

# UNDERGRADUATE RESEARCH Highlights

Brant JA, Massi DM, Holzwarth NAW, MacNeil JH, Douvalis AP, Bakas T, Martin SW, Gross MD, Aitken JA. Fast Lithium Ion Conduction in  $\text{Li}_2\text{SnS}_3$ : Synthesis, Physicochemical Characterization and Electronic Structure. *Chemistry of Materials*. 2015; 27: 189-196. (Duke University)

In this paper it was demonstrated, for the first time, that  $\text{Li}_2\text{SnS}_3$  acts as a fast  $\text{Li}^+$  ion conductor and possesses high thermal and environmental stability, making it a promising new solid-state electrolyte for lithium ion batteries. Jennifer A. Aitken is an associate professor in the Department of Chemistry and Biochemistry at Duquesne University. Danielle Massi graduated from Duquesne University with her BS in chemistry in May of 2012. She received her masters of education with a concentration in secondary chemistry from Cabrini College in December of 2014 and is now teaching chemistry and physics at Merion Mercy Academy in Merion Station, PA. This project was supported by the National Science Foundation under Grant no. DMR-1201729.

Fetcie K, Jacob B, Saavedra D. The Failed Zero Forcing Number of a Graph. *Involve, a Journal of Mathematics*. 2015; 8: 1:99-117. (Rochester Institute of Technology)

Zero forcing is a dynamical system on a graph (or network) that has applications in minimum rank problems and quantum mechanics. Conventionally, researchers have studied the minimum number of starting locations necessary to fill an entire graph. We introduced and investigated a new concept, called the failed zero forcing number, that is the maximum number of starting locations that fail to fill the entire graph. Bonnie Jacob is an assistant professor of mathematics at the National Technical Institute for the Deaf, a college of the Rochester Institute of Technology. Daniel Saavedra is a packaging-science major at the Rochester Institute of Technology. Katherine Fetcie recently graduated from the Rochester Institute of Technology with a bachelors degree in environmental sustainability, health and safety. She will begin a graduate degree in environmental toxicology in the fall at NYU.

Smolyaninova VN, Yost B, Zander K, Osofsky MS, Kim H, Saha S, Greene RL, Smolyaninov II. Experimental Demonstration of Superconducting Critical Temperature Increase in Electromagnetic Metamaterials. *Scientific Reports*. 2014; 4: 7321. (Towson University)

A recent proposal that the metamaterial approach to dielectric response engineering may increase the critical temperature of a composite superconductor-dielectric metamaterial has been tested in experiments with compressed mixtures of tin and barium titanate nanoparticles of varying composition. An increase in the critical temperature on the order of 5 percent compared to bulk tin has been observed for a 40 percent volume fraction of barium titanate nanoparticles. Vera Smolyaninova is a professor of physics at Towson University. Kathryn Zander, a physics major at Towson, participated in the research for independent study credit. Zander graduated from Towson University this spring and is planning to apply to graduate school. This research was supported in part by undergraduate research grants awarded to Zander and by NSF grant DMR-1104676 to Towson.

Wei-Ting C, Caleb HM, Elizabeth CD. Growth and Microstructure-Dependent Hardness of Directionally Solidified WC-W<sub>2</sub>C Eutectoid Ceramics. *Journal of the American Ceramic Society*. 2015; 98: 3. (North Carolina State University)

The research investigated the tungsten carbide (WC) based refractory ceramics typically used to manufacture high-performance cutting tools in an attempt improve their mechanical properties, using laser surface processing. The research involved using known eutectoid compositions between the WC and W<sub>2</sub>C phases to produce two-phase lamellar microstructures that together boost the mechanical properties beyond the limits of each of the individual phases. Using laser surface processing, the scale of the eutectoid lamellar microstructure could be controlled to examine the size dependence of the microstructure. It was found that the indentation hardness of material increased with decreasing lamellar spacing. An indentation hardness of 28.5 GPa was achieved with the smallest interlamellar spacing, the highest hardness value reported in the WC system. Elizabeth Dickey is a professor and director of graduate programs in the Department of Material Science and Engineering, as well as director of the Center of Dielectrics and Piezoelectrics and associate director of the Analytical Instrumentation Facility at North Carolina State University. Caleb Meredith took part in the research as an undergraduate from 2012 to 2014 while studying in the Department of Material Science and Engineering at North Carolina State. He is currently working as a researcher at a green-technology startup company in Raleigh, North Carolina. The research was supported by National Science Foundation grant CMMI-1139792.

Lee MD, Bingham KN, Mitchell TY, Meredith JL, Rawlings JS. Calcium Mobilization is Both Required and Sufficient for Initiating Chromatin Decondensation during Activation of Peripheral T-cells. *Molecular Immunology*. 2015; 63:2: 540-549. (Furman University)

This study examined the mechanism of activation-induced chromatin decondensation in peripheral T lymphocytes, focusing on the role of calcium in the process. This study shows that the mobilization of intracellular calcium is both required and sufficient to initiate chromatin decondensation. Furthermore, the decondensation was shown to be independent of the action of NFAT. Jason Rawlings is an assistant professor of biology. Kellie Bingham is currently enrolled at the Medical University of South Carolina. Megan Lee and Taylor Mitchell will both attend the University of South Carolina School of Medicine – Greenville. Jenna Meredith will attend the Mercer University School of Medicine. The research was supported by grants from the NIH (5 P20 RR016461 and 8 P20 GM103499), the NSF (EPS-0903795), and an HHMI USE award. Further support was provided by Furman University.

Guest L, Schap D. Rationales Concerning the Treatment of Federal Income Taxes in Personal Injury and Wrongful Death Litigation in the State Courts. *Journal of Legal Economics*. 2014; 21:1: 85-117. (College of the Holy Cross)

Awards of damages in certain tort cases are exempt from federal income taxes. Some state courts adjust awards in recognition of the tax advantage, while others do not. Based on a comprehensive survey of judicial reasoning in the various state courts, the study categorizes the varied rationales for the differing tax treatments and rationales as to whether juries ought to be instructed in the matter of taxes. David Schap is professor of economics. Lauren Guest is a 2013 graduate of Holy Cross and worked on the project as a research assistant during the summers of 2012 and 2013, as well as during directed research courses in fall semester 2012 and spring semester 2013. Guest now works for the software startup company Trio Health, whose software tracks patient data for various chronic diseases. A grant from the May and Stanley Smith Charitable Trust supported the summer research in 2012, and the Office of the Dean at Holy Cross funded the summer 2013 research.

John P, Pineno O. Biological Significance in Human Causal Learning. *Psi Chi Journal of Psychological Research*. 2015; 1. (Hofstra University)

The present study was conducted to assess the influence of fear-inducing cues on human causal learning, specifically on

a learning-reversal procedure followed by spontaneous recovery. The study found that spontaneous recovery was stronger with high-fear cues than with low-fear cues. This research has implications for the clinical treatment of fears. Oskar Pineno is an associate professor of psychology. Prescilla John is currently at Columbia University and is seeking to enroll in a doctoral program in clinical psychology.

Eriani G, Karam J, Jacinto J, Morris Richard E and Geslain R. MIST, a Novel Approach to Reveal Hidden Substrate Specificity in Aminoacyl-tRNA Synthetases. *Plos one*. 2015. accepted May 15, 2015. (College of Charleston)

This work describes a new technical and conceptual approach named MIST (Microarray Identification of Shifted tRNAs) designed to study the formation of complexes between transfer RNA and aminoacyl-tRNA synthetases (tRNA/AARS), two essential components of the cellular translation machinery. MIST combines electrophoretic mobility-shift assays with microarray analyses. Our results reveal important new trends in tRNA/AARS complex formation and potential deep physiological implications. Renaud Geslain is an assistant professor of biology. Joseph Karam and Jomel Jacinto co-developed this project in 2014 during their senior year at the College of Charleston, as part of their independent-study project. Karam is currently enrolled in a masters-of-science program in biomedical sciences at the Medical University of South Carolina with a focus on biochemistry and molecular biology. Jacinto is currently a first-year osteopathic medical student at the Edward Via College of Osteopathic Medicine in Spartanburg, SC. This research was supported by a Faculty Research Development grant to Geslain from the College of Charleston.

Carpi, A., Fostier, A.H., Santos, J.C., Gittings, M., Orta, O.R. Mercury Emissions from Soil Following the Loss of Forest Cover in the United States and Brazil. *Atmospheric Environment*. 2014; 96: 423-429. (John Jay College, CUNY)

This article explores the role that deforestation plays in the global mercury cycle. Mercury, a toxic and persistent pollutant, is emitted by a number of anthropogenic and natural sources. While previous research had identified the role that forest fires play in the release of mercury into the environment, this is the first study to show that mercury continues to be emitted into the atmosphere by soil surfaces post-deforestation. This article thus provides an important link in the chain of research examining and catalyzing a reduction in mercury use. Anthony Carpi is a professor of environmental chemistry. Olivia Orta is a first-generation college student who conducted undergraduate research with professor Carpi

through John Jay's PRISM research program and continued to work with him after graduating with her bachelor's degree. During this post-graduate training period, she took the lead on data analysis for the study, gathering, normalizing, and graphing hundreds of hours of data collected in the field. She conducted all statistical analyses for the study and contributed substantively to the writing of the manuscript. She is now in her third year as a doctoral student in epidemiology at the Harvard School of Public Health. Funding for the study was provided by a Fulbright Scholarship from the Fulbright program of the U.S. Department of State and by the São Paulo Research Foundation (FAPESP).

**Bell KM, Higgins L.** The Impact of Childhood Emotional Abuse and Experiential Avoidance on Maladaptive Problem Solving and Intimate Partner Violence. *Behavioral Sciences*. 2015; 5: 154-175. (Capital University)

The purpose of the study was to examine the joint influences of experiential avoidance and social problem solving on the link between childhood emotional abuse (CEA) and intimate partner violence (IPV). As part of a larger study, 232 women recruited from the community completed measures assessing childhood emotional, physical, and sexual abuse, experiential avoidance, maladaptive social problem solving, and IPV perpetration and victimization. Findings suggest that CEA may lead some women to avoid unwanted internal experiences, which may adversely impact their ability to effectively solve problems in social situations and increase their risk of violence by intimate partners. Kathryn Bell is an associate professor of psychology. Lorrin Higgins conducted this secondary-data analysis project in order to gain research experience prior to applying to graduate school. She began the project in spring 2013 and presented the findings at the annual convention of the Association for the Advancement of Behavioral and Cognitive Therapies in November 2013 in Nashville, TN. Higgins graduated from Capital University in May 2015 and plans to apply to graduate school in clinical psychology. Initial data collection was funded by Northern Illinois University with support from the Center for Family Violence and Sexual Assault. Travel to present findings was partially supported by Capital University.

**Calicchia, S.** "Play That Funky Music" or Not: How Music Affects the Environmental Self-Regulation of High-Ability Academic Writers. *Young Scholars in Writing*. 2014; 11: 62-72. (Utah State University)

Successful writing, achieved by self-regulated writers, depends not only upon focus and content, but also upon the writing environment, including the physical and social setting, which varies greatly among writers. Just as musical

tastes differ among individuals, there are strong preferences regarding the role of music in a writing setting. To better understand the environmental self-regulation of writers, a group of twelve high-achieving writers with a range of musical interests was selected, including nine professors and three undergraduate students across three academic fields. The results suggest that musical background impacts a writer's preferred setting, and academic writers should strongly consider this impact when establishing a successful writing environment. Sara Calicchia conducted this research during her sophomore year as an independent-study project in an honors English class. Calicchia has since graduated and currently works as a clinical research assistant at Ambry Genetics in Aliso Viejo, CA. Joyce Kinkead, the student's research mentor, is a professor of English. No funding was required for this project.

**Basu, P., Dixon, D., Varghese, S., Varghese, G., Varghese, G., Maier, C.** Detection of Estrogenic and Anti-estrogenic Activities of Dietary Plant Extracts by In Vitro Reporter Assays. *The FASEB Journal: The Journal of the Federation of the American Societies for Experimental Biology*. 2015; 29: 1. (Texas Woman's University)

This study aimed to establish the estrogenic agonism and antagonism of some dietary plants in the Ericaceae, Moraceae, Rosaceae, and Vitaceae families of plants. A steroid-regulated transcription system in *Saccharomyces cerevisiae* containing a human estrogen receptor alpha expression plasmid and a  $\beta$  galactosidase gene reporter plasmid was employed in this study. Estrogenic activities of plant extracts were detected by assessing their effects on estrogen receptor mediated transactivation of the reporter gene as compared to estradiol. This study reports for the first time anti-estrogenic activities of the above plant extracts, and it may lead to detection of new more potent phytoestrogens for possible chemopreventive effects and cancer treatments. Camelia Maier is an associate professor of biology. Paramita Basu, Dinu Dixon, Sherin Varghese, Gladys Varghese, and Gladwin Varghese are all undergraduate students in biology at Texas Woman's University. This research was funded, in part, by the Texas Woman's University Undergraduate Research Microgrant Program.