The Eighth Annual

UC Merced

Undergraduate Summer Research Symposium

Friday, August 08, 2014

Kickoff: 8:30AM in Bobcat Lair (KL 169)

Poster Session: 11:30AM-1:00PM in Library Lantern

Oral Presentations: 9:00AM-3:00PM in KL 260, KL 360, KL 362

Welcome to the

Eighth Annual

UCMerced

Undergraduate Summer Research Symposium

August 8, 2014

Sponsored by the Undergraduate Research Opportunities Center

A special thank you to our 2014 undergraduate research enrichment program partners:

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UC Leadership Excellence Through Advanced Degrees (UC LEADS)

The following student scholars are part of UC Merced's Leadership Excellence through Advanced Degrees (LEADS) Program. The goal of the UC LEADS research and graduate preparation program is to educate California's future leaders by preparing promising students for advanced education in science, technology, engineering and math (STEM) fields. The program is designed to identify upper-division undergraduate students with the potential to succeed in these disciplines, but who have experienced situations or conditions that have adversely affected advancement in their fields of study.

For more information, please visit http://uroc.ucmerced.edu/uc-leads.

Production of Recombinant Enterokinase Light Chain

Hawi B. Gemeda, Mike Jian, Patricia LiWang, PhD; School of Natural Sciences,University of California, Merced

Enterokinase, or enteropeptidase, is a serine protease, which cleaves after the amino acid sequence DDDDK. Recombinant Enterokinase (rEK) is commonly used to cleave off fusion tags during recombinant protein production. EK consists of a light chain and a heavy chain, with the light chain being the catalytic subunit. Many of the proteins of interest in our laboratory, such as 5P12-RANTES, are potent HIV inhibitors. These proteins are often recombinantly expressed with a fusion tag, requiring sequential enzymatic removal by EK cleavage. It is not feasible to use commercial rEK for large scale production of these proteins due to the high cost. A comprehensive search of current literature identified various methods to prepare rEK. We hypothesize that we can integrate and modify these methods to develop an optimized approach to produce rEK. The gene encoding the human EK catalytic light chain with a C122S mutation was subcloned into pET15b, pET28a, and pET32b expression vectors. The resulting plasmids were transformed into Escherichia Coli cells. rEK was overexpressed and then purified using an unfolding-refolding protocol. The product was analyzed for its specific protease activity. This homemade rEK is suggested as an economical alternative to the commercial enzyme. The development of this rEK production method will facilitate future large-scale purification of HIV inhibitor protein.

Assessing Soil Nutrient Fluxes and Ecosystem Health from Affected Areas of the Rim Fire

Jim Mendez-Lopez[1], Louis Mielke[2], Rebecca Lever[1], Asmeret Asefaw Berhe[1];
[1]University of California, Merced, [2]University of Minnesota

Fire is an important perturbation that controls ecosystem health. Specifically in soil, fire can lead to loss of organic layer and biogeochemical cycling of essential elements. The Rim Fire occurred in the Sierra Nevada Mountains of California in August of 2013. In this study we investigated the role of the Rim Fire in lateral mobilization of topsoil and associated soil carbon and nitrogen stocks from hillslopes that were burned. Samples were collected from sediment fences that were put in medium and high slope sites burned by moderate and high severity fires and from slopes in different landform positions in the area. We analyzed the mass of sediment mobilized and compared sediments from the different positions in terms of soil color, pH, gravimetric water content, particle size distribution and nitrogen and carbon content. We also measured bulk density in the source hillslope soils. We found that in all slopes and fire severities sediment samples decreased in mass over monthly increments between February and May, with soil color also shifting from black to dark reddish brown, and pH measurements showed a trend in slightly decreasing values. This suggests that early deposits remove burned soil and could possibly store pyrogenic carbon. With the collection and analysis of more data we will be able to understand and model the carbon cycling in ecosystems affected by fire, erosion, or both.

Disease-Relevant Mutant VCP Dysregulates NF-κB Activation and Upregulates the Expression of Ubiquitin E3 Ligases, Murf1 and Atrogin1, in C2C12 Myoblasts

Gema J Rodriguez, Julio C Flores, Carlos J Rodriguez-Ortiz, PhD, Masashi Kitazawa, PhD;
School of Natural Sciences, University of California, Merced

Inclusion body myopathy with Paget's bone disease and frontotemporal dementia (IBMPFD) is an autosomal dominant disease caused by mutations on the valosin-containing protein (VCP) gene. Over 80% of patients with VCP mutations develop progressive muscle degeneration. Its underlying pathogenic mechanisms, however, remain largely unknown. Previously, we have shown that disease-associated mutant VCP prolongs NF-κB activation in C2C12 myoblasts following an acute LPS stimulation. We hypothesize that the impaired resolution of NF-κB activation leads to aberrant transcriptional alterations, including up-regulation of inflammatory-related genes and muscle-specific ubiquitin ligases, which further promote degeneration of muscle cells. We examined the changes in muscle-specific ubiquitin E3 ligases, Murf1 and Atrogin1, following acute LPS exposure to C2C12 cells. Our preliminary data indicates an increased expression of Atrogin1 and Murf1 protein levels after NF-κB activation. To test whether VCP mutation exacerbates the expression of Atrogin1 and Murf1, we transfected C2C12 cells with wild type VCP or mutant VCP. Transfected cells were incubated for 1 hour with 1 μg/mL LPS as NF-κB activator, followed by 1-hour incubation for recovery without LPS. We expect greater protein levels of Atrogin1 and Murf1 in mutant VCP that may help to understand the underlying mechanisms of muscle degeneration in IBMPFD patients.

Porting Existing Robot Code to the Robot Operating System Software Platform

Luis A. Silva and Stefano Carpin, PhD; Electrical Engineering and Computer Science, School of Engineering, University of California, Merced

The Robot Operating System (ROS) software platform is quickly becoming the dominant application development medium in both research and industrial robots. ROS aims to build an open-source information repository of robot code from which other software developers can build up upon each other's work, allowing them to focus on new ideas, instead of getting bogged down by re-inventing the same software another developer might have already developed. It is therefore of interest to port existing robot code from older software platforms into ROS format and avoid building the infant repository from scratch. The existing robot code programmed in C++ controls the robot's sensors, multiple cameras and video all in the same code, limiting the development of the robot. Whereas, ROS approaches robot functionality with the use of publishers and subscribers, a method of sending and receiving messages from different nodes of the robot, each with their own code, to achieve the same functionalities as the old robot code. Consequently, this allows for software developers to distribute the development of specific functionalities to field experts, and then use the publisher-subscriber method to bring them all together into one robot, thus eliminating the functionality development limitation from before. Porting the code suggests that software developers will be able to make progress on ROS perception and intelligence rather than primitive and repetitive motions.

Cloud Computing: Benefits, Concerns, and Applications

Markus Walker and Mukesh Singhal, PhD; School of Engineering, University of California, Merced

Cloud computing is a way of delivering a seemingly infinite collection of hardware and software resources to customers as needed, with support for elastic resource provisioning and release, and ubiquitous access to the resources. Industry adoption of cloud computing is maturing at a rapid pace due to its benefits over traditional in-house information technology (IT) systems and services. Some of these benefits include the following: cost savings, fast deployment, scale/elasticity, consolidation, energy savings, elimination of capital expenses, resilience, redundancy, security and competitiveness. Although cloud computing has been shown to be very effective, there are many concerns with its daily usage. Recurring concerns come in various forms of data privacy as well as data security. Interesting enough, these are not new problems, but become more apparent in cloud computing. The focus of this presentation is to provide a general background on cloud computing. Firstly, I give a clear definition of cloud computing. From there, I explain the advantages the cloud brings and how it is applicable. From there, I will go over some of the technologies the cloud brings. Lastly, I will discuss data privacy and data security concerns across multiple scenarios and they're important issues.

Modeling the Corona Using Magnetohydrodynamic Equation

Emanuelle Lopez, College of Letters and Sciences, University of California, Berkeley

As satellites and space exploration become more prevalent, the need for understanding the sun and space weather becomes crucial. The solar atmosphere, called the corona, is a body composed of plasma held together by the Sun's magnetic field. The coronal plasma lines up along the magnetic field lines protruding from the Sun's surface in form of loops. These loops, filled with plasma, are anchor the surface of the Sun, which is composed of plasma much denser than that of the corona. Despite the slow motion of the foot-point with the surface plasma, the coronal loops can be stable for days. However, they often erupt, resulting in a solar flare or coronal mass ejection. These solar eruptions affect Earth by carrying magnetized material to our orbit, possibly disrupting the operation of satellites, power lines, or communication technologies in what is called space weather. Then, in order to predict solar eruptions, we need to understand the behavior of the coronal loops, and we choose to model them using magnetohydrodynamic (MHD) equations. The MHD equations are a system of partial differential equations that describe the electromagnetic behavior and the motion of the fluid-like plasma. This model will involve the numerical solution of the MHD equations since solving them analytically in this context is impossible. Previous research used this model but simplifying assumptions such as uniform density were used. The proposed research project will improve the current model by including non-uniform density.

Rational Design of Crumpled Graphene Oxide/ Titanium Oxide Composites for Photocatalytic Reactions

Yongsheng Sun, Yenchang Chen, PhD, Ishihara Hidetaka, PhD, Vincent C. Tung*
Material Science and Engineering, University of California, Davis

A fundamental design for graphene based composites is to prevent the aggregation of individual graphene sheets because extraordinary material properties, especially those pertinent to photocatalytic reactions, begin to falter by virtue of the strong van der Waals interaction. One approach to address this problem is to isotropically fold the 2-dimensional graphene sheets into three-dimensional crumpled balls, thus minimizing gattractive forces between adjacent sheets. Here we show that 3-dimensional crumpled nanoparticles made of single-to-few layers of reduced graphene oxide (r-GO) can be assembled in a high throughput fashion utilizing electrohydrodynamic forces presented in nano-colloidal droplets. These crumpled r-GO nanoparticles exhibit remarkable resistant to aggregation in both solution and dried states, preserving the available electrochemically active areas. As a proof-of-concept, photoelectrochemical electrodes made of TiO2 nanoparticles supported on the 3-dimentional crumpled r-GO scaffolds. The resulting 3-dimensional photoelectrochemical electrodes were found to increase solar light scattering rate and effective surface area, delivering much enhanced output characteristics that surpass those made of 2-dimenisonal counterparts.

California Alliance for Minority Participation (CAMP)

The following student scholars are participants in UC Merced's CAMP program. The Louis Stokes California Alliance for Minority Participation (CAMP) in Science, Technology, Engineering and Math, is a statewide initiative funded by the National Science Foundation (NSF) to strengthen the quality and quantity of underrepresented students receiving baccalaureate degrees in science, technology, engineering and mathematics studies at the University of California (UC). CAMP offers extensive resources and unique opportunities for students to excel in their respective fields of study. The CAMP program began at UC Irvine in 1991; currently, nine UC campuses participate in the program.

For more information, please visit http://uroc.ucmerced.edu/camp.

Biochar Production from Almond Shells using Pyrolysis Induced by Dielectric Breakdown

Christian G. Castillo, Andres Munoz-Hernandez, and Gerardo Diaz*, PhD; School of Engineering, University of California, Merced

Biochar has many applications in agriculture. Researchers have found that biochar helps plants retain more water, increase crop production, and mitigate climate change. To produce the biochar, a novel technique known as dielectric breakdown is used to induce biomass pyrolysis. Pyrolysis is the thermal decomposition of a material when there is little or no oxygen. The decomposition of the biomass also produces carbon monoxide and hydrogen which can be utilized as as a renewable fuel, but for the purposes of this experiment, it was not collected. In this experiment, pyrolysis was induced through dielectric breakdown using a high voltage power supply of 10,000 Volts and less than 100 Watts of power. Power outputs and times were recorded. Biochar samples obtained during the test are currently being analyzed to test the quality of the biochar. By requiring a low amount of power to produce biochar, the process can be easily implemented and become an economically viable option to increase crop production.

Building Energy Modeling With Energy Plus

Carlos Hernandez, Alex Beltran, Alberto E. Cerpa, PhD; School of Engineering, University of California, Merced

In the US, buildings consume 8% of worldwide energy. The main component of energy consumption is the, heating, ventilation, and air conditioning (HVAC) system, which accounts for 42% of energy utilized and makes it a critical priority to reduce energy consumption. Recent research efforts have attempted to reduce building energy consumption while providing suitable quality of service to its occupants. In this project, we have created a detailed energy model from a building at the University of California, Merced using the EnergyPlus simulation program along with the OpenStudio add-on. This energy model was built using the building's specifications along with the HVAC schedules currently implemented in the building. We verified the fidelity of the energy model by comparing the energy consumption results from EnergyPlus against the actual building energy consumption. By using the same weather patterns along with the same HVAC component configuration, such as building thermal zones, we were able to replicate the simulated model to the actual building. Through the use of this model, we can simulate optimizations and expect the same results when applied to the actual building. This energy model provides a framework for future research. In the future, we plan to integrate this energy model with a Model Predictive Control (MPC) framework, which seeks to optimize HVAC control in order to minimize HVAC energy consumption, while still remaining within comfort constraints of its occupants.

Effects of Social Ostracism

Anabel Castillo, Alexander Khislavsky, PhD, and Jeffrey Gilger, PhD; Psychology, University of California, Merced

The aim of this study was to show that ostracism could exacerbate ADHD characteristics. We tested the effect of ostracism on attention in healthy college-aged volunteers. Using a repeated-measures design Cyberball, we exposed parallel groups to 'ostracism' or 'inclusion'. We then used CCPT-II, which is a computer assessment that measures sustained attention. The individuals ostracized showed increased difficulties on CCPT-ll measures of sustained attention. Findings seem relevant to ADHD children, as their symptoms may intensify by ostracism.

Antagonism of Angiotensin, but not the Mineralocorticoid Receptor, Ameliorates ANG II-dependent Hypertension Through Reduction of Sodium Reabsorption

Diana L. Rodriguez, Rudy M. Ortiz, PhD; School of Natural Sciences, University of California, Merced

The renin-angiotensin aldosterone system (RAAS) is a hormonal cascade that controls systolic blood pressure (SBP) and fluid balance. This system is normally activated by sodium depletion with the production of renin in the kidney, which, in turn, regulates the synthesis of angiotensin II (Ang II). Two major effects of Ang II are the stimulation of aldosterone secretion and vasoconstriction, both of which lead to elevated blood pressure. However, the role of aldosterone in the control of blood pressure is still not completely understood. In this study, we hypothesized that both mineralocorticoid receptor (MR) and angiotensin type 1 receptor (AT1) blockade ameliorate hypertension by lowering sodium reabsorption. To test this hypothesis, we measured plasma aldosterone, epithelial Na+ channel (ENaC) expression, urinary Na+ excretion, and systolic blood pressure (SBP) in five groups of Sprague-Dawley rats: 1) control, 2) Ang II, 3) Ang II + AT1 receptor blocker (ARB), 4) Ang II + mineralocorticoid receptor blocker (Epl), and 5) Ang II + ARB + Epl (Combo). Treatments with ARB and combo reduced SBP levels and increased urinary sodium excretion and ENaC expression, as opposed to control and Epl infused groups. Accordingly, these data suggest that MR antagonism and ARB have an opposite effect on sodium reabsorption, and the inability of Epl to reduce SBP further suggests that Ang II-mediated events are major contributors to the elevation of SBP, independent of aldosterone effects.

Design and Test of a Copper-Based Mini Channel Solar Water Heating System

Keith Saechao, Van Duong, Gerardo Diaz PhD; School of Engineering, University of California, Merced

The process of heating water accounts for a significant portion of energy consumption in the world. Scientist and researchers have developed solar water heaters that are slowly being adopted in the residential as well as the commercial sectors. The main issue with these current solar water heaters relates to the efficiency in transferring the heat from the sun to the working fluid. The objective of our project is to further the advancement of solar water heaters through the addition of copper-based mini channel collectors. Prior to our project, there has been a prototype design of an aluminum-based mini channel collector. Although the results obtained for this aluminum collector showed improvements with respect to standard flat-plate collector designs, operation at higher temperatures requires other materials such as copper. The overall system to be implemented will include the collector, pump, piping, and sensors. A control logic will be implemented that will consist of input signals, measuring temperatures at the inlets, outlets, and within the water storage tank. The collector will be tested in single phase operating mode and also in steam generation mode. Computational models are being developed to compare with test data and allow for system optimization.

Quantifying Microbial-Mediated Methane Fluxes in High Elevation Lakes Experiencing Excess Nitrogen Deposition in Yosemite National Park

Mark C. Reynolds, J. Michael Beman, PhD; School of Natural Sciences, University of California, Merced

Yosemite National Park, spanning three California counties, is located downwind of agricultural and urban hubs including the productive Central Valley. Consequently, the park is vulnerable to deposition of pollutant nitrogen (N) from various anthropogenic sources. In many ecosystems, N deposition jeopardizes community functioning and water quality as a result of increased eutrophication, but how this phenomenon affects biogenic gas emissions via microbial activity in freshwater systems has largely been overlooked. Here, we demonstrate that well-mixed oligotrophic lakes can be a source of methane emissions with the magnitude of the flux depending on surface elevation and N deposition rates. After calculating surface methane profiles among six high elevation lakes in Yosemite National Park, our results support that the concentration of methane fluxes are positively correlated with an increase in elevation and, furthermore, higher nitrogen deposition rates. To address the conundrum of methane cycling in such oxygenated lakes, we will investigate the following in future studies: possible symbiotic substrate cycling in micro-anoxic zones among different metabolizers, substantial uncoupling of in situ methane production over consumption during both light/dark conditions, and how varying concentrations of inorganic N affect methane emission rates. Our findings provide new insight on how increased industrialization and usage of synthetic fertilizers in the Central Valley can impact atmospheric methane concentrations and its link to the Greenhouse Effect.

Maximizing Access to Research Careers (MARC)

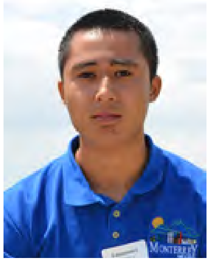
The following student scholars are part of the Maximizing Access to Research Careers - Undergraduate Student Training in Academic Research (MARC U*STAR) Program at UC Merced. The MARC U*STAR Program is funded by the National Institutes of Health (NIH). The program seeks to increase the number of highly-trained biomedical and behavioral scientists in leadership positions to significantly affect the nation's health-related research needs. MARC U-STAR provides support for undergraduate students who are underrepresented in the biomedical and behavioral sciences to improve their preparation for high-caliber graduate training at the Ph.D. level.

For more information, please visit http://uroc.ucmerced.edu/marc.

Increased Renal Potassium Secretion Prevents Hyperkalemia During Hemorrhage

Debby Lee[1], Claudia A Hernandez[2], Aileen K Sato[2], Lee-Ann M Murata[2], Catherine FT Uyehara, Ph.D[2]; [1] School of Natural Sciences, University of California, Merced; [2]Department of Clinical Investigation, Tripler Army Medical Center, HI

Trauma is the leading cause of death in young adults worldwide, and up to 50% of these deaths involve hemorrhage. Hyperkalemia has been reported to be associated with non-survival of severe hemorrhage. During shock, urine flow is dramatically decreased, and thus, in order to maintain electrolyte balance, renal handling of solute secretion must be altered. In this study, we tested the hypothesis that the kidneys respond to hemorrhage by increasing potassium (K) secretion to prevent hyperkalemia. We compared renal handling of K and sodium (Na) in conscious, chronically-catheterized rats (n=7) before, during, and after hemorrhage (2 ml shed blood/100 g body weight (BW)). After 1 hour of shock, rats were resuscitated with normal saline. With shock, urine flow dramatically decreased (28 ± 7 to 4 ± 1 ul/min/100g BW, $p<0.05$) between baseline and hemorrhage periods, and osmotic clearance also concomitantly decreased (44 ± 7 to 15 ± 2 ul/min/100g, $p<0.05$). Urine Na levels were not significantly altered (119 ± 14 to 101 ± 17 mmol/L), whereas urine K levels increased (76 ± 17 to 189 ± 15 mmol/L, $p<0.05$). We observed an increase in the trans-tubular K gradient (9 ± 1 to 16 ± 1, $p<0.05$) which suggests that a relative increase in renal tubular K secretion plays an important role in the regulation of K homeostasis during hemorrhage. This increase in K secretion may protect against hyperkalemia in hemorrhagic shock. The views expressed in this abstract are those of the authors and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the US Government.



Morphological Alterations in Microglia are Delayed Compared to the Induction of Cytokine mRNA Expression in the Brain and Sickness Behavior Following Acute Immune Challenge

Emmanuel Villanueva, Paige Trojanowski, Diana Norden, and Jonathan Godbout, PhD ,Neuroscience, The Ohio State University

Microglia interpret and propagate inflammatory signals initiated in the periphery, coordinating communication between the immune system and the brain. This response involves biochemical, physiological, and morphological changes in glial activation that influence behavior and cognition. One issue in glial biology is that analysis of morphology alone is used to interpret the activation state of glia. Therefore, the purpose of this study was to provide a detailed time course of inflammatory markers in the brain compared to the morphological profile of microglia in relation to behavioral changes. BALB/c mice received an intraperitoneal injection of lipopolysaccharide (LPS) (10 µg) that up-regulated mRNA expression of IL-6, IL-1β, and TNFα in the brain and was associated with the induction of sickness behavior. One acute injection of LPS was sufficient to evoke a pro-inflammatory response. Consistent with the up-regulation of cytokines, LPS challenge decreased food intake, body weight, locomotion, and social exploratory behavior in a time dependent manner. The increase in Iba-1 immunoreactivity was inconsistent with behavioral and biochemical changes. Cytokine expression temporally paralleled sickness behavior, although de-ramified microglial morphology did not. Although morphological analysis is useful to detect that microglial activation has occurred, cytokine mRNA data is more informative on their activation state and precedes morphological changes.

Interaction Between the Lung Pathogen, Chlamydia pneumoniae, and Epithelial Cells from the Oral Cavity

Joshua M. Cazares, Yotzelin Cervantes, Ye Zhu, David Ojcius PhD, Molecular Cell
Biology, University of California, Merced

Chlamydia pneumoniae (C.pn) is an intracellular bacterium that affects the respiratory tract and causes lung infections. C.pn can be transmitted by person-to-person by respiratory secretions and can go through numerous transformations during its life cycle such as monocytes, macrophages, and endothelial cells. Studies showed C.pn is present in the oral microbiota of normal subjects. However, it is not known whether C.pn can cause oral disease. Chlamydia infections are usually characterized through inflammation, which is an innate immune response. A variety of pathogens and endogenous danger signals activate inflammasomes, which are multiprotein complexes containing an adaptor protein, a protease called caspase-1, and a sensor such as NLRP3. Once the NLRP3 is stimulated, it triggers the secretion of proinflammatory cytokines, acting as a defense against infection. The human oral cavity contains numerous different bacterial, viral, and fungal species. The gingival epithelial cells (GECs) are the first line of defense against numerous oral pathogens, but it is not known whether GEC cells can be infected with C.pn and eventually lead to activation of the NLRP3 inflammasome. The hypothesis of this research is to determine whether C.pn can infect GECs and activate the NLRP3 inflammasome in GECs. The results from this study raise the possibility that under certain conditions, C.pn could cause inflammation in the oral cavity.

Acellularized Heart Tissue for Delivery of Functional Cardiomyocytes

Alejandra Preciado[1], Lian Wong[2], Kara E. McCloskey[2,3]
[1]School of Natural Sciences, UC, Merced [2]Graduate Program in Biological Engineering and Small-scale Technologies [3]School of Engineering, UC, Merced

Cardiovascular disease is the leading cause of death in the United States, often due to a myocardial infarction. During myocardial infarction, cardiac cells are deprived of oxygen and die. This ischemic tissue becomes a scar in the heart and can no longer contract with the rest of the heart, and will only weaken the heart's ability to pump blood. Tissue engineering approaches are currently being investigated as reparative/replacement therapies for the broken heart. Various biomaterials for cell delivery have been explored, however; most of these methodologies utilize either single cell populations and/or single biomaterial systems. A highly functional cardiac tissue patch requires combinations of factors including: biomaterial architecture, material strength, compliance, cell patterning, and incorporation of multiple cell types. In order to address this chasm, our group has developed a tissue delivery system that incorporates combinatorial synthesis of acellularized tissues, moldable hydrogels, cell patterning, and cell-sheet engineering to develop an organized patch for treating myocardial infarctions based upon the hypothesis that alignment of cardiomyocytes will increase patch integration, cellular retention, and cardiac function. The acellularized porcine heart tissue addresses many of these design concerns, providing increased compliance, material strength and architecture for cell patterning. This project will 1) slice porcine heart tissue, 2) acellularize the tissue using a variety of methods, and then examine the biomaterial for 3) removal of all porcine cell products, and 3) seeding and attachment of human cardiac cells. This material will then provide a base for the cardiac tissue graft being developed in the laboratory.

Undergraduate Research and Mentoring in the Agricultural Sciences (USDA)

The USDA Summer Scholar program is funded by a grant by the United States Department of Agriculture Hispanic Serving Institute Education Grant program. This program is developing the next generation of highly trained,graduate students in agricultural-related sciences. This is accomplished by:

• Recruting students from a Hispanic Serving Institute-UCM to participate in long-term, intensive research projects with participating UCM faculty and participating USDA researchers
• Providing students the opportunity to attend and present research results at national conferences such as SACNAS, which provide opportunities to undergraduate researchers in STEM field
• Incorporating practical agricultural science-related themes into the curriculum of UCM STEM courses

This program targets the highly diverse undergraduate population of the San Joaquin Valley, with the goal of increasing the representation of students from underrepresented groups into graduate programs related to the research area needs of the USDA.

Silicon-coated CNFs for Renewable Energy Applications

Angela Macedo Andrade, Jasper Zeng and Jennifer Lu, PhD; School of Engineering, University of California, Merced

Carbon nanofiber (CNF) based materials have been widely explored as conduits for transporting electrons in energy storage (batteries and supercapacitors), energy conversion (photoelectrochemical solar cells, fuel cells) and bio-sensing. In addition to their high electrical conductivity, CNFs can be used as scaffolds to host functional Si-containing polymers, which are hypothesized to render CNFs with electrocatalytic and electrochemical activities. Systematic studies indicate that polymers can be electropolymerized conformly on CNFs. In this work, CNFs are directly grown on stainless steel substrates (SS) by catalyst-assisted chemical vapor deposition (CVD). We have shown that mildly acid treated CNFs can achieve good storage capacity and exhibit oxygen reduction capability. This investigation focuses on establishing a process to fabricate silicon-containing polymers on CNFs and pyrolysis via examination of energy storage and conversion properties. This hybrid has shown larger capacitance and enhanced ORR capabilities, making it a promising new material in renewable energy applications.

Sustainable Approach for Dust Suppression

Presley Ramirez and Teamrat Ghezzehei, PhD; Earth System Science, University of California, Merced,

Dust emission is a major environmental problem that has negative implications on health and industrial applications. This problem is expanding for a number of reasons, including (a) climate change induced increase in drought frequency and magnitude; as well as (b) rapid growth of solar power plants in areas where the soil has been protected by fragile bio-crust. Current technologies for suppression of dust emission are involve either slowing down wind using breakers (e.g., plants or mechanical structures) or (bio)chemical stabilization of soil surface. Most stabilizers are toxic and expensive, which limits their application. The objective of this study is to test inexpensive and non-hazardous approaches of soil stabilization. Recent research in our group has revealed a process of soil stabilization by small amount of cementing agents. Wetting and drying cycles in the presence of dilute solution of biologically derived long-chain polymers results in strong adhesion between soil particles. In this study we tested whether dilute solutions of Xanthan Gum and PGA can be used as soil stabilizers. Both of these polymers are mimics of plant and bacteria derived polymers that are known to form stable soil aggregates. The commercially available compounds we used are widely used as additives in the food industry and are non-toxic. We tested the effectiveness of this approach, by subjecting the soil crusts to artificial wind energy. The results of this research can have an important implication in dust suppression in areas where air-borne diseases are prevalent and near solar-power facilities.

UC Merced- University of Alabama, Birmingham (UCM- UAB)

UCM-UAB SURP

A UC Merced & University of Alabama, Birmingham Partnership

The UC Merced/ University of Alabama, Birmingham Summer Undergraduate Research Program (SURP) is an 8-week paid summer research training opportunity at the University of Alabama at Birmingham (UAB) Medical Center. This opportunity, specifically for UC Merced undergraduate students, offers experience in Cardio-Renal Physiology & Medicine with emphases in acute kidney injury, chronic renal failure, diabetic nephropathy, hypertension, and polycystic kidney disease among others. The UAB Medical Center (www.uab.edu/medicine/home) represents an ideal environment for exposure to both basic biomedical science and the intricacies of modern clinical medicine. UAB is one of the top 4 largest academic medical centers in the United States and is ranked among the top 20 universities in funding from the National Institutes of Health.

Role of ETB Receptors in Circadian Control of Sodium Excretion

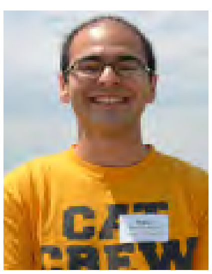
Jourdan A. Mason*, Jermaine Johnston and David M. Pollock, PhD, Department of Medicine, The University of Alabama at Birmingham
(*Jourdan Mason is also a participant in the UC LEADS program)

Our lab has demonstrated that male rats lacking functional ETB receptors have a delayed sodium excretory response to an acute salt load that may contribute to the exacerbation of circadian blood pressure rhythm in response to high salt intake. Since females have less salt-dependent hypertension, the goal of the current study was to determine if female ETB deficient rat have a blunted natriuretic response to an acute salt load. First, female ETB deficient rats were given a 900 μEq Na salt load by oral gavage, either at the beginning of their active period or inactive period (7pm or 7am, respectively), and urine was collected in 12 hour intervals. Female ETB deficient rats excreted most of the salt load given prior to the active period within the first 12 hrs (687±131 μEq Na/12 hrs). However, rats given the salt load before the inactive period showed a delayed response (393±177 μEq Na/12 hrs). In contrast, male rats exhibited a delayed response regardless of when the salt load was given. These findings reveal a sex difference in the diurnal control of sodium excretion and that the ETB receptor mediates the response to an acute salt load that is dependent upon the time of day the salt is given

High Salt Diet Increases Renal Excretion of Endothelin Type B Receptor

Jovana Navarrete and David M. Pollock PhD; Medicine-Nephrology, University of Alabama at Birmingham, AL

Endothelin-1 type B receptor (ETB) influences blood pressure by inhibiting renal sodium reabsorption. ETB receptors maintain normal circadian variation of blood pressure by promoting sodium excretion in response to increased salt intake; however, the mechanisms are not understood. The goal of our studies is to determine if increased renal ETB receptor expression contributes to regulation of circadian variation of blood pressure. We hypothesized that presence of ETB receptor in urine may correlate with changes in intrarenal activity. Male wild type and ETB deficient rats were maintained on a normal (0.4% NaCl) or high salt (4% NaCl) diet and urine was collected in 12 hour intervals on day 7. Wild type rats displayed no change in urinary ETB receptor expression in response to high salt intake during the inactive period; however, high salt intake significantly increased ETB expression during the active period. No difference was found in ETB deficient rats. Food intake, salt excretion, and urine output remained unaffected between genotype while high salt intake elevated urine sodium and water output in both genotypes. However, ETB deficient rats displayed elevated salt-sensitive baseline blood pressure. Therefore, upregulation of renal ETB receptor during the active period is crucial in maintaining normal blood pressure. The abundance of ETB receptors in the urine of high salt fed, normotensive rats may lead to the development of a novel biomarker to identify susceptibility to salt sensitive hypertension.



Lack of Endothelin 1 (ET-1) Protects Against Tunicamycin-Induced ER Stress in Renal Vessels

Marco Antonio Rodriguez, Carmen De Miguel, David M. Pollock, and Jennifer S. Pollock; Section of Cardio-Renal Physiology and Medicine, Department of Medicine Nephrology, University of Alabama at Birmingham, AL

Endoplasmic reticulum (ER) stress is caused by misfolded protein accumulation in the ER. Three different pathways compose the ER stress response: Activating Factors 6 and 4 (ATF6, ATF4) and spliced X-Box Binding Protein 1 (sXBP-1). Endothelin-1 (ET-1) is a potent vasoconstrictor peptide which is elevated during cardiovascular diseases. Recently, ET-1 has been implicated in the activation of ER stress pathways. We hypothesized that the lack of ET-1 in endothelial cells leads to reduced tunicamycin (TM)-induced ER stress in renal vessels. Female mice deficient in ET-1 in vascular endothelial cells (VEET mice) and their flox counterparts (n=5-9) received either TM (1.5mg/kg) or saline via intraperitoneal injection. After 24 hours, renal vessels were isolated. VEET mice showed a reduced expression of ER stress markers in response to TM when compared to flox mice: GRP94 (VEET vs. flox, fold change/flox+saline: 1.83±0.02 vs. 8.24±2.59), sXBP-1 (1.45±0.44 vs. 4.02±1.07), and CHOP (11.06±4.60 vs. 28.48±3.48, $p<0.05$). However, lack of ET-1 in VEET mice failed to decrease expression of ATF4 (2.18±0.89 vs. 2.27±0.69) and ATF6 (3.99±1.76 vs. 3.47±1.24). These results indicate that ET-1 specifically leads to the activation of the spliced XBP-1 arm of the ER stress response. Targeting the endothelin system may be a valid therapeutic approach against ER stress-induced renal vascular damage.

Arteriovenous Fistula Creation Leads to Neointimal Hyperplasia and Endothelial Dysfunction

Amy Hang[1,3], Brandon M. Fox[1], Maheshika Somarathna[2], Timmy Lee[2], MD, and Jennifer S. Pollock[1], PhD [1]Cardio-Renal Physiology & Medicine, [2]Division of Nephrology, University of Alabama at Birmingham, Birmingham, AL [3]School of Natural Sciences, University of California, Merced

Most end-stage renal disease patients utilize hemodialysis as their primary form of renal replacement therapy, necessitating arteriovenous fistula (AVF) creation. AVFs are the preferred method of dialysis access, but they are not often successful via mechanisms that remain poorly understood. We hypothesized that the arterial AVF segment develops neointimal hyperplasia and endothelial dysfunction. AVFs were constructed by end-to-side anastomosis (femoral vein to artery) of Sprague Dawley rats. The arterial AVF segments were harvested at day 7 and 14 after creation and stained for alpha-smooth muscle actin, desmin, matrix metallopeptidase-2, and matrix metallopeptidase-9 and demonstrated neointimal hyperplasia with positive staining for each protein. AVF arteries were harvested for vascular reactivity experiments at day 7 and 14; concentration-response curves generated to acetylcholine (ACh) and sodium nitroprusside (SNP) showed severely blunted vasorelaxation to ACh in the arterial AVF segment compared to the contralateral control artery but showed minimal change to SNP, indicating endothelial dysfunction. Pre-incubation with MS-275, class I HDAC inhibitor, showed restored endothelial function in the arterial AVF segment with minimal change in the contralateral control artery. These findings suggest that neointimal hyperplasia develops early after AVF creation with endothelial dysfunction in the arterial AVF segment. Furthermore, these data demonstrate that class I HDACs may mediate endothelial dysfunction in the arterial AVF segment, suggesting a possible therapeutic target to improve successful AVF maturation.

Applied Research in Modeling and Data-Enabled Science (ARCHIMEDES)

ARCHIMEDES
Applied Research in Modeling and Data-Enabled Science

In April 2014, UC Merced received funding from the National Science Foundation to host a Research Experience for Undergraduates (REU) program in applied mathematics for three summers. The REU program is called "Applied Research in Modeling and Data-Enabled Science", or ARCHIMEDES, and it focuses on data-enabled science and mathematical modeling. The objectives of the program are: to introduce students to scientific computing to strengthen programming skills, to use mathematical models to solve real-world problems, to apply computational tools to research-level problems, and to analyze results using data and translate into a scientific context.

The ARCHIMEDES program supports eight undergraduate students for nine weeks each summer as they learn and develop the mathematical and computational tools necessary for data-driven applications, and as they gain professional-level research experiences in preparation for careers in STEM fields. In the first week, students participate in a computational "bootcamp" designed to develop fundamental computational skills, preparatory to doing research during the rest of their summer program. The students then work intensely for the remaining eight weeks, in teams of four and with a faculty mentor, on projects with strong computational and modeling components. Students actively participate in weekly workshops and presentations to practice their communication skills. They will produce a technical report and a poster, and present at the Undergraduate Research Summer Symposium. The goal of the ARCHIMEDES program is to provide a rigorous and meaningful research experience in modeling and data-enabled sciences for undergraduate students in a team environment and improve the communication skills of future mathematical researchers.

Optimizing Medical Image Reconstruction

Abigail L. Benzine, Benjamin J. Bogard, Jimmy H. Nguyen, Aramayis K. Orkusyan,
Roummel F. Marcia, PhD; School of Natural Sciences, University of California, Merced

With the advent of higher resolution cameras and faster computer processors, digital images have become more commonplace. This prevalence can be observed in the exponential increase of images shared on personal electronic devices and social networks. In addition to personal use, the domains of academia and industry have gained from the expansion of digital imaging, in such fields as astronomy, meteorology, and security. In our research, we focus on imaging in health care—in particular, CT scanning. The medical field relies on CT scans to create visual representations of the body through noninvasive means, which in turn allows medical practitioners to inform diagnoses and track patients' progress. These images are acquired through x-ray data; however, the observed data are not an exact representation of the patient's anatomy. These data require computational methods to reconstruct the original image. The quality of this reconstruction depends on the quality of the data obtained, but the radiation from the x-rays can be harmful to the patient. Therefore, we need an efficient computational method that can reconstruct a high quality image while minimizing patient exposure to radiation. In this talk we will discuss various methods for optimizing this reconstruction of the original image from the data we are able to collect.

Sensitivity Analysis of a Mathematical Model of Blood Coagulation

Kristen J. Kohler, Joana L. Perdomo, Sabrina R. Lynch, Benjamin S. Guth,
Karin Leiderman, PhD, and Suzanne Sindi, PhD; Applied Mathematics, University of California, Merced

Blood coagulation is a series of biochemical reactions that, in part, leads to blood clot formation and the cessation of bleeding. Many players involved in these reactions are known as clotting factors. Blood platelets are vital to clot formation; clotting factors must bind to platelet surfaces for many of the reactions to occur. Early reactions in coagulation produce catalysts, known as enzymes, which speed up the rates of other reactions and allow for clotting to occur in a feasible timespan. Many in vitro tests of coagulation involve closed systems that employ lipids in place of cell surfaces for the reactions to occur. These lipids are thought to function analogously to cellular-surface binding sites found on platelets in blood, but are typically in much higher concentrations than the number of binding sites on platelets. Mathematical models have been developed to simulate these lipid-based experiments but fail to include the concept of cellular-surfaces, despite platelets being instrumental to blood clotting. In this study we will extend a current mathematical model of the lipid-based in vitro tests to include a limited number of binding sites on platelet surfaces. The purpose of this investigation is to better understand the role of platelet binding sites in coagulation and to quantify the sensitivity of the extended model to the number of surfaces.

UC Merced's Applications in Modern Material

The Applications in Modern Materials (AiMM) program is a comprehensive and collaborative research experience for undergraduates mentored by physics, chemistry, and engineering faculty at the University of California, Merced. Participants are involved in a wide array of research projects with applications in soft matter, biomaterials, nanomaterials, and/or materials for energy conversion and storage. These undergraduate researchers are involved in a wide array of activities including the synthesis, characterization, and/or modeling of modern materials. Every AiMM project is designed to include the student in cutting-edge research, with the expectation that their work can meaningfully contribute to publications or presentations. Complementing the interdisciplinary nature of the research areas, the program uses a three-pronged design of mentoring, networking, and professional development to support student researchers throughout (and beyond) the program. The participants are closely mentored by faculty and participate in additional networking and professional development activities to connect them with peers, postgraduates, and faculty within AiMM, as well as those associated with other currently funded University of California research programs, in addition to scientific professionals at Lawrence Livermore National Lab and within STEM-related industry.

Investigation of Copper Catalyzed Triazole Synthesis: A Computational Exploration

Samantha L. Bidwell and Hrant P. Hratchian; Department of Chemistry and Chemical Biology, University of California, Merced

The development of transition metal catalysts for facilitating efficient and economical organic transformations is an active and critical area of chemical research. One such reaction is copper-catalyzed selective azide-alkyne cycloaddition. While this “click chemistry” reaction offers a number of attractive synthetic features, the governing reaction mechanism remains largely unknown. Using density functional theory, we have investigated an interesting potential mechanism recently posited in the literature. Our results dispute that proposed mechanism, and we have sought a possible alternative route that is consistent with a number of well-established and published experimental results.

Single Molecule Detection of DNA: Precise Surfaces for Biosensing

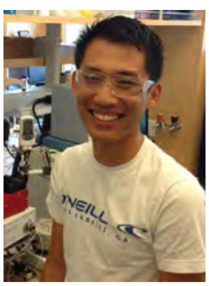
Chad I. Drexler, Aaron D. Craig, Tao Ye, PhD; School of Natural Sciences, University of California, Merced

The detection of single DNA molecules on chemical films is of interest in the design and manufacture of nucleic acid sensors. A common challenge is that the performance of many of these biosensors is highly sensitive to the molecular scale structures of such surfaces, such as orientations and conformations of probe molecules. One approach to strictly regulate said chemistries is to employ a carboxyl terminated switchable surface technique which allows for recognition of single target molecules by complementary probe molecules to occur in a mobile conformation, and the transduction of hybridized structures in an immobile conformation. To optimize experimental conditions for this switchable surface, a deeper understanding of near-surface conformational dynamics is required. While atomic force microscopy has excellent spatial resolution and has allowed for single molecule images to be obtained, the millisecond time resolution of total internal reflection fluorescence microscopy (TIRF) can be utilized to probe the dynamics of these single DNA molecules on switchable surfaces. By solving Maxwell’s equations for a region near a switchable surface, the enhancement factor, local electromagnetic fields and extinction spectra to be observed in a TIRF experiment were predicted.

Computational Study of Phonons in Nanocrystalline CdSe

Charlene G. Bwrede and Anne M. Kelley, PhD; Department of Chemistry and Chemical Biology, University of California, Merced

The purpose of this study is to carry out computational simulations of the phonons in core-shell semiconductor nanocrystals CdSe/CdS. These simulations will provide insight into the actual atomic motion involved in the phonons. In order to find out how the atoms in these nanocrystals move, we first need to find out how they interact with each other by developing a force field. We used the Stillinger-Weber type force field for InAs published by Han and Bester [Phys. Rev. B 83, 174304 (2011)] as a starting point and refined its parameters to reproduce the phonons and other structural and mechanical properties of bulk CdSe and CdS crystals. Using the General Utility Lattice Program (GULP) and two Fortran programs written by Anne Kelley, we calculate the equilibrium structures, phonon frequencies and modes, and electron-phonon coupling strengths of spherical nanocrystals with CdSe cores and CdS shells. This information is used to help interpret the Raman spectra of these materials. These semiconductor nanocrystals are important because they can potentially be used for the conversion of light into energy (solar power), energy into light (LED), and light of one color into light of another color (cellular imaging).

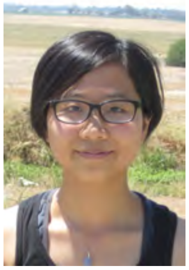


Progress Towards Understanding the Mechanism of the Dysprosium(III) Triflate-Catalyzed Aza-Piancatelli Rearrangement

Ryan Chung, Diana Yu, Van T. Thai, and Jason E. Hein, PhD; Department of Chemistry and Chemical Biology, University of California, Merced

First reported in 1976, the Piancatelli rearrangement of 2-furyl(alkyl)carbinols to trans-4-hydroxy-5-alkylcyclopentenones has proved to be a versatile tool in the synthesis of many important natural and biologically-relevant compounds that employ the cyclopentenone motif. Recent research has expanded upon Piancatelli's original work to allow for anilines, alcohols, and electron-rich aromatic amides to participate in the reaction. While it is known that the rearrangement can be catalyzed by Brønsted or Lewis acids, little is understood of the reaction kinetics and mechanism. Further insight, therefore, would allow for an improved catalytic system, broaden the list of compatible nucleophiles, and deconvolute the sequence of events within this deceptively simple transformation. Herein, we discuss our recent investigations on the dysprosium(III) triflate-catalyzed aza-Piancatelli rearrangement of 2-furyl(phenyl)carbinol and various aromatic amines using reaction progress kinetic analysis from data collected via in situ ReactIR measurements performed in concert with high-performance liquid chromatography/mass spectrometry (HPLC/MS).

Understanding Fluid Mixing Using Topological Entropy



Qianting Chen, Kevin Mitchell, PhD, Sulimon Sattari; School of Natural Sciences, University of California, Merced

Chaotic fluid systems are generally difficult to understand, even in a 2-D space. Researchers are interested in developing a model to accurately predict the dynamics of a 2-D periodically driven system. A lid-driven cavity is a basic example that has been explored to quantify the chaotic mixing using the exponential growth rate of material lines. This growth rate is also known as topological entropy (TE). One motivation for studying the lid-driven cavity is that the flow can be modeled by a period-3 mixing protocol, which is the simplest mixing model with non-zero TE. The traditional method to compute TE numerically for such a simple system is still computationally expensive, due to high sensitivity to initial conditions. Grover et al. developed a method using braiding to estimate the lower bound on TE [Grover et al., "Topological chaos, braiding and bifurcation of almost-cyclic sets," Chaos 22, 043135 (2012)]. With the purpose of predicting the TE more accurately, we develop a technique called homotopic lobe dynamics (HLD). This technique uses information contained in the intersections of stable and unstable manifolds to predict long-term dynamics. Using a finite number of iterates of manifolds, we were able to calculate a more accurate lower bound of the TE. With additional topological information, the TE converges even more closely to the traditional calculation. Furthermore, we predict using enough iterates in HLD will give the exact TE.

Solar Thermal Cooling in the Central Valley

Gustavo Cruz, Bennett Widoylar, Lun Jiang, Dr. Roland Winston

There is work at UC Solar, located at UC Merced's Castle facility that is looking to advance the applications and efficiency of Solar Thermal technology. The goal of the project is to improve the cost and efficiency of the solar thermal technology with a focus on an operating temperature range of 100 - 300 degrees Celsius. Solar energy is captured and utilized on site with external compound parabolic concentrators (XCPC), which are based on Dr. Winston's patented designs. The collectors are lined with reflective mirror film to concentrate light on an absorbing evacuated tube with a selective coating. The concentrators bypass the cost of a solar tracking system in that they do not require trackers to capture energy from the sun.The thermal energy that is captured by the concentrators can be used for pre-heating purposes, high temperature industrial processes or for Air-Conditioning. The solar array at Castle is used to power a Double Effect Absorption Chiller, which in turn provides air conditioning for a 12x60 foot trailer.

Bovine Serum Albumin Increases the Affinity of Lipid to Silica Bead

Diana Esparza, Chai Lor, Jing Xu, PhD, Linda Hirst, PhD; School of Natural Sciences, University of California, Merced.

Since it has been recognized that lipids are vital for cellular functions such as pathway signaling, generation of ATP, and compose the plasma membrane in cells, there has been great interest in the synthesis of vesicles to study membrane properties and functions. Vesicles are composed of amphipathic phospholipids and they serve as cargo to transport biological materials from one region in the cell to another. We have investigated the efficiency of lipid coverage onto silica beads in various solvents. The lipid DOPC (1,2-Dioleoyl-sn-glycero-3-phosphatidylcholine) was coated onto pretreated silica beads via vesicle fusion. Both fluorescent microscopy and differential interference contrast microscopy (DIC) were used to analyze lipid coverage. Our findings indicate that bovine serum albumin (BSA) increases the affinity of lipids onto silica beads compared to casein. Also, the lipid-coated beads are stable after treatment with general tubulin buffer (PEM).

Simulating a Gravitational Communications System

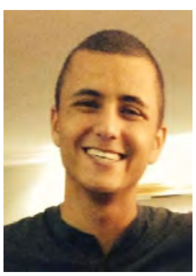
Enrique Guerrero, Jay E. Sharping, PhD; Physics, University of California, Merced

We present simulations of the signal generator for a gravitational communications system. The successful generation and detection of gravitational radiation would be profound in that it would confirm the existence of such radiation and validate the general theory of relativity. Moreover, a gravitational communication system would improve upon electromagnetic communications due to its ability to penetrate dense bodies such as the earth, sending a signal from one location on earth to another without the use of satellites. Crucial to this experiment is attaining resonant cavity with a high Q, a measurement of how purely our system resonates. Necessary Q values can and have been achieved using superconducting cavities. Because gravitational radiation is so weak, we propose to amplify it using a superconducting cavity. Simulations of the system are crucial to optimize cavity design parameters. Using COMSOL Multiphysics, we simulate a set of three resonant cavities to create and amplify a paired radio frequency (11 GHz) electromagnetic-gravitational wave and then shield away the electromagnetic component, leaving behind a gravitational signal. Coupling between gravitational and electromagnetic radiation is achieved via a membrane, which is driven into motion by electromagnetic radiation pressure. The simulation is being conducted concurrently with preliminary cavity experiments.

Role of Organic Ligands in Controlling Nanoparticle Behavior

Harmanpreet Panesar, Blessing P. Cao, and Jason E. Hein, PhD; Department of Chemistry and Chemical Biology, University of California, Merced

Metamaterials show potential to be used for improving lenses, telescopes, invisible cloaks, antennaes', etc. The challenge is to prevent precipitation and increase the stability of quantum dots that constitute the metamaterials. A recent study has identified a new organic ligand that is capable of both dispersing CdSe quantum dots in a liquid crystal host material as a stable colloid. In addition, this same ligand can guide the formation of micron-scale assemblies of quantum dots as stable micelles. This investigation aims to synthesize a new library of 16 organic ligands and test their ability to both disperse and direct the assembly of CdSe quantum dots in a liquid crystalline host. Each ligand is coupled to quantum dots via non-covalent interaction with the amine substituent. UV absorbance spectroscopy, polarized optical microscopy, photoluminescent scanning confocal microscopy, and X-ray diffraction are performed to analyze ligand and quantum dot interaction.



Optimizing Charge Storage in Lithographically Patterned Gold-PEDOT Core-Shell Nanowires

Justin van Staden and Erik J. Menke, PhD; School of Natural Sciences, University of California, Merced

Poly(3,4-ethylenedioxythiophene) (PEDOT) is a conducting polymer commonly found as the active material in electrolytic capacitors, and is also used for flexible electronic devices and as the hole-conduction layer in organic photovoltaics. Contrary to most materials, the physical and electrical properties of PEDOT are heavily dependent on a number of factors, including morphology, oxidation level, doping level, and crystallinity, all of which are a function of various synthesis parameters such as synthesis temperature, synthesis method, and solvent. Although PEDOT is a highly researched material, there are no clear trends between between synthesis parameters and material properties. The goal of this project is to address this issue and correlate PEDOT nanowire properties with synthetic parameters. In additional, gold-PEDOT nanowires were synthesized to determine how a conductive core affects nanowire properties. Lithographically patterned nanowire electrodeposition (LPNE) was used to synthesize these wires, which were later examined for the effects of different parameters; such as deposition voltage, deposition time, and nanowire size, on the electrical resistivity and the capacitance. The Raman spectra of the nanowires shows that the PEDOT oxidation state is independent of deposition voltage and time, while both the capacitance and electrical resistivity vary with deposition potential, deposition time, and nanowire size. We hypothesize that these differences are a result of variation in the PEDOT crystallinity and average chain length, and are currently working to test this hypothesis.

The Following Students Participated in the Louis Stokes Alliance for Minority Partipciation (LSAMP) NSF Program:

Designing a Robot with Shape Metal Alloy (SMA) as Actuator and Controlling it with Arduinos

Johnny Vang, The Nguyen Mechanical Engineering, California State University Fresno

The purpose of using shape-memory alloy (SMA) in replace of electric motors is to reduce the cost and weight of a product. The objectives of this research are to prove that SMA wire can be used to replace electric motors and show the efficiency of it versus conventional counterparts. A mini-robot was designed with four legs and one arm, which only used SMA wires to move each component. SMA is a smart metal that remembers its original shape. If the SMA is deformed through force or other means, it will return to its pre-deformed shape when heated. The SMA in this experiment was heated by passing electricity through each wire. Torsion springs were also used to deform the SMA and helped move the components back to their original position. The robot was then programed with the microcontroller Arduino that controlled the level of electricity being inputted to each SMA wire. The degree of inputted electricity directly relates to the output of heat to the SMA wire. Standard equations of motion for SMA were also derived and used to model how SMA would move in relation to the inputted electricity in Simulink (Simulation and Model-Based Design). With the combination of Arduino and Simulink, the robot was controlled via controller and demonstrated that SMA can be used in replace of electric motors. Though the adaptation of using SMA wire greatly reduces the efficiency of the robot, it proves that alternative methods can be used to electronic motors.

Giant Tusk-Tooth Salmon and Galapagos-sized Tortoises from the latest Miocene of Central California

Jake N. Biewer, Julia Sankey, Geology, California State University Stanislaus

The late Miocene Mehrten Formation exposed in the low foothills of the northern San Joaquin Valley consists of volcanic-sedimentary deposits representing lahar flows, stream, lake, and floodplain deposits. While the mammals from the Mehrten are well documented, the fish and herpetofauna have been less studied despite providing important paleoenvironmental, paleoclimatic, and paleogeographic information. We look at specimens found at Turlock Lake, California in order to determine this information. Oncorhynchus rastrosus is a three meter long, planktivorous, tusk-toothed salmon found from the western United States, notably California, Oregon, Idaho, and Washington, from both freshwater and marine deposits. At Turlock Lake it was found in a fluvial deposit, thus the salmon had traveled upstream to spawn, likely from a marine embayment in Southern California depicted in late Miocene/Pliocene paleogeographic reconstructions. We imagine it was traveling up a proto-Tuolumne that existed at the time based on the cobbles and coarse gravel at the site. Also found in the sediments of Turlock lake are shell fragments of the giant tortoise Hesperotestudo sp. Giant tortoises like Hesperotestudo, due to being ectothermic, generally require a higher ambient environmental temperature to maintain their body heat meaning that temperatures were likely warmer. Tortoises also tend to indicate a climate with rare frost which corresponds to paleoclimatic interpretations based on the flora, in particular the frost sensitive genus Persea, to which the avocado belongs.

The Role of the Central Complex: Visuo-Motor Control during Obstacle Avoidance

Shazia Ali, Joy Valenzuela, Sonia Mendoza, David Lent, PhD, Biology,
California State University, Fresno

In insects, the central complex has been found to be important in the selection of motor programs and in coordinating multi-joint movement. Importantly, the central complex has been shown to, in part, represent visual information and be critical in visuo-motor integration. For functional analysis of the neural basis of the visuo-motor integration programs, Drosophila melanogaster offers sophisticated methods for the genetic manipulation of a small subset of neurons. The primary focus of this study has narrowed down to the set of neurons that comprise the ellipsoid body in the central complex. The GAL4/UAS system, along with GAL80, is used in intent to silence the GAL4 neurons in the ellipsoid body. The technique used to uncover the most efficient construct of this system is by creating mutants from the three different lines of GAL80 crossed with the GAL4/UAS system, along with heat treatment. The final result will lead to controlled silencing of the GAL4 neurons. After determining the correct construct, Kir channels will be inserted into the ellipsoid body. One of the three GAL80 lines has failed to provide the silencing effect, while the other two are work in progress. This preliminary data will be used in future visual guided behavioral assay.

Solvent Effect in the Photophysical Properties of Free-Base Corrole

Anthony Loogman, Stephanie Becerra, and Elvin A. Alemán*
Department of Chemistry, California State University Stanislaus, Turlock, CA 95382

Corroles, which are tetrapyrrolic ring structures, have become a focus in research including the diagnosis and treatment of cancer and in the construction of artificial photosynthetic devices. They have structures and photophysical properties similar to that of porphyrins. Corroles, just one carbon shorter than porphyrins, show significant differences in photophysical properties when dissolved in nonpolar and polar solvents. These solvent dependent optical differences correspond to the formation of two tautomers with a different arrangement of the conjugated π-system in the macrocycle. New methods of synthesizing corroles have been discovered, providing better yields to further the research of its chemical and photophysical properties. In order to obtain greater yields of corrole, free-base triphenylcyanocorrole (CN-Corrole) was synthesized and purified. It was characterized using 1H-NMR and mass spectroscopy. The UV-visible spectra of CN-Corrole showed similar tautomeric effects to that of unsubstituted corrole, which demonstrated that CN-Corrole is a good model to study solvent effects in the structure and photophysical properties of free-base corrole. When CN-Corrole is dissolved in DMSO (polar solvent), the absorption spectrum is different than that in Toluene (non-polar solvent). These differences correspond to the formation of the two tautomers of CN-Corrole. However, when it was dissolved in acetone, acetonitrile, pyridine, and other solvents, the UV-visible spectra showed that both tautomers coexist in solution. The objective of this project is to characterize the photophysical properties of CN-Corrole and find how the solvent controls the tautomerization transition. The Corrole's optical properties will be compared to the solvent's properties.

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