NIH Increases Funding for Projects in 2016

Tessa Calhoun, David Jenkins, and Michael Best received funding from NIH for research projects in the Department of Chemistry.

“We are thrilled to see so many new NIH awards in the Department of Chemistry,” says Taylor Eighmy, vice chancellor for research and engagement at the Office of Research and Engagement. “Since implementing a strategic plan to grow UT’s NIH funding in 2014, we have created a number of new resources and development opportunities through the Office of Research and Engagement to support our NIH researchers and help them submit strong proposals. These calculated efforts are beginning to have a noticeable impact on our researchers’ success with NIH, and we hope this trend continues.”

Tessa Calhoun, assistant professor, received funding for her project “Imaging Amphotericin B’s Mechanism of Action with Transient Absorption Microscopy.” The dramatic rise of antimicrobial resistance has created the need for new approaches in the design of novel drug systems. Professor Calhoun’s project focuses on the study of Amphotericin B, an important antifungal therapeutic often used as a last line of defense for systemic fungal infections, which has developed limited cases of clinical resistance despite decades of use. A better understanding of how this drug operates within cells could inform our understanding of the design principles of novel drug delivery systems needed to reduce the occurrences of antimicrobial resistance. In her project, Calhoun will use transient absorption microscopy to directly image how Amphotericin B acts in both model and living systems to achieve its effective behavior.

David Jenkins, associate professor, is the PI of awarded project “Catalytic C2+N1 Aziridination from Organic and Carbamate Azides.” Aziridines are biologically active functional groups found in natural products, such as mitomycins and azinomycins, which are critical in biology and synthetic medicinal chemistry due to their antitumor properties. Despite the myriad uses for aziridines in pharmaceutical products, as well as synthetic intermediates, researchers have yet to achieve their efficient synthesis. In this project, Jenkins proposes to extend research on catalytic aziridination to include new directions relevant to the medicinal chemistry community—in particular, the synthesis of carbamate protected aziridines and chiral aziridines. Chiral aziridines are a useful tool in the synthesis of single enantiomer drugs.

Directed by Associate Professor Michael Best, the third awarded project is “Labeling of Lipid Products Using Synthetic Tagged Metabolite Probes to Analyze Lipid Biosynthesis and Trafficking.” While lipids control many of the most critical biological processes that lead to diseases (including cancer), tracking the production of these molecules in cells remains a significant challenge. In his project, Best explores novel approaches for the labeling of lipid structures that will enable tracking of the identity and location of lipids in cells, with a focus on cancer cells. These strategies will significantly enhance our understanding of the biosynthesis and movement of important lipid molecules within their native cellular environments.

Both Jenkins and Best were also NSF CAREER awardees in 2013 and 2010, respectively.
Innovations in Carbon Capture

Neil Williams started his college career as a biology student with hopes of going to medical school. All that changed when he took organic chemistry.

“I fell in love with the research and became one of those students who was in the lab all the time,” says Williams, a PhD student in the Department of Chemistry, working with Professor Sheng Dai.

His research involved binding different metals in water using a variety of different compounds. This experience provided Williams with the fundamental tools necessary to be part of a team at the Department of Energy’s Oak Ridge National Laboratory that recently discovered a simple, reliable process for capturing carbon dioxide from the air, which offers a new option for carbon capture and storage strategies to combat global warming.

“We stumbled on the process completely by chance,” Williams says. “Our initial project was to develop a way to remove sulfate from seawater.” Offshore oil rigs use seawater to cool the pipes they use to pump oil, but the sulfate in seawater reacts with the barium in the pipes and builds up over time, similar to the way cholesterol builds up in the arteries of a human body. Instead of putting the pipes on a diet, however, the oil companies simply replace them, which costs money, time, and has a toll on the environment.

To combat this problem, Williams and his fellow researchers synthesized a family of compounds based on simple guanidines designed to bind to contaminants and form insoluble crystals that are easily separated from water. They had difficulties getting a crystal structure of guanidine bound to nitrate, but when researchers left the guanidine solution in the open air, a different type of crystal started to form.

The team analyzed them and discovered they contained carbonate, which forms when carbon dioxide from the air reacts with an alkaline solution.

Even though carbon capture is not a new tool for scientists looking for ways to combat global warming, the process Williams and researchers at ORNL developed requires significantly less energy to capture and later release the CO₂ for storage.

“Current processes, while dirt cheap, need a lot of energy – up to 840 degrees Celsius – to release the CO₂ gas,” Williams says. “The beauty of our process is that it only needs to be heated to 120 degrees.”

While not ready for market yet, the team is hopeful for prospects of future applications.

“We are working to design a simple system so that anyone could set it up and capture carbon right in their garage,” Williams says.

The UT-ORNL partnership is what prepared him for a career in chemistry, according to Williams.

“The lab is well-known both nationally and internationally and the fact that a graduate student can put ORNL on their resume is great,” Williams says. “We do ground-breaking research that has an impact; it’s something that can change the world.”

THE RESEARCH WAS FUNDED BY THE DEPARTMENT OF ENERGY’S OFFICE OF SCIENCE.

This article was originally published in Higher Ground.
Polymer nanocomposites mix particles billonths of a meter (nanometers) in diameter with polymers, which are long molecular chains. Often used to make injection-molded products, they are common in automobiles, fire retardants, packaging materials, drug-delivery systems, medical devices, coatings, adhesives, sensors, membranes, and consumer goods.

When a team of scientists, including UT’s Alexei Sokolov, tried to verify that shrinking the nanoparticle size would adversely affect the mechanical properties of polymer nanocomposites, they got a big surprise. They found an unexpectedly large effect of small nanoparticles. The findings were reported recently in the journal ACS Nano.

In addition to Sokolov, the team included scientists from Oak Ridge National Laboratory, and the University of Illinois at Urbana-Champaign. Sokolov is a UT-ORNL Governor’s Chair based in the Department of Chemistry.

Blending nanoparticles and polymers enables dramatic improvements in the properties of polymer materials. Nanoparticle size, spatial organization, and interactions with polymer chains are critical in determining behavior of composites. Understanding these effects will allow for the improved design of new composite polymers, as scientists can tune mechanical, chemical, electrical, optical, and thermal properties.

Until recently, scientists believed an optimal nanoparticle size must exist. Decreasing the size would be good only to a point, as the smallest particles tend to plasticize at low loadings and aggregate at high loadings, both of which harm macroscopic properties of polymer nanocomposites.

“We see a shift in paradigm where going to really small nanoparticles enables accessing totally new properties,” Sokolov says.

That increased access to new properties happens because small particles move faster than large ones and interact with fewer polymer segments on the same chain. Many more polymer segments stick to a large nanoparticle, making dissociation of a chain from that nanoparticle difficult.

“Now we realize that we can tune the mobility of the particles—how fast they can move, by changing particle size, and how strongly they will interact with the polymer, by changing their surface,” Sokolov says. “We can tune properties of composite materials over a much larger range than we could ever achieve with larger nanoparticles.”

This article was originally published in Tennessee Today.

Small nanoparticles stick to segments of polymer chain about the same size as the nanoparticles themselves. These interactions produce a polymer nanocomposite that is easier to process because nanoparticles move fast, quickly making the material less viscous. At right, many segments of a polymer chain stick to a larger nanoparticle, making it difficult for that nanoparticle to move. Its slower movement results in a viscous material that is more difficult to process. Source: ORNL website
Faculty and staff in the Department of Chemistry welcome our newest tenure-track faculty member, Johnathan N. Brantley, who will join our organic division in fall 2017. Brantley obtained his doctoral degree in chemistry from the University of Texas at Austin in 2014 and conducted two years of postdoctoral studies under the guidance of Professor Dean Toste at the University of California, Berkeley.

Brantley’s research group focuses on addressing chemical problems at the interface of materials science and synthetic methodology. They envision new strategies for transforming reactive species into materials or chemical scaffolds that are challenging synthetic targets and are particularly interested in accessing functional polymers that exhibit tunable structures and physical properties. The development of novel organometallic species, and investigating their applications in both synthesis and materials science, is another exciting area of focus. Brantley’s research program integrates elements of physical organic chemistry, polymer science, synthesis, and organometallic chemistry to address both fundamental and applied problems. The group’s interdisciplinary approach to discovery provides burgeoning scientists at all stages of career development with an invaluable skill set.

Zachary Ogburn, a second year chemistry graduate student from the Frank Vogt Research Group, published his first paper titled “Microalgae as embedded environmental monitors” in Analytica Chimica Acta (ACA), a leading journal in analytical chemistry. Journal editors selected the paper to feature on the cover (Vol. 954).

In his first-authored paper, Ogburn developed analytical methodologies that utilize microalgae’s adaptation as a novel approach for in-situ environmental monitoring. Microalgae are an important component in marine ecosystems because of their ability to transform large quantities of inorganic compounds into biomass. The study specifically looked at phytoplankton’s sequestration of atmospheric CO2, a greenhouse gas, and nitrate, one cause of harmful algae blooms.

Frank Vogt, associate professor of chemistry and Ogburn’s mentor, is quite proud of Ogburn’s achievement.

“I want to point out that ACA is a leading journal in analytical chemistry and Zack got this paper accepted at the end of his second year!” Vogt says.
Professor Schweitzer Receives Central Methodist University Alumni Award

The significant achievements and exemplary careers of six graduates from Central Methodist University were celebrated at Central Methodist University’s 71st annual Alumni Awards banquet May 6. Among them is George K. Schweitzer, professor of chemistry.

The lifetime achievements of Schweitzer abound, and continue to this day. A native of Poplar Bluff, Missouri, he earned the first of his six degrees, a BA in chemistry, from then-Central College in 1945. His degrees include MS in geochemistry, MA in theology, PhD in chemistry, PhD in history and philosophy of religion, ScD for work in the history of science.

Schweitzer came to UT in 1948 to initiate the inorganic division of the newly established PhD program in chemistry and to participate in the early UT-Oak Ridge graduate instructional and research program. He has mentored over 130 graduate students, was elected UT Phi Kappa Phi lecturer, served as UT’s first Mace Bearer, gave the 1996 UT commencement address, has been named a Distinguished Service Professor by the UT Alumni Association and received the Joe Johnson Lifetime Service Award in 2014 in recognition of his 65 years of dedicated service to UT.

Schweitzer remains active in the Department of Chemistry. He served a faculty fellowship at Columbia University in New York City. The author of over 200 scholarly articles and publications, mainly scientific, but including some on the topic of genealogy, he has lectured to over 200 scientific, historical, and genealogical societies and universities in Europe and North America.

While his professional preparation has been in science, Schweitzer also taught university-level courses on the Civil War, the History of Religion, the History of Technology, and more. A man of many interests, he has done research in radiochemistry, nanoparticles, PET body scanner detectors, and solvent extraction, and his memberships range from the American Chemical Society to the American Philosophic Association.

Professor Jenkins Awarded at Chancellor’s Honors Banquet

Associate Professor of Chemistry David Jenkins received Research and Creative Achievement—Professional Promise Award at the 2017 Chancellor’s Honors Banquet April 19.

Jenkins has been called one of the most promising synthetic inorganic chemists of his generation. Colleagues describe him as a dynamic teacher and a leader in undergraduate chemistry education who is, as one put it, “a shining example of the kind of teacher-scholar that is the foundation of excellence in top 25 academic institutions.”

Jenkins’s work involves creating new synthetic “tools” that may help chemists more effectively produce pharmaceuticals such as chemotherapy medicines. Jenkins received a prestigious NSF CAREER award for his research in 2013 and just completed a successful proposal for NIH. He has published more than 30 papers in some of the top journals in chemistry, 18 of them written in the past five years. In that same span of time, he also completed two books and filed for a patent. He received the Department of Chemistry’s 2014 Mamantov Professorship Award for an outstanding junior faculty member in chemistry and the Chemical Communications Young Investigator Award in 2014.

Our annual Department of Chemistry Honors Day took place Thursday, April 27, 2017. Congratulations to the students, faculty, and staff who received awards for their many achievements.

To see the full list of winners, please visit www.chem.utk.edu/news/2017honorsday.
**Chemistry Professor and Research Team Wins R&D 100 Award**

Professor Sheng Dai led a group of scientists from UT, Oak Ridge National Laboratory, and 525 Solutions who developed U-Grabber, an adsorbent material designed to extract uranium and other metals from water inexpensively and efficiently. The project received 2016 R&D 100 Award. Known as the “Oscars of Invention,” the award honors innovative breakthroughs in materials science, biomedicine, consumer products, and more from academia, industry, and government-sponsored research agencies since its inception in 1963.

U-Grabber is made from polyethylene fibers, similar to PVC, woven into braids and grafted with chains of a uranium-attractive chemical called amidoxime. The free-floating uranium in the water binds with the fibers and can be extracted, purified and sold as nuclear fuel.

The fibers can be reconstituted and reused, are cheap to produce at scale, and can bolster dwindling terrestrial supplies of uranium. They can also be customized to bind with other toxic or valuable aqueous metals, providing an environmentally sound method of cleaning bodies of water such as mines or fly ash ponds.

The development team included Sheng Dai and Suree Brown from UT and Robin Rogers, Christopher Janke, Richard Mayes, Tomonori Saito, and Ronnie Hanes from 525 Solutions.

“Suree Brown played the most important role in developing this technology,” Dai says.

Brown, a UT chemistry alumna, is a research associate in Dai’s group at UT. Brown was born and raised in Thailand. After obtaining her BS in chemistry from Chulalongkorn University, she came to UT to pursue a PhD in chemistry under Professor Craig Barnes, during which time she acquired skills and experiences in organometallics and olefin polymerization.

Brown started working with Dai during the final year of her PhD study. After obtaining her PhD in 2002, she continued to work with Dai at ORNL and later on at UT.

“I had the privilege to work with various advanced materials, including nanomaterials, polymers, and hybrid materials, for a wide variety of applications, including radiation detection and uranium recovery from seawater,” Brown says.

“We cannot do the work we do without the help and support from the chemistry department as a whole and the staff here.”

U-Grabber is one of the seven winning projects at ORNL this year. For information about other winning projects, visit www.ornl.gov/news.
In memory of Professor Emeritus Bill Bull, 1933 – 2016

William Earnest Bull, chemistry professor emeritus, passed away Tuesday, December 27, 2016. Known to his friends and colleagues as Bill, he spent 40 years in the Department of Chemistry and retired as the associate head. Bill was a strong proponent of quality teaching in general chemistry and was co-author of the popular text, Fundamentals of College Chemistry. The largest lecture room in Buehler Hall, BU 555, bears his name in honor of his contributions to chemistry and the department. He earned his PhD in chemistry from the University of Illinois, Champaign, and was the first member of his family to graduate from college.

To read his obituary, originally published in the Knoxville News Sentinel, please visit www.chem.utk.edu/news.

ALUMNI NEWS

Barbour and Team Discover Static “Stripes”

Chemistry alumnus Andi Barbour (first from right), member of the Brookhaven Lab research team, found static “stripes” of electrical charge in copper-oxide superconductor. The team published their research results October 11 in Physical Review Letters. Barbour obtained his PhD degree in chemistry in 2009 and studied under Professor John Larese. Read the full article on Brookhaven National Lab website: www.bnl.gov/newsroom/news.php?a=111883.

Bacterial Genes Could Lessen Severity of Malaria

Shawn Campagna, associate professor, is part of a team of researchers who identified a set of bacterial genes that may help them find ways to lessen the severity of the disease malaria. Their findings could also aid the research of fellow scientists working in malaria-stricken regions around the world. The study was published in the journal Frontiers in Microbiology.

Campagna also received the College of Arts and Sciences Interdepartmental Collaborative Scholarship and Research award for his work with Professors Helen Baghdoyan and Ralph Lydic in psychology. The psychology/chemistry collaboration uses state-of-the-art chemical techniques to identify known and unknown brain molecules that regulate naturally occurring and drug-induced states of consciousness. The long-range goal is to establish causal relationships between specific molecules and behavioral states and physiological traits.
Chemistry Giving Opportunities

We rely on the generous financial support of our alumni and friends. Your contributions, no matter what size, play a critical role in supporting academic achievement and research by students and faculty.

Support the Department of Chemistry at UT by making a donation to our department or one of the endowments. You can donate one of three ways:

Option 1: Secure Online Donation: chem.utk.edu/giving

Option 2: Contact Don Eisenberg in Arts and Sciences Development at 865-974-2504 to explore giving opportunities supporting students, faculty, staff, or facilities in the Department of Chemistry.

Option 3: You are also welcome to contribute to any of the current chemistry endowments, including:
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- Burchfield Burrige Warner Endowment
- D.A. Shirley Endowment
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- Eastham Endowment
- Gleb Mamantov Endowment
- Graduate Student Leadership Endowment Fund
- Judson Hall Robertson Endowment
- Paul & Wilma Zeigler Endowment
- UT Chemistry Enrichment Endowment Fund
- UT Chemistry Support Endowment

Your gift counts more than ever! We sincerely thank the many alumni and friends who so generously support the Department of Chemistry. Gifts can be designated to the fund you prefer and will be most gratefully received.

Our newsletters can also be found online at chem.utk.edu/home/publications.