the TEST TUBE

THE NEWSLETTER OF THE DEPARTMENT OF CHEMISTRY & BIOCHEMISTRY

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THE CHEMISTRY BUILDING CIRCA 1930

AN EYE TO THE FUTURE

One of the original Texas Tech University buildings, the Chemistry building was constructed in 1929 and then expanded to its current size in 1971. With the most recent renovations to the original building in 1989, the building as a whole is starting to show its age. The saying goes that "Beauty is skin deep, but its what's inside that counts". The Chemistry building has maintained its outer architectural beauty, but the infrastructure inside the building is in many cases embarrassingly dated and not keeping pace with current needs.

In talks with our building supervisor, Jerry Walton, it is abundantly clear that building updates and remodels will be necessary to continue conducting both high level research and education. From the old backup generators, to the outdated building power system, maxed out air flow systems, and outdated and near capacity undergraduate teaching labs, things have to change not only for aesthetic reasons, but for student safety and effective teaching and research as well.

To help tackle some of these issues the department has begun a gradual process of renovating student labs and classroom spaces with an eye to the future (as funds become available). During the spring and summer of 2017, work was completed on renovations to the Inorganic Chemistry teaching laboratory and our largest lecture hall. In the Inorganic teaching lab, fume hoods, glove boxes and floors were replaced and updated. In CHEM 049 (large lecture hall) a renovation has added ADA accessibility and modern teaching tools, bringing it up to the standard of a "Raider Room". Funds for both projects came from state and university funds which were instrumental in completing these updates.

To continue the work that has been started, proposals for future renovations to the department have been requested and received from our faculty and staff. These proposals are expected to help position the department to be competitive in the current and future environment of federal research funding, while simultaneously providing our undergraduate and graduate students with the knowledge and skills to be competitive in the global job market.

...CONTINUED INSIDE

One of our current organic teaching labs. We have 17 labs for teaching general, organic, and more advanced chemistry lab courses that are mostly in a similar condition with the exception of one inorganic lab recently remodeled (seen on the next page).

TEXAS TECH UNIVERSITY
Department *of* Chemistry & Biochemistry

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AN EYE TO THE FUTURE

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Although using state and university funds has allowed us to schedule updates to several classrooms and labs, it will take us a long time to get where we need to be without additional funding. The following proposed projects represent the department's views on where we think the biggest impacts can be made immediately.

SHARED MATERIALS CHARACTERIZATION LABORATORY

Creation of a comprehensive Materials Characterization facility within the department that will provide access to a wide range of materials characterization techniques. The aim is to foster a more collaborative approach to research and facilitate research at the interface of disciplines. For this purpose, it would be advantageous to have a shared characterization lab that includes consolidating/upgrading of existing instruments plus strategic new equipment acquisitions. To accomplish this some existing instruments would be upgraded or repaired at an estimated cost of $25,000 and new instruments would be acquired to add TGA, DSC, porosity measurement, microwave synthesis, and modern FT/IR, UV/vis, spectrofluorometry, and circular dichromism instrumentation.

UPDATED INSTRUMENTAL ANALYSIS LABORATORY

Upgrading the Instrumental Analysis Teaching laboratory would involve the purchase or acquisition of modern laboratory instrumentation to replace aging and defunct equipment, along with updates to the lab fixtures. This lab is utilized by all Chemistry and Biochemistry majors and exposes them to an array of techniques that are essential to their future careers in industry or graduate studies. The primary instrumentation needs are for a microwave plasma atomic emission spectrometer, UV-Vis/Fluorescence dual system, and a potentiometry system. Funds to replace and upgrade these instruments would allow the department to not only transform the analytical course curriculum for undergraduate students, but would also improve our overall research capabilities

UPDATED BIOCHEMISTRY SHARED LABORATORIES

Renovations to the Biochemistry common laboratory spaces would involve updating three separate laboratory spaces. These labs are currently utilized by a quarter of our departmental research groups and are also used as a preparatory lab for the Biochemistry teaching laboratory. The goals of renovation would be to use space more efficiently and improve safety in the shared use labs. To accomplish this we will need to completely renovate the three labs, which includes removing unneeded cabinets, replacing flooring, benches, and storage and upgrade of electrical service).

SHARED NMR INSTRUMENT MAINTENANCE

Improvements to the maintainability of our shared use NMR (Nuclear Magnetic Resonance) instruments is of great concern to us. We currently have two JEOL 400 MHz NMR's and a Varian 500 MHz NMR spectrometer that are for shared usage for a wide range of research and teaching of organic and inorganic chemistry labs. These are complex instruments that have had their share of breakdowns recently. We'd like to purchase extended service contracts for the newer 400 MHz instruments so that we can have assurance of their continued availability for research and teaching purposes. The 500 MHz instrument is nearing the end of its useful life and we would like to be able to replace it with a newer system in the future.

OTHER RENOVATIONS

Finally, renovations to common spaces within the Chemistry and Biochemistry building are currently being investigated for feasibility and overall building enhancement. One of the main emphases would be on updating our aging periodic table display case and replacing it with a custom electronic periodic table display from RGB Research Ltd. If you haven't had the opportunity to view one of their interactive periodic tables before, you should visit their website (http://www.periodictable.co.uk/). Also, in our current age of electronic gadgets and mobile computing, having the ability to "plug-in" is becoming more important for students than ever. To this end, replacing outdated furniture with power capable tables and chairs throughout the study areas within the building and boosting the Wi-Fi signal throughout the building are also proposed projects as well. ■

Professor Jon Thompson – Personal Environmental Exposure Monitoring

Empirical evidence suggests low-level chronic exposure to particulate pollution may have profound effects on human health. Some estimates suggest a global burden of 4.2 million pre-mature deaths due to particulate pollution for the year 2015. Future projections suggest outdoor air pollution could cause 6-9 million premature deaths annually, at a financial cost of 1% of G.D.P by 2060. It is known from laboratory studies that particles and pollutant gases illicit cellular-level inflammation responses, induce apoptosis, and contribute towards ROS formation. More recent data suggests that ultra-fine particles smaller than approx. 40 nm in diameter may be able to directly enter the bloodstream, or even the brain after exposure. In the past, human exposure to airborne pollution has been estimated through spatial and temporal extrapolation from urban pollution monitoring networks. However, many municipalities have fixed-point sensors that are far too few in number and sampling frequency to adequately describe individual exposure for epidemiological studies. By developing inexpensive (<$200 per unit) and fully portable ozone and PM2.5 sensors that allow real – time personal exposure monitoring, Prof. Thompson and co-workers have made possible *personal* exposure monitoring. Initial results [1-3] have suggested that an individual's exposure to pollutants is highly circumstantial, and difficult to predict through using fixed point urban monitors. While ozone exposure was generally highest when outdoors, the highest exposure to particulate matter usually occurs indoors when in the vicinity of cooking operations. Future work can address improvements to sensor technologies and foster more widespread implementation of personal monitoring networks.

1. Cao, T. and J.E. Thompson "Personal Monitoring of Ozone Exposure: A fully portable device for under $150 USD cost." *Sensors & Actuators B*, 2016, 224, 936–943.
2. Cao, T. and J.E. Thompson "Fully Portable Personal Monitoring of $PM_{2.5}$ for Health and Exposure Studies." *Anal. Lett.* 2017, 50(4), 711-722.
3. J.E. Thompson "Crowd-Sourced Air Quality Studies: A Review of the Literature & Portable Sensors." *Trends in Environ. Anal. Chem.* 2016, 11, 23-34.

OTHER **NEWS**

SWRM in Lubbock!

By Robert D. Long, Ph.D. Councilor, South Plains ACS and Associate Director, TTU Chemistry & Biochemistry

The American Chemical Society (ACS), with sponsorship from the TTU Provost, VP Office of Research, and our department plus Bayer CropScience and others, recently hosted the ACS Southwest Regional Meeting in Lubbock this fall (Oct 29-Nov 1).

The venue was the beautiful Overton Hotel & Convention Center, located within a couple blocks of the TTU campus. The Overton Park area is located east of campus (between 4th and Broadway) and has been undergoing extensive private development over the past decade. It was a convenient and modern location for the event with various restaurants and attractions within walking distance. Overall, the SWRM Board reported multiple positive comments about the conference.

SWRM 2017 was well attended by visitors from Universities and Colleges across Texas, New Mexico, and Oklahoma in particular. It also gathered visitors from other states and all were invited to tour the TTU campus and Department of Chemistry & Biochemistry while here. An evening event at the Buddy Holly Center in Lubbock was also included. Estimated attendance at the event was ~640 and included 19 High school students and teachers, 108 Undergraduate students, 156 Graduate students, and 31 Postdocs (unofficial counts).

Our department's faculty and students presented 40 oral presentations, 25 posters, and 4 undergraduate research posters. This was a wonderful opportunity for us to showcase our research and interact with regional colleagues.

Oh the Places You'll Go!

This past spring, senior biochemistry major Amanda Miller was selected for the prestigious Harvard Amgen Scholar program. Of the twenty students selected this year, Ms. Miller was the only student from Texas to be selected. This award allowed her the opportunity to spend 10 weeks conducting research within the Sensor Group under the mentorship of Olivier Henry (Ph.D.) and Don Ingber (M.D., Ph.D) within the Wyss Institute.

Amanda is currently finishing up her senior year and has been broadly applying to various MD/PhD programs across the country and hopes to become a physician scientist. Outside of the typical course work and her current undergraduate research with Prof. Dominick Casadonte, Amanda is also currently drafting a sci-fi novel exploring the ethics in biotechnology research for her Honors College thesis that she hopes to publish.

Read more about Ms. Miller's experience at http://today.ttu.edu/posts/2017/08/amgen-scholar.

Prof. Andrew Harned named Assoc. Editor

Prof. Andrew Harned has been named an Associate Editor and member of the chemistry Editorial Board for Royal Society Open Science (http://rsos.royalsocietypublishing.org), a multidisciplinary open access journal, covering 12 subjects across all of science, engineering and mathematics. Although the Royal Society owns the journal, the chemistry content is published in collaboration with the Royal Society of Chemistry. Of particular note, Prof. Harned will be the journal's first Associate Editor for chemistry content to be based in the United States. He is Editor of the book Nonnitrogenous Organocatalysis, which will be published by CRC Press in 2018.

THE COINAGE METALS **DONATION PAGE**

As with any remodeling project, funds are a necessary part of the equation and it is not always possible to do everything at once. While we have been extremely appreciative of previously received monies for small projects from the University, we are looking towards the future and what would be possible with more of our proposed projects finished and being fully utilized by our undergraduates, graduate, faculty, and staff. As we continue to strive for student excellence and research recognition, your support is always appreciated and will be used to the fullest.

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For an extended list, please see our website: *www.depts.ttu.edu/chemistry/departmental/donation.php*

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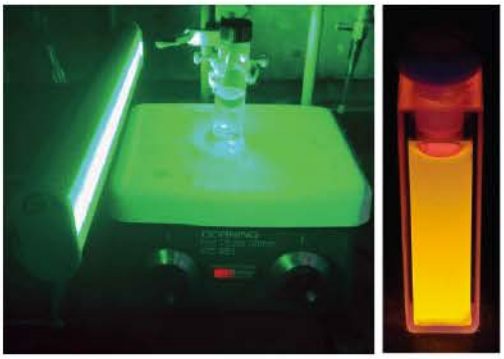
DEPARTMENT **RESEARCH BRIEFS**



Light-driven reactions provide a new mechanism to effect organic chemistry. 525 nm LED light source used for reaction in photo.

Collaboration Lights the Way!

A collaborative effort involving four faculty members has demonstrated that copper complexes under LED irradiation can catalyze reactions in organic chemistry.

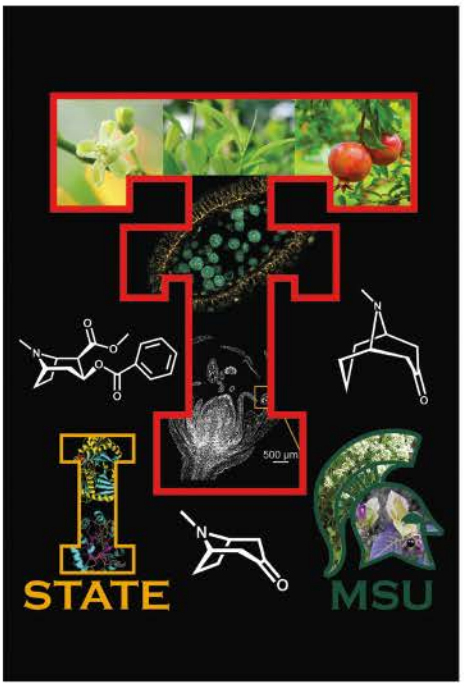
Professors Casadonte, Cozzolino, Findlater and Mayer recently joined forces to explore the use of copper phenanthroline complexes in catalyzing the atom transfer radical addition (ATRA) reaction between carbon tetrabromide and styrene (Dalton Trans. 2017, 6553-6569). The project made use of the PIs expertise in synthesis, theory, photophysics and catalysis and included graduate student co-authors. "This kind of comprehensive study is only possible when researchers with complementary skill sets come together," says Findlater, "the use of photophysics and theoretical calculations allowed an unprecedented level of insight into the behavior of the copper-based catalysts that had been lacking from the literature" Findlater added. The authors plan to build on this preliminary work and pursue external funds to support future collaborative efforts.

Collaborative Study of Alkaloid Biosynthesis

Prof. John D'Auria joins forces with researchers at Iowa State University and Michigan State University

NSF grant funding has fostered a collaboration involving a systems approach to the study of tropane and granatane alkaloid biosynthesis. Tropane and granatane alkaloids contain a core bicyclic ring structure and appear scattered across unrelated plant families. The research project will utilize a top down approach of combined transcriptomics and metabolomics coupled with comparative functional, biochemical and structural biology based approaches to elucidate the pathways and mechanisms that underlie the biosynthesis of the pharmaceutically important tropane and granatane alkaloids. Gene discovery will occur in three distinct and important crop families: Brassicaceae, Lythraceae and Erythroxylaceae and the resulting data will be compared to an established tropane pathway in the Solanaceae. This comparative approach will be used to test the hypothesis that novel biocatalytic activities within the tropane biosynthetic pathways of distinct species are the source of the independent emergence of the tropane alkaloid system within the plant lineage. Additionally, the research explores the possibility that the different components of tropane alkaloid metabolism were independently coopted during evolution to build new metabolic systems (e.g. granatane alkaloids). Overall, this approach will lead to enhanced understanding of tropane and granatane alkaloid biosynthesis.

Moreover, knowledge of the biosynthetic steps leading to tropane and granatane alkaloids is crucial for quantitative modeling and metabolic engineering of these pharmacologically active chemicals.



Prof. Huazhong Shi – Gene Regulation & Stress Response in Plants

Dr. Shi's research centers on understanding of the molecular mechanisms of plant abiotic stress response. He uses forward genetics, molecular and biochemical tools to study how plants respond to environmental stresses such as salt, heat and drought. Several regulators important for stress-inducible gene expression have recently been identified from Dr. Shi's group. These include SHI1 and SHI4 that are critical for salt-inducible gene expression, LHR1/PUT3 that is a modulator of heat-inducible genes, and the chloroplast protein HCF106 regulating plant drought resistance. In addition, Dr. Shi's group also found that sulfonation of small molecules such as salicylic acid plays important roles in plant defense to pathogens and xenobiotics.

The findings from Dr. Shi's research not only enhances basic knowledge about gene regulation in plant stress response, but also provides potential genes as targets for crop improvement in abiotic stress resistance.

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