

KSU CHEMIST



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From the Department Head

Dear Friends:

Late this spring, our colleague Prof. Chris Culbertson, was named the new Associate Dean for Research (ADR) for the College of Arts and Sciences. While the research-related endeavors of the College will be in excellent hands under his guidance, his daily presence in our department will be greatly missed. Chris was very active in service within our department and acted as our lead undergraduate advisor for many years. One of Chris's duties as lead advisor was assessing student records and awarding scholarships. During our transition to a new group of advisors, I have taken over awarding of scholarships and have found this to be a most enjoyable activity. We have a solid group of outstanding students and the process of reviewing their academic records is a real joy. Our students clearly have bright futures ahead of them and I look forward to seeing them graduate and move on to graduate school or permanent employment. Of course our ability to award scholarships relies upon the generosity of

our many alumni and friends. And for these contributions, we are all profoundly grateful! We currently award one or more scholarships to about 30 different undergraduate students each year, totaling more than \$100,000 in annual financial assistance. With the ever-increasing costs of tuition, room, board, books, and supplies, these scholarships help reduce or even eliminate the debt that is frequently accumulated by our students. They also help our students concentrate on their studies, rather than seeking part time jobs to help pay college expenses. Each year we host a Scholarship Banquet in recognition of our scholarship winners. If you are in town, we would love to have you attend – invitations will be mailed soon. On behalf of all our students and faculty, I offer a hearty THANK YOU to all those who have been able to help our students in this manner.

David A. Higgins

Enhancing Student Safety in Our Teaching Labs

The proper use of personal protective equipment (PPE) is critical to lab safety in Chemistry. Our undergraduates have long been required to wear safety goggles in the lab, to dress appropriately, and to wear proper shoes. In our research labs, our researchers are required to use appropriate PPE at all times, including wearing proper lab coats. I am told that many years ago our undergraduates were also required to wear lab coats in the teaching labs. That requirement was just recently reinstated. However, lab coats only provide proper protection when they meet standards and are properly maintained and laundered. A dirty lab coat can actually increase the risk of exposure to chemical hazards, rather than protecting against them. Going forward, instead of simply requiring our undergraduates each purchase a lab coat and hope they launder them, we have contracted with a vendor to provide our students with rented lab coats that will be laundered whenever necessary. While the cost is nominal to our students, the sizing, distribution, and collection of about 2000 lab coats each semester will be a real challenge. Our Chemical Hygiene Officer, Tingting Liu will be managing this program and will be hiring students to help! This program will not only enhance lab safety but will also help better educate our students in the safety protocols they will use throughout their future careers!



New 400 MHz Liquids/Solids NMR

In last year's newsletter I announced that we had just received funding from the National Science Foundation to purchase a new nuclear magnetic resonance (NMR) spectrometer. Well, this system has since been acquired and installed, and it is now being routinely used by a large number of faculty, postdoctoral associates, graduate students and undergraduates in their individual research projects! The instrument is a hybrid 400 MHz NMR with both solution and solid-state capabilities. NMR spectroscopy is one of the most powerful tools available to chemists for the elucidation of chemical structures, to identify unknown substances, and to study the dynamics of interactions between molecules in solution or in the solid state. The acquisition of this instrument will enhance our research and educational efforts at all levels and will directly impact projects involving, for example, investigations of the catalytic asymmetric oxidation of C-H bonds, synthesis of dye-labeled peptides for single cell analysis in microfluidic devices, synthesis of dyes for use in studies of aldol condensation reactions and heterogeneous nanostructures at the single molecule level, characterization of peptides for the rapid profiling of proteases in early detection of cancer, studies of dye-decolorizing peroxidases for use in converting lignin into useful chemicals and fuels, for understanding molecular interactions in engineered host-guest materials, to facilitate the creation of bio-inspired metal-organic-frameworks (MOFs) for applications in catalysis and disease detection and treatment, and to elucidate the functional characteristics of new olefin metathesis catalysts for use in commercially relevant chemical reactions. NSF-required matching funds for this instrument were provided in part by the many generous donors to our department. Thank you once again to all those who have been able to help in this manner!



New Seminar Series in Memory of Ken Klabunde

Ken Klabunde was a longtime member of the chemistry faculty at Kansas State University. He first came to our department in 1979, having been hired to serve as Department Head. Ken served in this role for 9 years and was named University Distinguished Professor immediately thereafter. He had a long and productive career, and was well known as a leading expert and innovator in the field of nanotechnology. He and his research group published well over 500 scientific articles and were awarded over 20 patents. He also received broad exposure in the popular press, having been awarded a Breakthrough Award from *Popular Mechanics* in 2005. Ken retired from teaching and research in 2013. After his passing in 2017, his family established the Kenneth J. Klabunde Memorial Lecture in his honor. The inaugural lecture in this series was delivered by Prof. Vicki Grassian from UC San Diego on May 2, 2019. Her talk was entitled "Nanoparticles and the Environment: Chemistry, Applications and Impacts." Vicki got to know Ken through their shared interests in nanomaterials and through their multiple professional interactions in the Midwest Region of the American Chemical Society, while she served on the Chemistry faculty at the University of Iowa. We look forward to many excellent seminars in this series in the coming years! Thank you to the Klabunde family!



Transitions in the Chemistry Department

Dr. Boris Averkiev

A New Arrival

Boris Averkiev will be joining our faculty in July 2019. He will serve as a Teaching Assistant Professor, lecturing in our Chemical Analysis, Environmental Science: A Chemistry Perspective, and Honors Chemistry 2 courses. He will also serve as the new Lead Advisor to our undergraduate chemistry majors. Boris received his Ph. D. in Physical Chemistry from Utah State University in 2009 and an M. S. degree in Chemistry from New Mexico Highlands University in 2005. Most recently, he has been teaching Chemistry at Stockton University in Galloway, New Jersey.

Prof. Chris Culbertson

New Duties

Chris was appointed to a five-year term as the Associate Dean for Research in the College of Arts and Science in late spring of 2019. He has made outstanding contributions to our department over the years, since his arrival here in 2002. These contributions have come in part from his research program in lab-on-a-chip devices and microfluidic chemical separations, which he plans to continue. His research has been well funded by several different federal agencies and private donors over the years. His other contributions include teaching several different courses in Analytical Chemistry, including Chemical Analysis, Honors Chemistry 2, and our Graduate Chemical Separations Course. Recently, he has also coordinated our Freshman Seminar program, Frontiers in Chemistry, and has taught online sections of our freshman courses. He has made substantial contributions through his service as our lead advisor to our undergraduate students, and he has led our efforts in maintaining our NSF-funded REU program for many years. While his regular presence in the department will be missed, we know he will do a fantastic job advocating for our college and in running programs across the 26 affiliated departments.



Departures

A few departures from our program also occurred during the previous year. First, Dr. Elizabeth Ploetz, who helped teach Chemistry 2 in fall 2018, returned to concentrating on her duties as a postdoctoral researcher in Prof. Paul Smith's lab. She was really happy to get back in the lab and focus more on pursuing her own research interests! Prof. Jamie Townsend completed his academic-year-long sabbatical with us, teaching General Organic Chemistry, Organic Chemistry 1, and Organic Chemistry 2 at various times throughout the year. After teaching General Organic for us this summer, he will return to his regular duties at Kansas Wesleyan University. Our students will miss his interactive, engaging style of lecturing!

Word from the Glass Shop

Air and moisture sensitive chemical reactions frequently require anhydrous and oxygen free solvents. Historically, this was done through distillation of the solvents using reactive metals such as sodium or potassium as the drying agent. These distillations can be hazardous due to the high flammability and reactivity of the reagents. Many chemists now use solvent purification systems to avoid these hazards. The various commercial systems all function in the same basic way but have various methods for dispensing the solvents. Since differing researchers require different solvents, and the systems are expensive, it would be convenient and more economical if they were able to easily share the dry solvents, regardless of the dispensing method. The picture at the right shows a custom designed adapter allowing two different methods of collecting the dry solvent depending upon the user's needs. Fabricating specialized glassware to fill specific research needs is one of the services the scientific glassblowing shop at K-State provides.

James Robert Hodge



Recent Graduates

Bachelor of Science

Nathan Lee Booe
Johnathan Michael Dallman
Cassidy Allyssa Rae Frost
Olivia Haney
Hannah Lou Henderson
Alexandra Leigh Jinks
Zachary Harris Johnson
Madison Danielle Long
Erin Meyers
Monika Juliett Perez
Elizabeth Anne Poppe
Skyler James Roth
Elijah David Stowe
Makena Marie Utech
Elizabeth Anne Weesner

Graduate Degrees

James Emery Brown, Ph.D.

Major Prof: Jun Li
Title: Advances in Electrical Energy Storage Using Core-shell Structures and Relaxor-Ferroelectric Materials.

Lauren A. Chlebanowski, Ph.D.

Major Prof: Stefan Bossmann
Title: Rational Design and Synthesis of Mesoporous Silica Nanostructure-based Drug Delivery.

Janaka Chaminda Gamekkanda Gamaethige, Ph.D.

Major Prof: Christer Aakeroy
Title: Crystal Engineering with Coordination, Hydrogen- and Halogen-bonds, and the Construction of Porous Solids.

Kaimin Jia, Ph.D.

Major Prof: Ping Li
Title: Activity-based Substrate Profiling of N-terminal Methyltransferase 1 (NTMT1).

Ruwandi Shamila Kumarasinghe, Ph.D.

Major Prof: Daniel Higgins
Title: Single Molecule Investigation of the Structural Aspects and Mass Transport Dynamics of Mesoporous Silica Nanopores.

Stephanie Lee, M. S.

Major Prof: Emily McLaurin
Luminescent Indium Phosphide Nanocrystals Formed from Single-Source Precursors using Fluoride-Containing Ionic Liquids

Zi Li, Ph.D.

Major Prof: Daniel Higgins
Title: Single-molecule Fluorescence Microscopy Studies of DNA-surface Interactions on Chemically Graded Organosilane Surfaces.

Nilusha Lakmali Kariyawasam

Manachhige, Ph.D.

Major Prof: Paul Smith
Title: Computer Simulations of Small Molecules and Proteins in Solutions.

Tuyen Duong Thanh Nguyen, Ph.D.

Major Prof: Santosh Aryal
Title: Engineering Nanoparticles Using Chemical and Biological Approaches for Tumor-targeted Delivery.

Bhupinder Kaur Sandhu, Ph.D.

Major Prof: Christer Aakeroy
Title: Exploring and Anticipating Supramolecular Synthons: From Fundamental Science to Practical Applications.

Christopher Sean Satterfield, M. S.

Major Prof: Tendai Gadzikwa
Uniform, Independent Bifunctionalization of a Metal-Organic Framework Material.

Kathleen Ann Sellens, Ph.D.

Major Prof: Christopher Culbertson
Title: Microscale Analysis Systems for the Study of Proteins and Proteases.

Raghavender Siramdas, Ph.D.

Major Prof: Emily McLaurin
Title: Tuning the Size and Surface of InP Nanocrystals by Microwave-assisted Ionic Liquid Etching.

Mohammad Sadegh Yazdanparast, Ph.D.

Major Prof: Emily McLaurin
Title: Complimentary Tuning Semiconductor NCs Properties Using Precursor Reactivity, Doping and Post-synthetic Modification.

Jing Yu, Ph.D.

Major Prof: Stefan Bossmann
Title: Structure Determination, Mechanistic Study, and Safe Delivery of an Anti-Cancer Peptide.

Giving to the Chemistry Department

A Hearty **THANK YOU** to all who have given to Chemistry this past year!

Total giving to the Department of Chemistry from July 1, 2018 to June 30, 2019, in each of four areas is shown below. We are grateful to all our faithful alumni and friends for their continued support!

Undergraduate Student Scholarships: \$84,250

Undergraduate scholarships are awarded directly to our individual students majoring in Chemistry. The funds are commonly used by the students to pay tuition, room and board expenses, and to purchase textbooks.

Graduate Student Fellowships: \$33,000

Graduate student fellowships help pay student stipends so that they may concentrate on their research projects.

General Departmental Support: \$150,450

General departmental support is critical to the operation of our department, and is used to pay for seminar speakers, faculty travel to conferences, startup funds for our new faculty, and matching funds for large equipment grants.

Chemistry Instrumentation Support: \$520

These funds are used to help maintain our chemical instrumentation for use in both teaching and research. Due to recent budget challenges, they are now also used to help pay the salaries of our skilled instrumentation support staff.

News from Our Research Groups

Analytical

Jun Li's group continues to work on developing new nanotechnologies for cancer diagnosis, next-generation batteries, and fuel cell catalysts. These projects are supported by NIH, the Johnson Cancer Center at KSU, the NSF, and the DOE and led to 11 publications and 2 patents in the last year. Takashi Ito and Dan Higgins renewed their joint DOE grant, which funds molecular-level investigations of diffusion within cylindrical nanoscale pores. Their groups published an invited fundamental review on optical microscopy studies of polymeric materials in *Analytical Chemistry*.

Inorganic

Tendai Gadzikwa and her group continue their NSF-funded work on "Enzyme-Inspired Catalysis in Multifunctional Metal-Organic Framework Materials", and recently had their first manuscript accepted for publication in *Inorganic Chemistry*. The Sues group continues their work in the fields of olefin metathesis, small molecule activation, and electrochemistry developing novel ligand architectures and inorganic/organometallic complexes. The Aakeroy group's collaborative project supported by the ARO received funding for another year. Their work developing new technologies for improved shelf life and delivery of a well-known fertilizer continues to receive recognition in "general interest" publications, on the web, and in the technical scientific literature.

Organic

Santosh Aryal's group continued their work developing biomimetic nanomaterials for tumor-targeted drug delivery, resulting in 4 publications during the past year. In addition to projects supported by NIH and NSF, Ping Li's group has made progress on identifying biological substrates of N-terminal methyltransferase 1, a PTM enzyme involved in many cancers and developmental diseases. The results have been recently submitted to *Chemical Science*. Members of Duy Hua's lab are working on several NIH and NSF funded projects. One involves the design and synthesis of environmentally friendly chiral polymers to stabilize bimetallic nanoclusters as chiral catalysts used in the asymmetric oxidation of alkenes and C-H bond oxidation of cycloalkanes or natural products. The methods produce novel drug-like molecules. Stefan Bossmann continues to develop nanomaterials for early-detection and treatment of pancreatic cancer and glioblastomas in work supported by NSF, NIH, the Johnson Cancer Center at KSU, and the KU Cancer Center. He is also the only active researcher in a Chemistry Department in the US with funding from the National Endowment for the Arts, with Jason Sculla (Art). Ryan Rafferty and his group continues their efforts toward the re-design of therapeutic agents and the total synthesis of bioactive natural products, resulting in 4 publications. They are also constructing new chaperone-like small molecules to facilitate compound transport across the blood-brain barrier and bacterial membranes, in work recently funded by the NSF.

Physical

Christine Aikens and her group are working on several DOE and NSF funded projects that focus on understanding the optical properties, luminescence, and electron dynamics in gold and silver nanoparticles. Paul Smith and his group continue to work on projects funded by the NIH, and the Keck Foundation, exploring the effects of solvents and cosolvents on the structure and dynamics of biomolecules in solution. Viktor Chikan and his group have shown that ultrasound generated by high frequency magnetic pulses can be used to trigger drug release from magneto-liposomes for cancer treatment. Ryszard Jankowiak and his group published 9 papers this past year, and received renewed funding from the DOE for their studies of the spectroscopy and photophysics of light harvesting antennas and photosynthetic reactions centers.

Recognition and Awards

Faculty	Graduate Students
<p>Stefan Bossmann: Named University Distinguish Professor, July 2019</p> <p>Takashi Ito: Ervin W. Segebrecht Distinguished Faculty Achievement Award, 2019</p> <p>Michael Hinton: Department of Chemistry Distinguished Service Award, 2018</p> <p>James Hodgson: Department of Chemistry Distinguished Service Award, 2018</p> <p>Ryszard Jankowiak: Olin Petefish – Higuchi/KU Endowment Award in the Basic Sciences, 2019</p> <p>Ryan Rafferty: National Science Foundation CAREER Award, 2019</p>	<p>Lauren Chlebanowski (Bossmann): PLU Award</p> <p>Herman Coceancigh (Ito) and Mahboobe Jasses (Jankowiak): Graduate Research Award</p> <p>Tuyen Nguyen (Aryal): Mitsugi Ohno Award</p> <p>Zeinab Harandizadeh (Ito): Meloan Award in Analytical Chemistry</p> <p>Obdulia Covarrubias-Zambrano (Bossmann): Chemistry Alumni Award</p> <p>Elizabeth Goentzel (Sues) and Olivia Hull (Aikens): PLU Classroom Performance Award</p> <p>Olivia Hull (Aikens): Department of Energy Computational Science Graduate Fellowship</p> <p>Sagar Rayamajhi (Aryal): First Place poster presentation at the K-State GRAD Forum.</p> <p>Elizabeth Goentzel (Sues): Scott Fateley Memorial Award</p> <p>Wasandra Hulangamuwa (Rafferty): Fateley-Hammaker Collaboration Award</p> <p>Nandini Sarkar (Aakeröy): John Berschied and Donna Derstadt Fellowship</p> <p>Gowri Kuda (Aikens): Jerry and Judy Reed Fellowship</p> <p>Anthony Fatino (Rafferty): Noticxe Fellowship</p>
<p style="text-align: center;">Undergraduate Students</p> <p>Sonia Barrett (Bossmann) and Danica Smith (Culbertson): PLU Undergraduate Research Award</p> <p>Erin Meyers and Makena Utech: Senior PLU Classroom Performance Award</p> <p>Ethan Kallenberger and Abigail McCormick: Junior PLU Classroom Performance Award</p> <p>Marcel Chlupsa and Douglas Farleigh: Sophomore PLU Classroom Performance Award</p> <p>Josh Habiger and Carson Orr: Freshman PLU Classroom Performance Award</p>	<p>Cover Photo: Students graduating with degrees in Chemistry, along with Professors Rafferty and Higgins. May 2019 spring commencement ceremony. Photo Credit: facility staff.</p>