

KSU CHEMIST



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Reach out to us at:

WEB: www.ksu.edu/chem

Phone: 785-532-6665

E-Mail: chemdept@ksu.edu

Twitter: @KStateChemistry

From the Department Head

Dear Friends:

As I write this short introduction to our 2020 newsletter, we are just beginning to reawaken research in our department from an ~10 week long hibernation resulting from the COVID-19 pandemic. These last three months have been nothing less than unprecedented. Everything was operating as usual when spring break started in early March. Then, as the break came to an end, the university administration described concerns that most of us had also recognized: bring more than 20,000 students back to campus from all over the world was a serious risk. What began as a brief delay in the return of our students quickly morphed into plans to shift to all remote (online) instruction for the remainder of the semester, with most students remaining at home. Very few of us had much experience teaching online classes. Nevertheless, everyone quickly looked at the different possibilities and settled on methods that seemed to work for each of us. Our students recognized the challenges we were all facing and worked

very hard to achieve a strong finish to the semester. While there were a few problems here and there as things changed dramatically over the course of only a few days, it appears the semester ended on a positive note, and many of us are justifiably proud of what we were able to accomplish.

Research, on the other hand, took a serious hit, with lab work on campus shutting down in March as well. The vast majority of us worked from home for the duration. While it was a good time to read and write, much less real progress can be made without access to our labs. Everyone seems very excited to return to campus and we all believe this can be done safely. With fewer than 90 people working in facilities that provide almost 1000 sq. ft. per person, we should be able to properly socially distance. With plans to wear masks in common spaces and to routinely disinfect surfaces, our goal is to reopen with no negative consequences. Wish us luck!

David A. Higgins

COVID-19 Related Projects in the Department of Chemistry

The coronavirus SARS-CoV-2 is the most threatening pathogen since the 1918 H1N1 pandemic. In the Chemistry Department, three research groups have worked on methods for either detecting or treating SARS-CoV-2 and related coronaviruses.

Santosh Aryal. Dr. Aryal and his K-State collaborators received NSF funding to explore the interactions of coronavirus lipid, protein and on copper and copper/zinc oxide coated personal protective equipment surfaces and their relationship to viral infectivity.

Stefan Bossmann. Current coronavirus diagnostics identify active cases using polymerase chain reaction (PCR)-based tests. However, there is a need for a diagnostic test that can measure the activity of SARS-CoV-2 in mammalian (or human) hosts. The Bossmann group is developing ultrasensitive Fe/Fe₃O₄ core/shell nanoparticle-based nanobiosensors for use in COVID-19 assays that will measure the activity of viral proteases that are mandatory for coronavirus proliferation. *In-vitro*, *in-vivo* (mouse model), and clinical studies will be performed at the University of Texas Medical Branch Galveston National Laboratory, which is one of the leading institutions in research on viral pathogens.

Duy Hua. The Hua group has collaborated with researchers in the K-State College of Veterinary Medicine, at Wichita State University, and at the Ohio State University to discover broad-spectrum antivirals targeting coronaviruses. Together they hold a patent (US 9,474,759 B1) that has been licensed to Cocrystal Pharma, Inc. for use in possible COVID-19 drugs. In collaboration with Govindsamy Vedyappan, Duy Hua has just filed an invention disclosure on the development of drimane sesquiterpenes for use as potent antiviral drugs.

Ping Li. The Li research group is working to develop inhibitors that not only prevent viral entry into host cells, but also allow recruitment of the human ubiquitin-proteasome system to degrade the virus if it finds its way into the cells. This represents a new way to potentially eradicate the virus. Novel SARS-CoV-2 enters host cells via a viral spike glycoprotein, S-protein. The heptad repeat 1 (HR1) of the S-protein was selected for inhibition as it is less susceptible to mutation. Known HR1 inhibitors are being modified to improve their cell permeability and to allow recruitment of E3 ubiquitin ligase for viral deactivation at a low dosage. The efficiency of this approach will be determined first using the S-protein fused with a fragmented green fluorescence protein (GFP), and then using infections with a pseudovirus and SARS-CoV-2 through collaboration.

Word from the Glass Shop

Location, location, location. The work began with a call from former Kansas State engineering student Michael Cochran. He was seeking help with a glass water/oil separator for essential oil distillation. The tricky part was that the separator would be used by the Meyah indigenous people of Papau, Indonesia. Access to the area requires a one-day jeep ride, if the roads are passable, followed by a one-day hike on foot. This is not a place to be using fragile glassware, particularly with no scientific glassblower anywhere nearby! The essential oil was being distilled from Vetiver root. The Vetiver plant plays an important role in the lives of the Meyah. The deep roots of the Vetiver plant help mitigate soil erosion on slopes of up to 70 degrees in an area with mountains over 16,000 feet tall and tropical rainfall. The essential oil that can be distilled from the roots is used in 90% of perfumes and is comprised of over 150 aromatic compounds. Clearly, it represents a potential source of important income for the Meyah!



This project involved creating a robust alternative design to replace fragile glassware. The material forming the body of the separator was changed to stainless steel, which is easily cleaned, relatively inexpensive, strong, and readily available. However, a transparent sight glass with a side port to remove the oil is still required. This part of the project required adding a hose barb to a very short (10 cm long), very heavy walled (5 mm) glass cylinder. Longer stock tubing was also unavailable. Standard glassblowing procedures just don't work well with such short tubing. The solution was to attach handles on each end by cold sealing, attach the hose barb and then



remove the handles. Photographs of the completed sight glass and the full separator are shown on the left and right. This was a particularly rewarding project where K-State connections allowed us to help people in a remote location on, literally, the other side of the world!

James Robert Hody

Undergraduate Scholarships Awarded for 2020-2021

Benjamin Biggs, Manhattan: the Jack and Betsy Lambert Scholarship

Marcel Chlupsa, Manhattan: the Jack and Betsy Lambert Scholarship

Amanda Currie, Garden City: the M. Dale and Janet Hawley Scholarship

Tyler Davis, Wakarusa: the Dow-KSU Alumni Scholarship and the Joseph V. Paukstelis Memorial Scholarship

McKenzie Dalby, Burlington: the Jack and Betsy Lambert Scholarship

Taylor Davison, Salina: the Jerry P. and Geraldine L. Hefling Scholarship

Jane Eilers, St. Charles, MO: the Lewis A. and Opal D. Gugliemelli Memorial Scholarship in Chemistry

Douglas Farleigh, Olathe: the Eugene E. Howe Scholarship and the George and Linda Hawks Scholarship

Daniel Hubin, Weatherford, OK: the Lewis A. and Opal D. Gugliemelli Memorial Scholarship in Chemistry

Samantha Jenkins, Olathe: the Dr. Duane L. and Virginia Eddy Barney Scholarship and the H. H. King Memorial Scholarship

Carissa Jonak, Grand Island, NE: the Raymond A. Voet Chemistry Scholarship

Joseph Kempin, Olathe: the H. H. King Memorial Scholarship and the Jack and Betsy Lambert Scholarship

Logan Kleinsorge, Gardener: the Jack and Betsy Lambert Scholarship

Caleb Kline, Salina: the Jack and Betsy Lambert Scholarship

Karrin Larson, Clay Center: the George and Linda Hawks Scholarship and the Manzo-Lathrop Chemistry Scholarship

Elizabeth Linenberger, Great Bend: the Jack and Betsy Lambert Scholarship

Nathan Marshall, Hutchinson: the Douglas L. Nelson Chemistry Scholarship

Trae Megaffin, Hays: the Richard J. Van Winkle Memorial Scholarship

Avery Miller, Overland Park: the Jack and Betsy Lambert Scholarship

Carson Orr, Wichita: the Chemistry Undergraduate Academic Scholarship and the Jack and Betsy Lambert Scholarship

Rachel Pang, Overland Park: the Isobel and Dale Smith Chemistry Scholarship

Marcus Schmeidler, Great Bend: the Jack and Betsy Lambert Scholarship

Mario Schneider, Olathe: the Jack and Betsy Lambert Scholarship

Chahat Sehgal, Nevada, MO: the Future Chemists Scholarship

Emma Spartz, Ellington, CT: the Herbert C. Moser Scholarship

Jacob Suiter, Macksville: the Philip A. Van Winkle Memorial Scholarship and the Travis W. Miller Memorial Scholarship

Kylee Trout, Scott City: the Georganne Fowler Hiser Chemistry Scholarship

Fiona Turner, Gardner: the Jerry and Judy Reed Chemistry Scholarship

Brooke Vogt, Manhattan: the Nancy Mundwiler-Peters and Bruce Peters Chemistry Scholarship

Lex West, Manhattan: the Jack and Betsy Lambert Scholarship

Gage Wright, Derby: the Baldwin Reinhold, Jr. Undergraduate Scholarship in Chemistry and the Jerry

A Note of Thanks

Our department presently awards 25-26 distinct, named scholarships to undergraduates. The total amount awarded is usually well over \$100,000 each year. This provides valuable assistance to our students, which is greatly appreciated. In some cases, it helps to reduce the amount of time a student must spend working outside of school to meet their educational and living expenses, allowing them to concentrate more on their studies. In other cases, this assistance allows them to borrow less money for their education, helping them more quickly reach financial security after graduation. In still other cases, it may allow them to enroll in additional courses that they could not otherwise afford to take, broadening their knowledge, better preparing them for more diverse careers, or simply making them more well rounded students. Our students are all very honored to receive these scholarships and are grateful to all those who have given generously to establish these valuable educational aids. From all of our students and faculty, *thank you* for all you have done to facilitate learning at Kansas State University!

A Timely Retirement and Move to Manhattan

Prof. Jeffrey Petersen

In the fall of 2019, we found ourselves unexpectedly short by one faculty member to meet our teaching needs. As luck would have it, Dr. Jeffrey Petersen, Professor Emeritus in the Department of Chemistry at West Virginia University had contacted us several months beforehand to let us know that he and his wife were retiring to Manhattan. He wanted to establish a connection with our department. Of course, having just retired, we doubt he was really looking for work, but when we asked him about possibly teaching a graduate course for us for one semester, he jumped at the chance. In fall 2019, he taught CHM 862: Organic Spectroscopy with an enrollment of 15 graduate students. This was a new course for him, but his students seem to have thoroughly enjoyed the course and his decidedly student-centered approach! Jeff spent his entire career on the faculty at West Virginia University, having completed his Ph.D. with Prof. Larry Dahl at the University of Wisconsin-Madison, followed by brief periods as a Research Associate and Visiting Scholar at Argonne National Labs and Northwestern University, respectively. Jeff is now a regular attendee at departmental functions. We have enjoyed getting to know him and look forward to interacting with him on campus and around town for many years to come!



Recent Graduates

Bachelor of Science

Fatimah Ali Al Ibrahim
 Cesar Benjamin Aparicio
 Sonia Maria Barrett
 Kayla Alicia Davis
 Camila Andrea Faundez Inostroza
 Lauren Foley
 Jared Daniel Hague
 Joseph Lane Hammer
 Adam Sinderson Huber
 Courtney Johnson
 Ethan Kallenberger
 Tanji Renee Lewis
 Abigail Anne McCormick
 Maria Luiza Montes-Gonzalez
 Reagan Keely Montre
 Mikaela Marie Moore
 Nicole Christine Ohlde
 Alec Preston Pendergrass
 Samantha Pilcher
 Kaitlynn Reece Simms
 Danica Ocanne Denise Smith
 Tingrui Zhang

Graduate Degrees

Casey A. Ackley, M.S.

Major Prof: Peter Sues
 Title: Biologically Inspired Calixpyrrole Ligands for Nitrogen Reducing Catalytic Complexes.

Judith Bautista Gomez, Ph.D.

Major Prof: Daniel Higgins
 Title: Fluorescence Studies of Aldol Catalysis and Vapor Plotting of Chemically Graded Films.

Laszlo Bodnar, M.S.

Major Prof: Viktor Chikan
 Title: Manipulation of Magnetic Nanoparticles with Rotating and Pulsed Magnetic Field.

Herman Coccoancigh, Ph.D.

Major Prof: Takashi Ito
 Title: Material Modification and Characterization Based on Small Molecule Diffusion.

Obdulia Covarrubias, Ph.D.

Major Prof: Stefan Bossmann
 Title: Development of an Effective Cell Penetrating Peptide: Towards Viable Approaches to Gene Delivery and Chemotherapy Against Cancer.

Govinda Ghimire, Ph.D.

Major Prof: Takashi Ito
 Title: Charge Transport and Molecular Diffusion within Self-Assembled Nanostructures.

Zeinab Harandizadeh, Ph.D.

Major Prof: Takashi Ito
 Title: Application of Block Copolymer Thin Film as a Platform for Electroless Deposition and Biosensor.

Chathurangani Wasundara Hulangamuwa, Ph.D.

Major Prof: Ryan Rafferty
 Title: Synthetic Efforts Towards the Natural Products Brocazine F and G.

Mahboobe Jassas, Ph.D.

Major Prof: Ryszard Jankowiak
 Title: Excited-State Structure and Energy-Transfer Dynamics in Various Photosynthetic Antenna Complexes: Hole Burning and Modeling Studies.

Levon LeBan II, M.S.

Major Prof: Jun Li
 Title: Microwave-Assisted Synthesis of Reduced Graphene Oxide and Vanadium Pentoxide Hybrid Materials for Enhanced Performance in Next Generation Batteries.

Nilusha Lakmali Kariyawasam

Manachchige, Ph.D.
 Major Prof: Paul Smith
 Title: Computer Simulations of Small Molecules and Proteins in Solution.

Nandini Sarkar, Ph.D.

Major Prof: Christer Aakeröy
 Title: Supramolecular Chemistry from Small Molecules to Cavitands: Predictive and Experimental Approaches.

Giving to the Chemistry Department

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

Total giving to the Department of Chemistry from June 1, 2019 to May 31, 2020, 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: \$46,500

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: \$14,860

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

General Departmental Support: \$101,500

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

Chemistry Research Support: \$755

These funds are used to help maintain our research infrastructure by paying for incidental instrument repairs and purchasing replacement parts, upgrades, and general supplies, when not supported by grants or user fees.

News from Our Research Groups

Analytical: Chris Culbertson and his group continue their work in the development of microfluidic devices for use in single cell analysis and cancer diagnosis. Judith Bautista Gomez in the Higgins group, and in collaboration with researchers from Chemical Engineering, completed a lengthy project on the design, synthesis and characterization of a new fluorescent dye for use in single molecule detection studies of Aldol condensation reactions. Takashi Ito's group continues their work supported by DOE and NSF that aims to thoroughly understand nanoconfinement effects on chemical processes such as mass/charge transport and chemical recognition. Jun Li's research on nanotechnologies has been recognized by his election in 2019 to the National Academy of Inventors and through awards to group members, including a postdoctoral fellowship by Translational Research Institute of Space Health (TRISH) to Dr. Morgan Anderson, Meloan award to Ayyappan Elangovan and PLU undergraduate research award to Gage Wright.

Inorganic: The Aakerøy group recently licensed "CoForm", a user-friendly software application that facilitates the development of new solid forms of high-value chemicals important to the pharmaceutical, agrochemical, food, and fragrance industries. In collaboration with the Department of Agronomy (funded by Global Food Systems), the group is building a sustainable technology for delivering fertilizers to soil solutions in a controlled and responsive manner. Tendai Gadzikwa and her group continue their NSF-funded work on enzyme-inspired catalysis. They published two papers on synthesis strategies for metal-organic framework (MOF) materials in the past year. Kanchana Samarakoon won a poster prize from the Virtual Systems Chemistry Symposium held in place of a canceled Gordon Research Conference and also presented to 220 people on the last day of the meeting. The Sues group has made significant progress in developing novel ligand architectures for small molecule activation and olefin metathesis, and continues towards their goal of developing more sustainable catalysts.

Organic: Santosh Aryal's group continued their work developing biomimetic nanomaterials for tumor-targeted drug delivery, resulting in 8 publications during 2020. The Bossmann group is designing and synthesizing peptides and peptide-based biomaterials for nanoparticle-based nanobiosensors for protease detection and drug delivery to adrenal tumors, glioblastoma and pancreatic cancer, methylation markers in epigenetic studies, and isoelectric focusing devices. They continue to develop ultra-high field MRI methods for cancer imaging, as well as NMR-quantification of neurotransmitters in rodent brains. Mark Hollingsworth recently returned from his sabbatical at the Stanford Synchrotron Radiation Lightsource. He and his group focus on synchrotron studies of phase transitions in channel inclusion compounds and on obtaining the crystal structure of true polyacetylene. With support from the NIH and NSF, the Duy Hua group has synthesized and evaluated a class of tricyclic pyrone (TP) molecules using Alzheimers transgenic rats. Treatment using TP molecules produced significant memory improvements in water maze and step-through passive avoidance tests without causing seizures or brain excitotoxicity. Ping Li's group continues their NIH and NSF funded work on polyhydroxyalkanoate (PHA) biosynthesis and dye-decolorizing peroxidases. Their PHA project to understand the bacterial synthesis of biodegradable plastics will be highlighted on the Biomedical Beat Blog in June. His recent publication (*Chem. Sci.* **2019**, *10*, 8094) on protein N-terminal methyltransferases (NTMTs) was selected as a cover article. The Ryan Rafferty lab has continued their efforts in the development of new compounds for the selective transport of chemotherapeutics across the blood-brain barrier and into gram-negative bacteria. In collaboration with the Chikan group, they have developed a new method for the enhanced delivery of anticancer agents to cancerous cells with the use of nanoparticles and inhomogeneous magnetic fields.

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. The Chikan group, in collaboration with the Rafferty group has developed a novel methodology for delivery of drugs to cancer cells utilizing pulsed magnetic fields; a patent is pending on this work, which has also been published. The Chikan group also published in collaboration with ELI-ALPS, the first civilian large-scale high-power laser research facility, in Szeged, Hungary. 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 mutated light harvesting antennas and photosynthetic reactions centers. 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.

Recognition and Awards

Faculty	Graduate Students
<p>Christine Aikens: Named University Distinguish Professor, July 2020. 2020 Rising Star Award, Women Chemists Committee, American Chemical Society</p> <p>Viktor Chikan: Ervin W. Segebrecht Distinguished Faculty Achievement Award, 2020</p> <p>Daniel Higgins: 2019 E. Ann Nalley Volunteer Award</p> <p>Jun Li: Elected Fellow of the National Academy of Inventors, 2019</p> <p>Yasmin Patell: Department of Chemistry Distinguished Service Award, 2019</p> <p>Ryan Rafferty: Promotion to Associate Professor with Tenure, July 2020</p>	<p>Judith Bautista Gomez (Higgins): PLU Award</p> <p>Gowri Kuda-Singappulige (Aikens) and Sagar Rayamajhi (Aryal): Graduate Research Award</p> <p>Kanchana Samarakoon (Gadzikwa): Mitsugi Ohno Award</p> <p>Ayyappan Elangovan (J. Li): Meloan Award in Analytical Chemistry</p> <p>Viraj DeSilva (Aakeröy), Asantha Fernando (Rafferty), Shana Havenridge (Aikens), Shashika Perera (Rafferty), Omid Shafiee (Chikan), Shin Suh (Smith), Vinusha Wickramasinghe (Smith): PLU Graduate Classroom Performance Award</p> <p>Ayyappan Elangovan (J. Li): KSU International Leadership Award</p> <p>Olivia Hull (Aikens): Department of Energy Computational Science Graduate Fellowship</p> <p>Shana Havenridge (Aikens): Scott Fateley Memorial Award</p> <p>Jose Covarrubias (Bossmann): Fateley-Hammer Collaboration Award</p> <p>Amila Abeysekera (Aakeröy): John Berschied and Donna Derstadt Fellowship</p> <p>Kayla Eschliman (Bossmann): John Berschied and Donna Derstadt Fellowship</p> <p>Basanta Acharya (Chikan): Jerry and Judy Reed Fellowship</p> <p>Vinu Panikkattu (Aakeröy): Noticxe Fellowship</p>
Undergraduate Students	
<p>Joseph Hammer (Bossmann), Mikaela Moore (Ito), and Gage Wright (J. Li): PLU Research Award</p> <p>Abigail McCormick and Danica Smith: Senior PLU Classroom Performance Award</p> <p>Marcel Chlupsa and Nathan Marshall: Junior PLU Classroom Performance Award</p> <p>Carson Orr and Chahat Seghal: Sophomore PLU Classroom Performance Award</p> <p>Karrin Larson and Rachel Pang: Freshman PLU Classroom Performance Award</p>	
<p>Cover Photo: Many of our departmental scholarship winners. November 2019 scholarship banquet. Photo Credit: Ryan Rafferty.</p>	