FALL 2018

CBE UPDATE

TENNESSEE CHEMICAL & BIOMOLECULAR ENGINEERING




A Department on the Rise

Four NSF Early CAREER Award winners are shaping everything from health care to energy. Page 6.

CBEUPDATE

In this issue

2


6

17

FEATURES

DEPARTMENTS

Department Head
Bamin Khomami

Academic Coordinator I
Rita Gray

TCE Director of Communications
Christie Kennedy

Designer
Mitchell Williamson

Project Manager
Melissa Callahan

Writers
Randall Brown, **David Goddard**, and **Whitney Heins**

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University Printing & Mail

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A MESSAGE FROM THE DEPARTMENT HEAD

The Department of Chemical and Biomolecular Engineering at the University of Tennessee, Knoxville, continues to make dramatic strides in national leadership in chemical engineering education and research. I don't like to focus on rankings, but for the first time ever, we have moved in to the top 40 of public university chemical engineering programs, achieving 39th in the U.S. News and World Report 2019 rankings. Evidently, our hard work over the past ten years is paying off with higher national visibility, ultimately greatly benefiting our students and alumni network.

Speaking of students, with approximately 65 full-time PhD students and 425 undergraduate students, we have the largest student body in the history of the department. Furthermore, with 19 instructional and research faculty, we have the largest number of educators housed within the department since the 1980s. Our research profile continues to ascend, with expenditures and publications likewise rising.

In spring of 2018, we added two new members to our Hall of Fame. Joining Professor John Prados—our inaugural inductee in 2016—and subsequent inductees Michael T. Harris and James B. Porter Jr., are two alumni who have been employed at Eastman Chemical Company for over 70 years combined: Mark Cox ('89, BS) and Stephen Crawford ('87, BS). We are very grateful to have such esteemed alumni in executive management positions at a company that is internationally recognized for its leadership and innovation in the chemical industry.

Professor Emeritus Charlie Moore was inducted into *Control* magazine's Process Automation Hall of Fame, and Gibson Chair Stephen Paddison was appointed as a fellow of the Royal Society of Chemistry. Furthermore, UT-ORNL Governor's Chair for Biorefining Art Ragauskas received AIChE's 2017 Professional Achievement Award for innovations in green process engineering.

Our faculty continue to achieve research milestones and garner major national awards. Each of our last four assistant professor hires has won a prestigious NSF CAREER Award during the past two years, bringing our total number of faculty members to have achieved this award to six. Also, our UT-ORNL Governor's Chair for Electrical Energy Conversion and Storage Tom Zawodzinski's project, Reversible Fuel Cells for Long-Duration Storage, was chosen by the US Department of Energy as one of 10 recipients of Advanced Research Projects Agency–Energy grants.

Lastly and most importantly, our outstanding body of students have also been recognized for their hard work and dedication. Senior Amany Alshibli was recognized for her academic achievement, leadership, and outstanding service with the highest student honor—the Torchbearer award. This is the second CBE student recipient in less than five years. Senior Christopher Neal was selected as a 2018–2019 Fulbright alternative for a study and research grant to Germany. Undergraduates Michele Christy, Katherine Krouse, Andy Skipper, and Alshibli, were awarded the Extraordinary Academic Achievement citation. The Chancellor's Citation for Extraordinary Professional Promise was awarded to undergraduate students Jared Clements, Alshibli, and Neal, as well as doctoral students Nelly Cantillo Cuello, David DeSimone, and Brian Mendoza. A record number nine CBE students achieved chancellor's citations, tops among all UT academic departments.

I am sincerely grateful to all our alumni, private donors, and corporate sponsors, especially Eastman Chemical Company, who have continuously supported CBE over the past ten years, thereby enabling us to have achieved the tremendous growth I mentioned above. We feel truly honored to have such a talented, generous, and dedicated group of supporters. With your help, we have now begun to be recognized for the superior education and research that our department excels at. Thank you for your support.

Bamin Khomami

Granger and Beaman Distinguished University Professor
Head, Department of Chemical and Biomolecular Engineering

Reflections

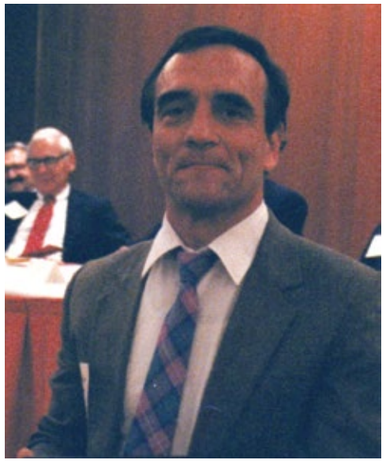
by Charlie Moore

In May, I retired from UT after 50 years of service. My last class was on May 27 and I was honored that some faculty, staff and former students attended that lecture. I don't fully recall what all I said in that lecture other than wishing that I had been better prepared. The idea of a swan song didn't occur to me until I walked into that classroom. Afterwards, Rita Gray, who attended my lecture, asked if I would consider writing something for the CBE magazine and I immediately agreed.

Over the past several months I have thought a lot about what these reflections should include. It's not an easy question, times have changed. UT today is quite different from the UT when I joined the faculty 50 years ago. The focus back then was on undergraduate education. We had a graduate program but our main product was our bachelor of science in chemical engineering. Today, the focus is much more on the graduate program. The turn came when Bamin Khomami arrived on campus. He immediately began recruiting an impressive new generation of young faculty who are increasing the visibility and national prestige of our program. The future for CBE looks great and I am pleased to have played a role. That said, I must admit that I feel fortunate that my career started 50 years ago. I am very proud of my career, but I realize it simply would not have been possible today.

Unfortunately, there is a problem with thoughtful reflections. They get out of hand and it becomes impossible to adequately summarize in the word space available in the magazine. I appreciate the opportunity to published my full reflections on the CBE website. The reflections posted are a collection of stories knitted together to describe my career in the history of those times. Hopefully, you will find my stories both entertaining and informative. (Spoiler alert: In these stories I do tell the truth about my football days at LSU.)

My Path Here. I joined the UT faculty in December of 1968 after completing both my undergraduate and graduate work at LSU. I did not expect nor did I even entertain the possibility of an academic career. I fully expected to accept a job as a chemical engineer for one of the many companies located in south Louisiana. Fortunately, during my junior year I took a couple of classes that literally changed my life. I was blown away by both the teacher and subject matter. Dr. Paul Murrill was a new faculty member doing pioneering research on using digital computers to automatically control chemical processes. I was hooked and wanted more so I applied to the graduate program to study under Dr. Murrill. It worked out well. A couple of years later, I had a PhD, a dissertation, a half a dozen published papers and was about to start a teaching job at the University of Tennessee that would last almost 50 years.



Choosing Tennessee. After a frantic week of interviews, Tennessee became a clear choice. Because of the mystery surrounding my interview, I didn't have much of a chance to meet the faculty or graduate students but I liked the campus and I loved the idea of raising my family in East Tennessee. But by far the most appealing part of UT's offer was the possibility of quickly establishing a research lab. Back then the department was a combination of Chemical, Metallurgical and Polymer Engineering. A year earlier the department had been awarded a large DOE grant for new research equipment. I was invited to use the remaining funds to establish a research facility. It was turbulent times, but a few months later I had purchased a small computer system and with the help of the departmental shops it was interfaced to equipment in the unit operations laboratory. I recruited a few students and my research was off running.

50 Years—Then and Now. It was interesting to me to note that two popular campus icons, the torchbearer statue in Circle Park and the "Rock" on Volunteer Boulevard, arrive on campus about the same time I did. 50 years ago, engineering students still used slide rules and engineering faculty wore coat and tie to the classroom. There was only one digital computer on campus. Class sizes were much smaller, but we taught multiple sections and had Saturday morning classes. Dougherty was a relatively new building back then but is now beginning to show it age. Renovations to the undergraduate labs have helped, plus it is surrounded by newer more modern engineering and science facilities.

2018 Department Awards

First Place, Undergraduate Research Poster Award
Kelsey Grady and Kaitlin Glynn

AIChE Service Award
Catherine Weiss

Dow Outstanding Junior Award
Drake Crawford and Grant Rigney

Professor Jack S. Watson Graduate Award for Excellence in Separation Research
Mark Moore

Professor Jack S. Watson Undergraduate Award for Excellence in Separation Research
Natasha Ghezawi

Kenneth M. Elliott Outstanding Senior Award
Andy Skipper

Jim and Sandra McKinley Outstanding Graduate Student Award
Nelly Cantillo-Cuello and Tyler Cosby

Exceptional Progress Award for Outstanding PhD Candidate
Erick Ribeiro

Most Exceptional Student Award
Ruby Millican

Student Awards from Outside the Department

Alpha Chi Sigma Albert Cooper Award
Katherine Krouse

American Chemical Society Outstanding Senior Award
Amany Alshibli

AIChE Outstanding Student Award
Delaney Fisher

AIChE Outstanding Baccalaureate Award
Jared Clements

Faculty and Staff Awards

Outstanding Staff Member Award
Sarah Humphries

Outstanding Teacher Award
Siris Laursen

Outstanding Faculty Mentor Award
Eric Boder

Tom and Ruth Clark Excellence in Chemical Engineering Award
Charles Moore

HALL OF FAME

Stephen Crawford, Mark Cox Inducted into CBE Hall of Fame

The department welcomed a pair of alumni with connections to Eastman as its 2018 Hall of Fame class.

Stephen Crawford and Mark Cox, who earned their bachelor's degrees in chemical engineering in 1987 and 1989, respectively, bring the total number of alumni so honored to five.

Both play key roles at Eastman, a Fortune 300 company with 40 locations and 15,000 employees that serves as an important UT partner with headquarters in Kingsport, Tennessee.

Crawford and Cox first served as co-op students at what was then known as Eastman Kodak in the mid 1980s and remain there more than 30 years later.

Crawford, a native of Kingsport, has held several positions on both the operational side and in technology. He helped develop the company's innovation strategy, including the Eastman Innovation Network in both the Asia/Pacific theatre as well as in Europe. Crawford is currently a senior vice president and chief technology officer, roles he has held since 2014.

Crawford is a member of the American Chemical Society, the Society of Chemical Industry, and the Industrial Research Institute. He also champions the research agreements between Eastman and UT and serves on the department's board of advisors.

He said he was humbled to hear of the recognition by the CBE committee and was happy to hear that Cox—whom he calls a lifelong friend—had also been selected.

"I will forever be grateful for the academic, social, and leadership training that I received at the University of Tennessee, and I'm even more excited today than ever about the future of the department," Crawford said. "Dr. Khomami and staff have done a phenomenal job growing the department and I'm confident they are producing future thought leaders for our industry."

Cox has served in various elements of leadership within Eastman, and is senior vice president and chief manufacturing, supply chain, and engineering officer, having held both roles since 2014.

He was instrumental in the creation of the Eastman Unit Operations Laboratory that is now housed in the Nathan W. Dougherty Engineering Building.

Cox is a senior member of the American Institute of Chemical Engineers, a member of Tau Beta Pi Engineering Honor Society, and sits on the Tickle College of Engineering Board of Advisors.

He cited his experience at UT as a factor that continues to motivate and shape his career to this day.

"Whenever you hear someone say 'I'm a Vol for life,' I think it often conjures up an image of Big Orange football, because we have such a storied program," Cox said. "I am one of those fans, too, but when I say it I'm thinking first about my experience at the Tickle College of Engineering. I am grateful to all who have been a part of making Tickle excellent."

Longtime department fixture John Prados was the first inductee to the CBE Hall of Fame in 2016. He was joined last year by Michael Harris, the department's first African-American doctoral graduate and holder of 11 patents, and James Porter, who spent 42 years at DuPont and is a former chairman of the college's Board of Advisors. Prados and Porter are also previous Nathan W. Dougherty Award winners, the highest honor the college bestows.

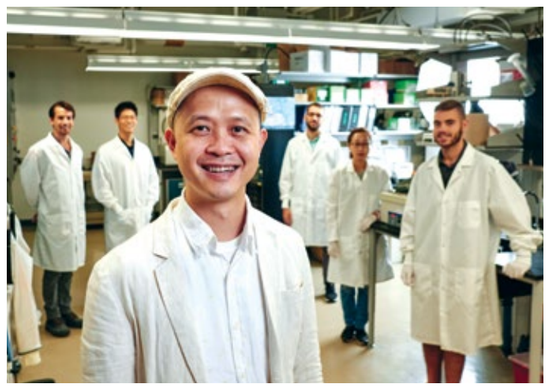
Stephen Crawford

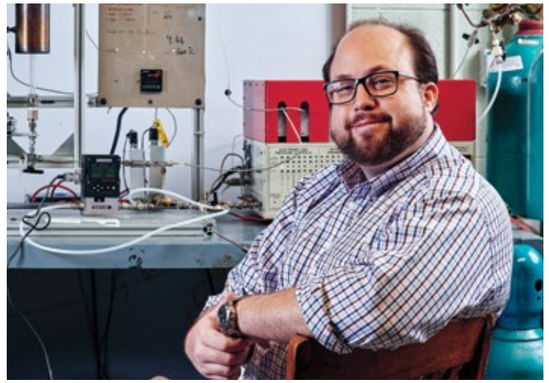
Mark Cox

A Department on the Rise

By David Goddard. Photography by Shawn Poynter.

Ferguson Faculty Fellow **Cong Trinh** and Assistant Professors **Steven Abel**, **Siris Laursen**, and **Joshua Sangoro** are adding to the momentum of the Department of Chemical and Biomolecular Engineering, helping showcase the ways in which the work of the CBE faculty impacts the world. Here's a look at how these four early career award-winning faculty members are shaping everything from health care to energy through three distinct areas of research.





One Problem, Two Approaches: Solving the Cellular Riddle

While the earliest concepts surrounding what we would now know as immunity were described more than 2,000 years ago, the field of immunology as a matter of science is barely a century old.

In that time, knowledge has advanced from understanding that some medical issues were a response to disease, bacteria, or other contaminants to a place where treatments for such bodily responses were invented to help mitigate or eradicate them.

Now, humanity stands on the cusp of a new leap forward in immunology, one that has reach far beyond medicine.

Researchers are closer than ever to being able to develop cells that are specifically tailored to fight a given disease, improve biomass yield, even protect crops.

Such a breakthrough would, for instance, help fight cancer without subjecting patients to chemotherapy, or prevent infection from spreading without the overuse of antibiotics.

Assistant professors Steven Abel and Cong Trinh are at the forefront of the innovation, with distinctly different approaches.

Trinh Tackles Cells at Their Core

One of the hardest things for a patient to do is to play the waiting game on their medical test results. The uncertainty of not knowing what might be wrong can sometimes feel as dreadful as the diagnosis itself.

Those lag times in identifying and responding to diseases weren't acceptable to Cong Trinh, so he set out to find ways of speeding up the process.

He and his team wanted to improve the issue while making sure that any increase in diagnosis didn't come at the cost of health and safety.

One of the most recent examples of that work is the Virulent Pathogen Resistance program (ViPaRe) that he developed that combines a wide range of math, science, and computing to more readily identify cellular invaders and help eradicate them before they have a chance to spread.

"Time is everything when it comes to stopping disease, both on an individual level and in terms of outbreaks and epidemics," said Trinh. "By utilizing technology to analyze small molecules, we are creating 'smart' equipment that can adjust diagnosis and treatment in a much faster manner."

Some of Trinh's earlier work could also have an impact on the medical field.

He received a 2015 CAREER award from the National Science Foundation for his work in helping further push a concept known as modular cells.

As part of that, Trinh is developing microbial manufacturing platforms, basically a series of different cells that can be exchanged and utilized as needed for various purposes.

"The basic idea behind building microbial platforms is that they allow a far more efficient biosynthesis of materials," said Trinh. "That improvement not only means that you can make them quicker, but that in doing so you can make more of them and bring down overall cost."

One product that is more easily produced through the use of such interchangeable platforms is a group of substances known as esters.

While his original focus was to develop more cost-effective esters for use in solvents, flavors, and biofuel production, esters are also important players in health care.

The ester salicylic acid acetate is perhaps the most common painkiller in the world, better known as aspirin.

Other medicinal uses of esters include treatments for arthritis and nervous disorders. Even their importance to the artificial flavor industry has ties in the medical field, with many otherwise bitter medicines being made palatable by the use of esters.

So while Mary Poppins might credit sugar for helping the medicine go down, true credit goes to chemical and biomolecular engineering.

For Abel, It's All About the Data

Steven Abel is a model researcher, literally.

His group creates physical or mathematical models at some of the smallest levels imaginable, helping researchers gain a better understanding of how cells behave.

"Our first goal is to solve the riddle of how cells recognize one another," said Abel. "For example, we know that white blood cells are able to tell when something bad has entered the body and distinguish that from other cells. We just don't know how they do it."

The group is exploring the idea that identification is based on cells being able to recognize amino acid sequences in other cells. Those sequences vary by protein, and so would show up differently from substance to substance.

Abel's team correlates their data with what is known to be true in the medical field to help ensure accuracy of their models, then uses that to try different approaches to finding the best result.

While many scientific breakthroughs come from someone "thinking big," Abel's group took the opposite approach and thought small.

How small? Consider a newton, the measurement of how much force is required to give one kilogram of mass an acceleration rate of one meter per second, per second.

Abel's team carries out observations measured in piconewtons, a force one one-trillionth the strength of a newton.

"To be able to do research at the minute levels of cells that we are talking about, we had to think small," said Abel. "No one has done it at this scale before."

Abel's methods have a number of other advantages, too.

By using data and modeling, they can not only experiment until they find something that works, but they can better explore why ideas that failed were unsuccessful and use that to make a better attempt the next time.

Furthermore, since the cells in question exist as data-driven substitutes for their real counterparts, the modeling can be used to simulate humans, animals, or plants, allowing for greater collaboration.

"We can and have worked across departments and colleges, including with people in biology, chemistry, even agricultural-related efforts," Abel said. "The ability to simulate any cell structure could help in things such as improved crop yields, disease-resistant plants, or even more productive biofuels."

Abel noted that, like any emerging field, there are unexpected challenges, but that he sees the newness of the concept as an opportunity to position his group—and UT—as a trailblazer.

A Catalyst for Change

A memorable scene from the 1985 movie *Back to the Future* shows one of the main characters placing organic garbage in a device called "Mr. Fusion" to power the car.

While it still seems far-fetched to think such a scenario might ever be possible, the reality is that research being done by Assistant Professor Siris Laursen has led to breakthroughs that are turning seemingly unimaginable concepts on their heads by taking new approaches to science.

Laursen's work is in the realm of catalysts—materials that help improve the speed and efficiency of a huge range of chemical processes without being consumed by the transformation, meaning they can be used over and over again.

From fuel to food, catalysts have played a key role in shaping society since the dawn of the industrial revolution, but one of the things preventing them from having an even greater impact is the cost of the catalysts themselves.

"The most widely used material in catalysts for many decades now is platinum," said Laursen. "It has served its purpose, but it comes with limitations, not the least of which is its price tag."

Laursen has proposed a new tactic: using computers to explore possible catalysts at the atomic level, studying information on their surface areas, and gathering data about their performance.

His method also includes combining two or more metals in preparing the catalyst, giving his team increased flexibility in fine-tuning the finished product based on what the computer modeling shows to be the most effective design.

This development of using what is known as intermetallic compounds also opens up the use of catalysts in areas where platinum has historically not performed as well or at all, leading to seemingly endless possibilities.

"The approach we are taking will reduce our reliance on such an expensive material, while at the same time giving us the ability to do new and exciting things," Laursen said. "The use of emerging materials will allow us to keep up with changing needs and demands."

Chemicals, rubber, foam, medicine, and yes, even one day turning garbage into fuel are just the start of how Laursen's work could change our own future.

Worth its Salt

By Whitney Heins. Photography by Shawn Poynter.

Remember a year or so ago when Samsung Galaxy smartphones kept exploding? They were recalled but the threat still exists…in every smart phone we use.

Well, actually, in a lot of things we use.

The source of the explosion was the failure of the lithium ion battery—the standard kind of battery used in many tech products.

"The batteries' electrolytes have numerous carbonate additives," explained Joshua Sangoro, assistant professor in chemical and biomolecular engineering. "One of the major problems with those is that when mixed with lithium ion salts, spontaneous chemical reactions are known to occur at temperatures as low as 140 degrees Fahrenheit. These reactions release hydrofluoric gas which is highly toxic and can easily catch fire."

In addition, after recharging the battery a couple of times, some root-like patterns called dendrites begin to grow from one electrode towards the counter-electrode of the battery. This leads to an electrical short-circuit characterized by sparks. Fueled by the accumulated hydrofluoric gas and other flammable electrolyte constituents, the sparks ultimately lead to explosion of the lithium ion battery.

There's got to be a better, safer way to power our technology, and Joshua Sangoro's work is getting us closer to that way.

"I would really like to make an impact in changing the type of electrolytes that we have—or be able to design new ones that aren't as dangerous as the current ones we use," he shared.

The answer lies in salt. Liquid salt, that is.

Also known as ionic liquids, these materials have low vapor pressure, are electrochemically stable, non-flammable, form a layer around electrodes to prevent the growth of dendrites, and remain liquid in a wide temperature window.

This all means there's no danger of them spontaneously combusting.

What's more, they consist of negatively and positively charged ions rendering them electrically conductive—a key requirement for rechargeable batteries. However, because ionic liquids consist of large molecules, the electrical conductivity is low compared to standard electrolytes. So, Sangoro is researching the impact different molecular structures have on ionic conductivity. All with the goal of designing a better, safer battery.

Sangoro and his team of students are doing this by leveraging the power of an experimental technique called broadband dielectric spectroscopy. This method, only being used by a handful of researchers in the country, enables them to alter the molecular structures by exposing the materials to electric fields through a wide range of timescales. Knowledge of timescales is crucial to understanding the physical properties of materials including how much electrical energy a material can store and conduct.

"We apply a small electrical field to disturb the molecules and then monitor how the molecules get back to their equilibrium positions," explained Sangoro. "The goal is to find ways of designing ionic liquids with higher ionic conductivity."

> **"We look at how motions of the ions are affected and what happens if we vary the chemical structures and interactions."—Joshua Sangoro**

Pinpointing optimal energy storage and conductivity in ionic liquids is almost akin to finding a needle in a haystack. Because they have a lot of positively and negatively charged ions, the liquids hold the possibility of creating trillions of new chemically distinct materials with different properties and uses. This makes them very promising for improving all types of technology but also very difficult to study.

"This vast number of chemical structures require scientific design criteria based on understanding of the correlation between structure, interactions, and desired properties," explained Sangoro.

Sangoro's team consists of postdoctoral, graduate and undergraduate students supported by grants from the National Science Foundation and US Department of Defense.

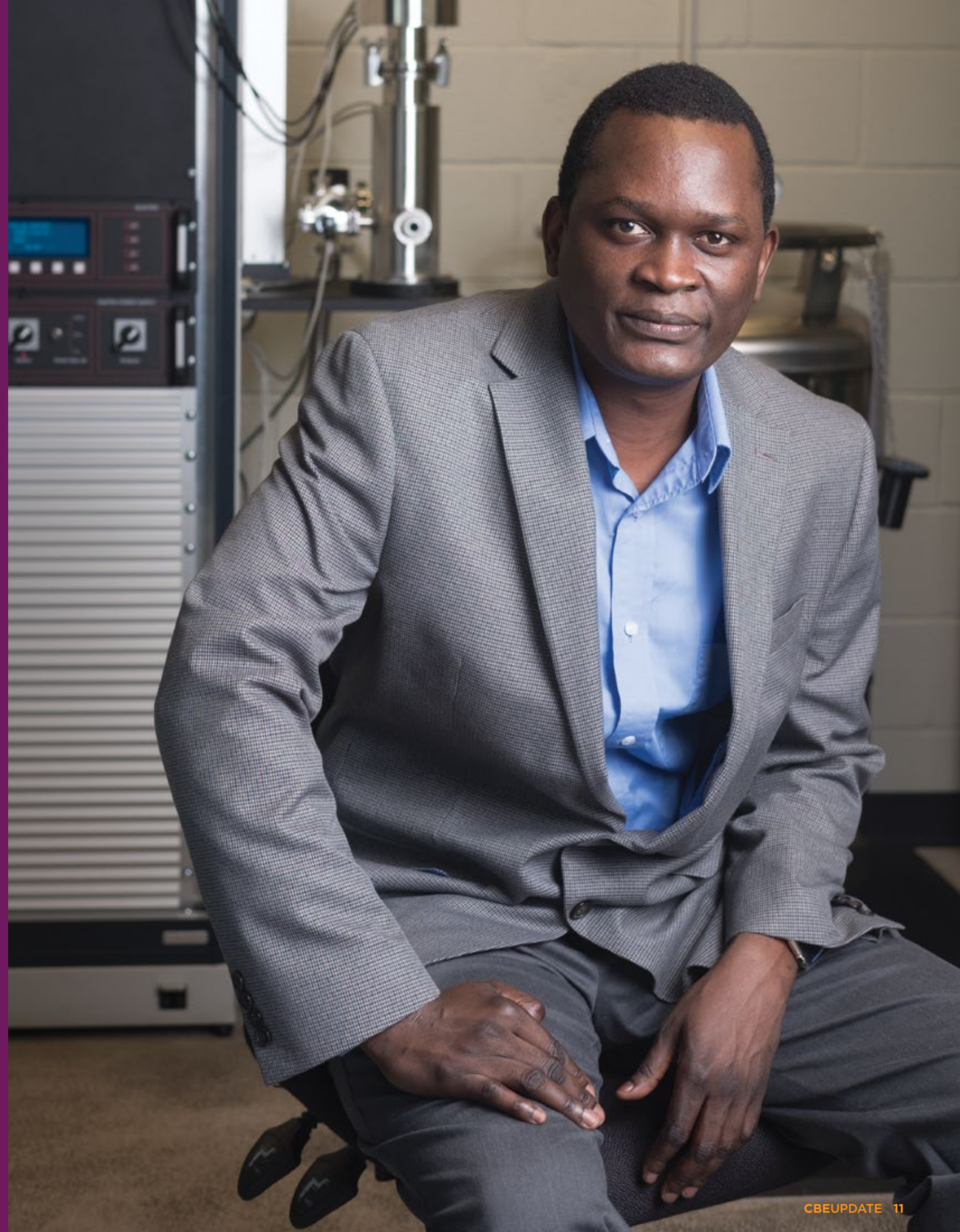
Sangoro says engaging with students inside the classroom and the lab is one of the most rewarding parts of his job.

"It's amazing when you see the students understand the concepts when they arrive not knowing any of them," he shared. "It is really gratifying."

Also gratifying? Making our world a safer and better place to live.

"Science should be useful ultimately to society, and we should understand the basics of how everything works so that we can make steps forward."

Sangoro is working on it.



Grad Students Feel Spark from McKinley Scholarship

The Jim and Sändra McKinley Scholarship is awarded to outstanding graduate students who show a high degree of effort and hard work in their studies. The three most recent recipients exemplify these qualities and appreciate the incentive to maintain their pace.

McKinley winner **Tyler Cosby** joined the CBE graduate student family in 2013 as the first PhD student in Assistant Professor Sangoro's newly established research group. He investigates the development of structure-property relationships in soft matter.

"In hydrogen-bonding and ionic liquids, I have discovered new experimental signatures of the slow motion of these extended structures," he said. "This provides new insight into these important materials and will allow us to better design them for application in emerging technologies such as batteries, fuel cells, and super capacitors."

Cosby appreciates the company this award puts him in.

"I have an immense amount of respect for the students selected in past years and am honored to be among them," he said. "I'm especially thankful for the all the effort that Professor Sangoro has expended on my behalf and the faith he has shown in my ability to grow and achieve my goals."

Cosby has participated in two other CBE department research groups and has worked with the college's HITES12 summer pre-college program.

"As part of that program, I worked with other students in my lab to develop and lead high school seniors in a week-long lab-based introduction to soft matter research," he said.

Cosby maintains a keen interest in the teaching and learning aspects of his UT journey. The department chose him to receive a GAANN fellowship for teaching and research in an area of national need.

"As part of this program, I have been a teaching assistant for four semesters and participated in several programs offered by the UT Graduate School and the Teaching and Learning Center at UT," he said. "The department is home to an excellent graduate student cohort, with whom I have always found to be extremely supportive and open. The staff is similarly excellent and has been a great support in setting up and maintaining our new lab and helping me navigate to the right resources."

Recently, Tyler was recognized as the best poster presenter at the Gordon Research Conferences meeting on molecular structure elucidation held in mid-August in Sunday River, Maine.

PhD student **Hadi Sefiddashti** received the McKinley award in 2017 for his ongoing contributions to understanding the strange behavior of entangled liquids. Unlike the constant viscosity of an ordinary liquid like water, the viscosity of more complex liquids can change with the strength of their flow. It's important to know how these will act in industrial devices like an extruder.

"I'm focused on understanding the flow behavior of these on a molecular level," Sefiddashti said. "We need to understand molecular mechanisms in flow in order to understand the strange phenomena that we see in polymeric liquids."

His earlier research background was not directly in this area, and Sefiddashti thanks his advisor Brian Edwards and co-advisor Bamin Khomami for guiding him in the right direction.

"They have helpful and deep input," he said. "They tell you where to start to understand a problem. I'm honored and very grateful to receive this award," he said, adding that the resources offered by the CBE department are geared for success.

"I had good coworkers in my research group, and facilities that we needed for research were available for us."

Nelly Cantillo, PhD student and 2018 McKinley recipient, stays motivated with the knowledge that her work adds to the development of the next wave of renewable electrochemical energy-storage and generation devices.

"My dissertation examines the interaction between the electrode components in proton-exchange membrane fuel cells (PEMFC) and the impact these interactions can have on the electrode structure and, ultimately, on the overall PEMFC performance," Cantillo explained.

The award recognition has invigorated her academic spirit.

"As an international student and first-generation college graduate, pursuing my PhD has been a challenge," said Cantillo, who earned her master's and bachelor's degrees in her native Colombia. "Receiving this award motivates me to keep working hard for my goals and set an example for the next generation in my family and my home country."

Cantillo credits her research advisor Thomas Zawodzinki as her mentor and has worked closely with other faculty including Gabriel Goenaga, Stephen Paddison, and Joshua Sangoro.

"These interactions inside and outside the classroom have contributed to my professional and personal development," Cantillo said. "Working in a diverse and dynamic environment have made a difference in my experience as an international student in the US."

Cantillo is active in the Pipeline: Vols for Women student organization, leading the creation and coordination of a program to promote early-career mentorships between graduate students and postdocs or faculty in STEM. She also served as tutor and mentor to middle- and high-school students in different outreach programs.

Said Cantillo, "I am passionate about encouraging and inspiring women to pursue careers and higher education in STEM fields."

Chance to Have **Personal Impact** Led Alshibli to Success

Amany Alshibli has always had an interest in medical-related research, so her path to biomolecular engineering seemed almost a foregone conclusion.

"I always knew I was interested in medicine and in bio-research," Alshibli said. "I considered biomedical engineering for a while, but I liked how the classes in chemical and biomolecular engineering let you look at and solve issues at a much smaller scale."

Specifically, she took an interest in learning about the possibilities related to regenerative medicine and stem cell research and how breakthroughs in those areas could lead to specifically tailored treatment, something she called the "caretaking component."

One early research opportunity that fueled her imagination came through the International Genetically Engineered Machine (iGEM) competition.

iGEM brings together teams of students from around the world with a common goal of using genetic engineering to solve a problem or contribute to the greater good.

As a member of UT's 2016 team, Alshibli and her fellow students used E. coli bacteria to convert byproducts of petroleum processing such as benzene into useful products such as fragrances and flavorings.

In that way, the team was able to take substances that would have been otherwise harmful to humans and considered waste products into harmless and purposeful materials.

"One of the requirements of iGEM is that you can't just focus on the research; you also have to demonstrate how it would impact society and undertake outreach efforts," Alshibli explained. "It was a lot of fun, and it helped each member of the team learn to play to their strengths for the overall good of the project."

She pointed out that biomolecular research has led to other uses of E. coli as well, including as a source of manufactured insulin.

Her next step is to begin medical school this fall, further highlighting the work of the department and how it impacts humanity.

Alshibli already has some experience in a medical setting, having served at a regenerative healthcare center in Edinburgh during one of two summer undergraduate study abroad trips to Scotland.

Taking advantage of such opportunities is something she would encourage current and future students to do, but with a caveat:

"Don't be afraid to try new things, but remember to tell yourself that it's OK to stop if the excitement wears off," Alshibli said. "If you go to the first meeting of a group or attend an event, it doesn't mean that you're bound to go to the rest. You only have so much time as a student. Use it wisely."

With medical school, a bright future, and a path of her choosing ahead of her, it's clear she's done just that.

Five Questions: Amany Alshibli

For Alshibli, the question wasn't so much whether she'd come to UT after high school, but rather what she'd study once here.

Her father, Khalid, is the associate department head of graduate studies and professor in the Department of Civil and Environmental Engineering, and her older sister, Noor, is also a UT grad.

Alshibli won several accolades during her time at UT, including being named a Torchbearer in 2018, the university's highest student honor.

Question: When did you know you wanted to be an engineer?

Alshibli: I knew a lot of good things about the college, so it just made sense to come here. Before that first year was out, I realized how awesome my choice had been and some of the amazing things that were possible.

Q: What are some of the experiences that shaped your time here?

A: Like many, I took engineering fundamentals as a freshman, opting for the program's honors path. That experience was tough, but cool, and was the perfect gateway to the rest of my time in engineering.

Q: How did the freshman program serve that role?

A: It helped me transition into college life and also helped me make a lot of friends with whom I'm still connected.

Q: Do any faculty members stand out for the way they shaped your experience within the department?

A: Associate Professor Eric Boder was a major influence during my time in the department. He focuses on engineering proteins, immunology, and molecular biology, and was able to help me see potential career paths through the innovative nature of his classes.

Q: What, in particular, stood out about his classes?

A: His classes allowed us to merge technology and science. Being able to connect those two was exciting. It really piqued my interest.

STUDENT NOTES

AIChE Students Power on to National Conference

Chemical engineering students placed second in the Chem-E-Car Competition at the 2018 AIChE Southern Student Regional Conference hosted by Louisiana State University on April 7, 2018. The team advanced to the 2018 Annual AIChE Student Conference in Pittsburgh, Pennsylvania, in October.

The competition engages college students in designing and constructing a car powered by a chemical energy source that will safely carry a specified load over a given distance and stop. The team's car, the Myst-Air-y Machine, is powered by a PEM fuel cell, which uses hydrogen from a rubber balloon and reacts with oxygen from the air to produce the electricity.

Team members include co-captains **Christopher Neal** and **Catherine Weiss**, **Matt Adams**, **Matt Bush**, **Maria Bruce**, **Jason Chung**, **Hana Gouto**, **Tyson Johnson**, **Michelle Lames**, **Shannon Mulhall**, **Jason Pan**, and **Lacey Roberts**. **Gabriel Goenaga** (CBE) is the team faculty advisor. **Douglas Aaron** (MABE) is the team safety advisor.

Dylan Chitwood Keeps Time with Engineering

Dylan Chitwood grew up in the quiet rural town of Winfield in Scott County, Tennessee. Anyone looking for him there might have followed the sound of his clarinet, an instrument he picked up in fifth grade. He still plays, but dual enrollment courses in high school sparked his interest in chemical engineering.

"It seemed like the best way to combine my interests of math, chemistry, and biology," he explained.

The musical/chemical combo ignited impressive time-management skills as well. The Chancellor's Honors senior now maintains a rhythm of duties as a member of Associate Professor Cong Trinh's ViPaRe research group, as a student ambassador for the college, and as assistant drum major (ADM) for UT's Pride of the Southland Band.

"As the ADM, I am responsible for knowing everything that head drum major Rebecca Percy does from week to week," he said. "We play between nearly every single play and coordinating that takes two people."

Chitwood's other duties include teaching the marching drill and other Pride traditions to incoming freshmen.

"I am very excited for the opportunity to act as a teacher," he said. This Volunteer spirit echoes in his academic and research priorities. For his biomolecular engineering thesis, he examined recently discovered anti-CRISPR proteins as a potential mechanism for the delivery of antimicrobial drugs.

"I really want to make an impact in the medical community by developing pharmaceuticals," Chitwood said. He looks to advance these efforts as he weighs potential futures in academia or industry, and he intends to provide his own soundtrack along the way.

"I hope to continue playing in ensembles at my graduate institution or in a local community band," Chitwood said. "Music has brought me many great experiences, opportunities, and friends over the last eleven years and I couldn't imagine just giving it up."

Kelsey Grady earned multiple awards this year for her work with UT-ORNL Governor's Chair Thomas Zawodzinski's research group. Her poster, entitled "Effect of Membrane Pretreatment on the Mass Transport of Vanadium Redox Flow Batteries," earned her third-place at the AIChE Southern Regional poster competition and first place in the CBE department's student competition.

"Placing third at the AIChE SRC was a huge accomplishment for me," Grady said. "I was up against about 50 other students from universities all over the southern region. I felt really confident immediately after the competition because I felt I had done well."

She capped her regional showing with the departmental win.

"I honestly was not expecting it because I did not know who I was up against or how many other students had submitted their posters," Grady said. She credited Gabriel Goenaga, senior research associate in CBE, with motivating her to create her poster and enter it into multiple competitions. "It definitely would not have happened without all of his help and encouragement."

Grady has moved forward with career plans since graduating in May 2018.

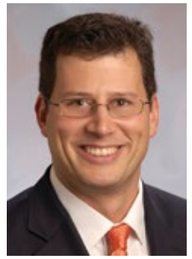
"Nothing is officially decided yet," she said. "But I am definitely looking to find a job in the chemical engineering field that I really enjoy."

Christopher Neal, of Murfreesboro, Tennessee, a senior majoring in chemical and biomolecular engineering and a member of the Chancellor's Honors program, is a Fulbright alternative for a study and research grant to Germany and could be offered a grant at a later date.

Senior **Michael Lin** (CE) is a member of the Food Recovery Network, which was awarded the Student Organization Environmental Leadership Award at the Environmental Leadership Awards Dinner in May. The group was recognized for their efforts during the 2017 football season. Group members helped recover nearly 8,000 pounds of food from Neyland Stadium after football games.

PhD candidate **Naigia Hoa** was selected as a semi-finalist in the 2018 3MT (Three Minute Thesis) competition. She earned a $50 cash prize for her participation.

FACULTY NOTES



MABE Department Head **Matthew Mench** and UT-ORNL Governor's Chair Tom Zawodzinski joined a group of national leaders in electricity storage in February at the Union of Concerned Scientists Electricity Storage Strategic Workshop in Washington, DC. Attendees contributed to the development of a plan to advocate for more federal funding and produce recommendations to Congress on the needs and opportunities for funding enhanced research, development, and demonstration of electricity storage. Scientists and legislators discussed research and responded to recommendations made during the workshop.

The American Association for the Advancement of Science named UT's **Bamin Khomami**, the head of the Department of Chemical and Biomolecular Engineering, as a 2018 Fellow.

Khomami, who also serves as the Granger and Beaman Distinguished University Professor and director of the Sustainable Energy Education and Research Center, was chosen for his contributions to modeling and research that have led to a better understanding of fluids.

"Being chosen as a fellow of the AAAS is a tremendous and humbling honor," said Khomami. "Getting recognized by your peers like this speaks highly of the work I've been able to accomplish and of the people with whom I've collaborated."

Khomami was inducted in February at the AAAS Annual Meeting in Austin, Texas.

The American Association for the Advancement of Science is the world's largest multidisciplinary scientific society and publisher of the Science family of journals. The AAAS Council elects fellows whose "efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished." It was founded in 1848 and includes 254 affiliated societies and academies of science serving 10 million individuals.

Professor **Paul Frymier** was tabbed in July to serve as interim associate dean for faculty affairs for the college. He most recently served as chair of the college's Promotion and Tenure Committee for the 2017–2018 year and currently serves on both the college's Graduate and Undergraduate Advisory Committees for Diversity.

UT-ORNL Governor's Chair **Tom Zawodzinski** was chosen for an Advanced Research Projects Agency-Energy (ARPA-E) grant for his work on fuel cell technology. Zawodzinski will receive up to $1.5 million through the grant.

As part of their typical processes, fuel cell reactions result in the production of water via the combination of hydrogen and oxygen. Building from a discovery made through his research group, the new device will instead produce hydrogen peroxide, which can be easily stored.

As needed, these fuel cells can provide electricity to the grid while producing peroxide which will be converted into oxygen during the charging cycle. The biggest impact of the breakthrough is that the system could allow renewable electricity inputs such as solar or wind, to be leveraged over long periods.

Art Ragauskas, UT-ORNL Governor's Chair for Biorefining, received the 2017 Professional Achievement Award for Innovations in Green Process Engineering at the American Institute Chemical Engineers Annual Meeting in Minneapolis in October.

He was recognized for his outstanding professional achievement in advancing Green Process Engineering and his distinguished contribution as an educator.

In addition, Ragauskas was presented with the Albert Nelson Marquis Lifetime Achievement Award by Marquis Who's Who in May.

Cong Trinh, Ferguson Faculty Fellow in the department, has been chosen by the Department of Energy to lead an effort to create specifically-designed bioesters using strains of the Yarrowia lipolytica fungus. Those bioesters, in turn, will be able to be used as potential fuels, solvents, flavors, and fragrances, with the key advantage that those products would all be produced in sustainable ways. The overall award is for $1.4 million, with $1.1 staying within the department and the rest being used by team members from Oak Ridge National Laboratory and the USDA.

ALUMNI NOTES

Love is Orange

By Laura Tenpenny

"I was a bit confused until I discovered the card signed by Coach Fulmer, and then I realized that someone must have reached out to UT," said **Charles Shaw**, a two-time graduate of chemical engineering (BS ChE '80), upon receiving a get well card earlier in the year.

Shaw's daughter, Honey, had contacted his old chemical engineering department on a quest to lighten her father's spirits as he went through treatment for cancer. In a feat of administrative coordination and love, the department worked with other units around campus to send Shaw care packages and cards from the university and from his fellow UT chemical engineering alumni.

"It boosted my pride in my university that the folks there care enough about an old alumnus and die-hard Vol fan to take time from their busy jobs to make my day a little brighter," Shaw said of this show of support.

As a wide-eyed student, he was similarly overawed by the university.

"Coming from a small town like I did, UT exposed me to so many new ideas and people and opened up a world of opportunity for me," Shaw recalled.

Part of that opportunity included participation in the engineering co-op program, through which he was able to work for TVA.

"UT gave me my career. My experience at UT provided the educational background and the vocational awareness through my co-op experience to prepare me for the successful engineering career I have enjoyed over the past 38 years," Shaw said.

Since leaving UT, Shaw has worked for TVA, Porex Technologies, and Osmose, with experience in plant design, product design, operations management, and more. Of most importance to him, however, is his family, which includes his wife, Lynne, and his daughters, Honey and Maggie.

People are also what Shaw considers most important when he reflects on his time at UT, and especially his recent experience as an alumnus.

"I think the people make UT special. While the gesture of reaching out to me during a tough time may seem insignificant to some, I believe it is part of the make-up of everyone who has ever been associated with the Volunteer family. I love the University of Tennessee and am proud to be part of the Vol nation and believe it is our duty to help each other. I know I certainly appreciate the effort that has been shown on my behalf," Shaw said.

Shaw's cancer is responding well to treatment, and he wants his Vol family to know that he is doing well. He expressed his gratitude for all involved in the kindness he received:

"Thank you for your interest in me and my situation. I am grateful for the life that my time at UT prepared me for and I just want to continue to pay it forward to help others and exhibit that Big Orange spirit while I do it!"

Harold Conner Named to Nuclear Engineering Board of Advisors

Harold Conner, a senior executive of URS|CH2m Oak Ridge LLC (UCOR), has been named to the Board of Advisors of the University of Tennessee Department of Nuclear Engineering.

The board consists of high-level managerial and technical executives from government, education, business, and industry. Its purpose is to provide influence, advocacy, counsel, and support to ensure that the programs, activities, and initiatives of the department are national in scope and that the department is increasingly recognized as a major center of excellence for nuclear education and research.

"We are very pleased to have a talented executive with Harold's credentials and experience on our Advisory Board," said Department Head Wes Hines. "His expertise will add greatly to our plans for growth and enhancement of the nuclear engineering program."

A career veteran of multiple nuclear projects, Conner currently serves as senior advisor to Kenneth J. Rueter, UCOR president and chief executive officer. UCOR is lead cleanup contractor for the Department of Energy's East Tennessee Technology Park (ETTP), former home of the Oak Ridge Gaseous Diffusion Plant, and other sites on the Oak Ridge Reservation.

A registered professional engineer in Tennessee and South Carolina, Conner received bachelor's and master's degrees in chemical engineering from UT and earned his doctorate in industrial and systems engineering from the University of Alabama in Huntsville.

THE UNIVERSITY OF TENNESSEE KNOXVILLE

DEPARTMENT OF CHEMICAL & BIOMOLECULAR ENGINEERING

419 Nathan W. Dougherty Building
1512 Middle Drive
Knoxville, TN 37996-2200
Phone: (865) 974-2421
Fax: (865) 974-7076
Email: cbe@utk.edu
Web: cbe.utk.edu

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