the proximity of a wide range of other functional groups. A fuller understanding of how ions (and polar functional groups) in close proximity enhance or diminish hydrophobic interactions will provide a means to fine-tune these forces in the design of all sorts of molecules that perform useful functions in water.

"You can imagine new designs of self-assembling materials, ranging from shampoos to optical metamaterials to drug delivery systems, where hydrophobic interactions might be usefully controlled by manipulating the status of charged functional groups near non-polar domains," Nick says.

Celebrating summer lab!

The summer lab is a tradition that dates back to 1914, challenging Wisconsin chemical engineers to apply what they've learned as undergraduates before they're ready to head out into the real world. Formally known as *Operations and Process Laboratory* (CBE 424), the five-week course is a requirement for all CBE undergrads. Not only is the summer lab a full-time workload all by itself, it also pushes students to carry out hands-on experiments without the predetermined parameters and constraints that usually guide earlier undergraduate lab work.

"Most of the time is spent on informal experiments, where they're given some open-ended challenge and have to go in and design some experiments, assemble some equipment, decide what questions they want to answer, figure out what's accessible and what's realistic within about four days, and then get some data and draw conclusions," says Professor Thatcher Root, who directs the course. "They're not given a lab protocol—they're inventing it."

Herb Hentzen *(fourth row, third from left)* ***with his summer lab classmates and instructors in 1948.*** *Find your summer lab photo: summerlabphotos.che.wisc.edu*

Each summer, two summer lab sessions of about 30 students each take place on the UW-Madison campus, in addition to international sessions offered in Oviedo, Spain, and Vienna, Austria. In 2014, Herbert Hentzen, who endured a summer lab himself before earning his bachelor's degree in chemical engineering in 1949, made a simple yet meaningful gift: He established a fund that provides a little over $1,000 per year to support an end-of-summer-lab picnic, complete with catered barbecue, for both sessions that take place in Madison.

After five weeks of working in the lab all day and writing reports at night—and, for many students, completing their last requirement for graduation—a little recognition is in order, Thatcher says.

"Typically, the last report is due at 9 a.m. on the last Friday," Thatcher says. "We have to grade them that day, but the students are done as of 9 a.m., and a lot of times the students want to do some kind of celebration."

Herb says he made the gift to encourage bonding between students and their professors. He retired in 2000 after a long career at his family's Milwaukee-based industrial paint coatings company, Hentzen Coatings, including 30 years as its president. Hentzen, who now lives in Mequon, was inspired to give back after a conversation a few years back with a group of retired friends who used to get together for a regular card game. The group, which included doctors, dentists, and businessmen got on the subject of teachers and coaches who'd influenced them—which for Herb included chemical engineering professors like the late Roland Ragatz and Otto Kowalke. Herb and most of his friends, though, ended up realizing they'd never really gotten to say thank you to these influential figures in life after becoming successful.

"That got me thinking that too often, it's much later in life that you realize something that a teacher said or someone did for you influenced your life," Herb says. "I just thought it would be a great thing if we had a picnic or a cookout for chemical engineering students so they might to get know their professors a little better."

Herb says his summer lab experience back in 1948, while presenting him with technical challenges, also taught him some basic lessons about working with people, which would later serve him as a business leader. "There's nothing wrong with asking for help," he says to sum up one of those lessons. "If you have an enemy, maybe ask him for help and you'll become good friends. But nobody will give you help unless you ask for it."

Thatcher agrees that the post-summer lab picnic Herb is supporting is a good way to show students that their work is appreciated, and to reaffirm their bond with the CBE family before they leave campus. The first celebration picnics, on the final Fridays of the two 2014 Summer Lab sessions, were held on the Engineering Mall. The students relaxed and decompressed after five weeks of challenging work, and also enjoyed casual conversation with lab instructors and other faculty who dropped in.

"For many of these students, this is the last course they take here, and then they're headed off to a job, and so now we can send them off with a celebration," Thatcher says. "It's very thoughtful of him."

Thejas Wesley's sophomore year finds him already deep in the world of catalysis. While still a high school student in Madison, Thejas took advantage of a program that gave high school students opportunities to participate in research on campus. He ended up working with Steenbock and Michel Boudart Professor Jim Dumesic's renowned research group, where he's since taken on greater responsibility, currently working alongside a postdoc on questions of bimetallic catalysts.

"We are just trying to understand how they interplay with each other, because they do confer some synergistic effects," Thejas says of the novel catalysts the lab is exploring. "I don't even know if there *is* a better place for the pure science aspect. Dumesic is really encouraging with whatever you do."

Majoring in chemical and biological engineering sparks Thejas's clear passion for the fundamentals of chemistry, and in fact he's thinking of double-majoring in chemistry. He says he could easily envision spending decades thinking about the profound chemistry questions involved in catalysis, and plans to pursue that by remaining in academia.

"Catalysis brings together many aspects of fundamental physical chemistry—how these metals interact on an atomic basis, and how that reflects their catalyst activity and all their selectivity—and useful applications, such as actually making biofuels or improving some petrochemical process," Thejas adds.

Recently Thejas also has acquired some early experience as a teacher, running a discussion section as a student assistant for CBE 255, *Introduction to Chemical Process Modeling*. While he often finds himself drawn to spend many extra hours in the lab, he's also found it fun and rewarding to work with other students.

A recent recipient of the BP America scholarship, Thejas says he's looking ahead to a graduate education, and he sees a great deal of excitement ahead in his chosen field.

"You'll see a new problem every day, and not only do you have to work to fix that problem or find an answer to something unexpected, but then you've also got this larger project that you're trying to wrap your head around," he says. "That's the most challenging part, but that's also why it's so much fun."

Lynn, Mavrikakis receive Vilas Distinguished Achievement Professorships

Professor David Lynn and Paul A. Elfers Professor Manos Mavrikakis, along with three other faculty in the College of Engineering, have been appointed Vilas Distinguished Achievement Professors, one of the highest honors UW-Madison confers upon its faculty.

Lynn

Mavrikakis

The award aims to honor and support UW-Madison professors with extraordinary track records in research, teaching, and/or service. Each recipient is provided with $75,000 in flexible funds over five years to support his or her research efforts.

One long-running theme in Dave's research is the development of ultrathin coatings that can be used for localized, time-controlled delivery of drug and DNA therapies. Dave says the Vilas Professorship funds will support some crucial steps forward in bringing this research closer to potential applications. "What we've done over the last several years is develop an understanding of how these materials behave, and how we can control them, in defined environments. What we'd like to do now is move from in vitro assays to looking at how they behave in vivo," Dave says. "These funds will give us the flexibility to do this and start developing the therapeutic potential of this approach."

More recently, Dave and his group have developed an interest in highly hydrophobic and oleophobic materials, with potential applications in protective coatings and industrial processes that require separation. "That's a new direction for us, so this funding will also help us push further in that direction," Dave says.

Manos is currently looking at ways to use ammonia as a fuel in fuel cells, seeing possible advantages in the chemical's liquid state and its energy content. "People know how to handle ammonia and there's infrastructure for it," Manos says, pointing out that using hydrogen gas as a fuel requires expensive new infrastructure.

He is focusing on developing a catalyst that can react with ammonia to produce dinitrogen, as opposed to nitric oxides, electricity and water. "Vilas Professorship funds will allow us to gather preliminary data, which is critical to attracting new funding for this important fundamental research problem, which could impact wide-ranging applications," he says.

In the area of environmental remediation, Manos is also looking to develop better catalysts for converting toxic waste gases, like automobile exhaust, into more benign gases. This process currently relies on expensive metals like platinum and rhodium, and Manos believes his group can develop a less expensive catalyst. "All of this requires a very fundamental understanding of the reaction mechanism—and lots of supercomputing—and then experiments to get us to the point where we can predict a material, and then ask if we can synthesize and evaluate its catalytic performance," he says.

This research is currently funded by the U.S. Department of Energy, but funds from the professorship will help him engage more students, including undergraduates, in the project. "That's a big part of my research vision, to make sure the next generation of CBE students is also trained in atomic-scale reaction engineering," Manos says.

Save the dates!

Each year, the College of Engineering hosts several alumni events around the country. Save the date for an event near you—and if you'd like us to add you to the invitation list for a specific event, please contact Stephanie Longseth, (608) 265-3496 or slongseth@wisc.edu.

January 13—Houston, TX

February 18—Bonita Springs, FL

March 26—San Francisco, CA

May 21—Seattle, WA

June 26—Chicago, IL

July 17—Fox Valley, WI

August 20—Twin Cities, MN

September 15—Milwaukee, WI

October 4—Washington, D.C.

October 16—Madison *(Engineers' Day)*

TBA—San Diego, CA

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Fellowships support diverse research in Lynn group

Professor David Lynn and the researchers in his lab work at the intersection of advanced materials, chemistry and biotechnology. The group's work offers vast and diverse promise in biomedical and industrial applications, as a couple of fellowships recently awarded to two of Lynn's PhD students illustrate. Xuanrong (Gavin) Guo *(left)* has received a 3M fellowship to support his work developing microcapsules, and Visham Appadoo received an American Heart Association fellowship for his role in developing technologies for localized delivery of DNA.

The microcapsules Gavin is working on serve as vessels for liquid crystals that can potentially be used in sensing applications, a project that ties in with liquid-crystal technology that John T. and Magdalen L. Sobota Professor Nicholas Abbott is developing. Its applications include sensing dangerous chemicals and detecting antibodies for certain diseases.

"I design the functionality of the capsules, which can be immobilized on surfaces; we then load liquid crystals into the capsules for fundamental studies aimed at exploring these materials in the context of sensing applications," Gavin says.

Visham, who comes from a chemistry background, works on developing thin films that enable controlled release and delivery of DNA from surfaces. The thin films are composed of multilayers of polymer and DNA, and offer a lot of flexibility in terms of controlling various factors such as the release rate (e.g. minutes or weeks) and the amount of DNA loaded. By delivering the DNA to a specific region of the body and at a controlled rate, it is possible to improve the effectiveness of treatments as well as developing new treatments that target specific physiological processes.

"In particular, I'm focusing on using this system to develop new materials and methods that can allow for treatments for vascular diseases—for instance, coating these thin films onto angioplasty balloons, so that you do the angioplasty but simultaneously deliver DNA to the injured region," Visham says. "The Heart Association fellowship was given to me to develop strategies for the rapid delivery of DNA to vascular tissue, with the overarching goal of improving treatments for peripheral vascular disease," Visham says.

While some fellowships are aimed at specific projects and others provide a more general support base, they all help the Lynn group make the best of other research grants and maintain an ambitious scope.

"Fellowships basically provide you an independent source of funding, so that you are not using up funds from your principal investigator's grants," Visham says. "That frees up more funds for research purposes."

And for a dynamic group like David's, that means crucial flexibility for pursuing exciting new avenues in materials and biotechnology.