2017

Summer Undergraduate Research Mentored Experience

at The University of Texas at El Paso

PROGRAM OVERVIEW

The Summer Undergraduate Research Mentored Experience (SURME) Program engages highly motivated undergraduate students in 10 weeks of multidisciplinary, hands-on research. Each student is carefully matched with a faculty mentor based on a project of interest. SURME's holistic approach includes enriching professional development workshops and immersive social/cultural activities. The aim of the program is to encourage students to gain valuable professional skills through immersion in research projects and cultural exchange, enabling them to acquire a deeper understanding of our global connectedness.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

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BEHAVIORAL & HEALTH SCIENCE PROJECTS

Dr. Feng Yang

Department of Kinesiology

Faculty Profile Link

Research Lab Link

KIN-01: VIBRATION TRAINING FOR PREVENTING FALLS AMONG OLDER ADULTS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Majors related to Biomechanics, Kinesiology, Sports medicine, and Mechanical engineering are qualified for this project. Skill of computer programming will be a plus.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Falls among older adults present a significant medical, societal, and economic challenge, affecting not only the frail or impaired, but the active and vigorous. Vibration therapy has been used to train seniors to improve their balance because it is easy-to-operate, safe, and cost-effective. However, it remains unknown if vibration training could indeed reduce falls among older adults. The overall purpose of this proposed project is to examine the effectiveness and feasibility of vibration training in preventing falls in elderly. Our project is scientifically and clinically significant. It will advance our understanding of vibration training in reducing falls in older population. If our results do support that vibration training can reduce falls among seniors, this type of training will provide another novel avenue to develop paradigms training older adults to reduce their likelihood of falls. As a result, the injuries and the incurred medical cost would decrease. The quality of life among older adults and their family will be improved. Our society will benefit as well.

RESEARCH QUESTION(S)

The overall objective is to systematically examine the effectiveness and feasibility of vibration training in preventing falls among elderly. Specifically, we will 1) determine if and to what extent an 8-week vibration training can reduce the likelihood of falls among older adults; and 2) determine the potential retention period of the training effect resulting from the vibration training.

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Two groups (training vs control) will participate. The training group will go through an 8-week vibration training course while the control group does not. An side alternating vibration platform will produce vibration stimulation to the body when subjects stand on the platform. After the training, both groups will be exposed to a simulated slip perturbation created by a treadmill.

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Dr. Ana Schwartz

Department of Psychology

Faculty Profile Link

PSYCH-01: PRIMING CONCEPTS ACROSS BILINGUALS' LANGUAGES TO IMPROVE READING COMPREHENSION

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Psychology background is preferred. Basic skills using excel are needed.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Through this research a new model of bilingual text comprehension will be formulated. Currently, theories of how readers form meaningful representations of what they read apply only to monolinguals. Bilingual reading is fundamentally different from monolingual reading because a bilingual's two languages are in continual interaction. This research will examine the effect of cross-language activation of concepts on the ability to comprehend new concepts that are described in a text written in a second language.

RESEARCH QUESTION(S)

- Does retrieving concepts in a dominant language lead to superior comprehension of new concepts presented in the weaker language?
- Does retrieving concepts in a weaker language interfere with later comprehension of new concepts presented in the weaker language?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

In this research we will use a combination of eye-movement tracking and computer tasks. For eye-movement monitoring, participants will read texts on a computer screen while an eye-tracking system records their eye fixations and eye-movements. For the computer tasks, participants will read texts on a computer screen and then recall as much as they can from what they read.

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ENGINEERING PROJECTS

Dr. Roger Gonzalez

Department of Engineering Education & Leadership

Faculty Profile Link

Research Lab Link

BIOMED-01: UNIVERSITY OF TEXAS JOINT LOAD SIMULATOR OR LIMBS INTERNATIONAL

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Desired Majors: Mechanical, Electrical, and Biomedical Engineering.

Valued Skills: Computer-aided Design, Mechanical Design, Electrical Design, and Program Design.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Dr. Gonzalez' Joint Lab has been developing the University of Texas Joint Load Simulator (UTJLS) for investigation of human knee stability, knee ligament injury, and osteoarthritis (OA). Knee ligament injury and the instability that follows is a major clinical problem. While bony geometry of the knee provides marginal joint stability, surrounding soft tissues such as ligaments, meniscus, and the active force contributions of muscles are necessary for withstanding some of the highest dynamic forces in the body. As such, injury to the anterior cruciate ligament (ACL) often results in knee instability, damage to collateral ligaments and menisci, and increased risk of OA. / The UTJLS is capable of overcoming critical barriers to progress in knee stability research by synchronously recreating muscle loads, external ground reaction forces, and joint kinematics on a cadaver knee specimen while measuring intersegmental force, ligament strain, and tibial translation.

RESEARCH QUESTION(S)

- How does ACL rupture change internal knee loading conditions, and how does it influence onset of osteoarthritis?
- Are knee braces effective in reducing risk of ACL failure?
- What role does bony knee geometry play in ACL failure?
- How does dynamic activity as compared to quasi-static knee movements alter internal knee loading conditions?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

A wide range of engineering design techniques will be employed to support UTJLS development. This includes Solidworks (CAD), Labview (Visual Programming Language), and Component Fabrication (Mill, Lathe, Assembly,

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etc.). Undergraduate students will be exposed to standard musculoskeletal research techniques (e.g. motion capture) and cutting-edge in vitro simulation (e.g. operation of the UTJLS).

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COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Ivonne Santiago

Department of Civil Engineering

Faculty Profile Link

Research Lab Link

CIVIL-01: NATURAL ZEOLITE AND PECAN SHELLS FOR SALINITY CONTROL,MOISTURE RETENTION AND SLOW-RELEASE FERTILIZER

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Basic knowledge of chemistry and geology, and have been exposed to a chemical laboratory. A basic knowldege of statistical concepts is prefered. Should be proficient in MS Office (Word and Excell).

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Innovative, efficient, inexpensive and environmentally acceptable alternatives, such as the use of natural materials like zeolite and agricultural waste such as pecan shells are needed to abate salt-affected soils, improve water use efficiencies, and optimize the amount of fertilizer applied to crops and fields. Saline soils occupy more than 20% of the irrigated lands and results in reduced crop yield. Use of water for agriculture accounts for more than 70% of all water withdrawals, so addressing conservation issues in agriculture are important to the effective management of our world water supplies Agriculture is one of the largest sources of nitrogen pollution as it is common practice to uniformly apply fertilizer everywhere irrespective of variables such as geology or natural nitrate reducing capacity in the soil. Excess nitrogen may be leached into the subsoil and enter the ground water and/or be carried by stormwater and agricultural return flows into surface water reservoirs impairing sources for drinking water due to eutrophication.

RESEARCH QUESTION(S)

The research questions that drives the experimental design of this project are:

1) Can we use natural zeolite and pecan shells as soil amendment for moisture and salinity control?
2) Can we effectively use surface modified zeolite as slow-release fertilizer in agricultural applications?
3) Can we use zeolite for treatment of marginal saline water and agricultural return flows?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Student will perform kinetic and equilibrium batch and column studies and will learn how to analyze isotherm and column data, how design experiments, and perform basic statistical analysis techniques using Minitab software. Student will learn to use analytical equipment consisting of basic pH, dissolved oxygen, and conductivity measurements, as well as an ion analyzer and a soil moisture meter.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

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Dr. Ivonne Santiago

Department of Civil Engineering

Faculty Profile Link

Research Lab Link

CIVIL-02: NATURAL ZEOLITE AS SOIL AMENDMENT TO CONTROL SALINITY AND MOISTURE CONTENT IN SANDY SOIL

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

MS Office (word and excell), basic chemistry and statistics.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Irrigation waters generally contain appreciable quantities of salts and crops extract water from the soil while leaving most of the salt behind. Unless leached away (continuously or intermittently), such salts sooner or later begin to hinder crop growth. In the El Paso area, like much of the arid southwestern United States, decreased supply of surface water has resulted in increased use of groundwater to supplement the drought-impaired surface water supply, which in turn has resulted in a groundwater overdraft, significant drops in groundwater levels, and a rise of brackish water levels. This means that more wells have been drilled and the wells have to be drilled deeper to find good quality water, which means higher energy costs. We are proposing to evaluate the use of natural zeolite as soil amendment to control salinity of the irrigation water and retain moisture in the soil. This proposal will provide a feasible and sustainable alternative for agricultural applications.

RESEARCH QUESTION(S)

The research questions drive the experimental design of the components:

1) What is the capacity of the zeolite to absorb salinity from solutions containing salts normally found in water supplies used in agricultural applications in the El Paso
2) What is the capacity of the zeolite to retain moisture?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Student will perform kinetic and equilibrium batch studies and will learn how to analyze isotherm data, will learn to design experiments, and perform basic statistical analysis techniques using Minitab software. Student will learn to use analytical equipment consisting of basic pH, dissolved oxygen, and conductivity measurements, as well as an ion analyzer and a soil moisture meter.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. David Novick

Department of Computer Science

Faculty Profile Link

Research Lab Link

CS-01: RAPPORT BETWEEN HUMANS AND EMBODIED CONVERSATIONAL AGENTS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

- Programming skills in an object-oriented language such as Java or C#
- Curiosity
- Strong verbal skills

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Dr. Novick's research program focuses on interactive systems and, especially, building rapport in multimodal conversation. Current research projects include making conversations with embodied conversational agents (ECAs) more effective through modeling and implementing conversation control acts, and improving agent's capacities to produce and understand gesture.

An ECA is a computer program that produces an intelligent agent that lives in a virtual environment and communicates through an elaborate user interface. How ECAs can build rapport with humans remains an open question, though. Human-agent communication cannot yet achieve the naturalistic and spontaneous communication that humans do unconsciously; familiarity-enabled ECAs are a step towards a more naturalistic human-agent conversation.

In the last two years, our team has built two major ECA-based systems that serve as test-beds for experiments that explore the effects of changes in ECA behaviors on perceived rapport.

RESEARCH QUESTION(S)

1. Does increasing the gesture size, which is associated with increase in familiarity, lead humans to perceive increases in human-ECA rapport?
2. What are the differences, if any, in ways in which extraverts and introverts produce and perceive gestures?
3. What would be usable design and implementation for XML-based authoring tools for ECA systems?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Depending on the specific research project, things to be learned might include:

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- Modeling and game tools, such as Maya and Unity
- Motion-capture and animation techniques
- Building XML-based authoring tools
- Experimental design and analytical methods for study of human production and perception of gesture
- Statistical analysis of experimental results

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Christopher Kiekintveld

Department of Computer Science

Faculty Profile Link

Research Lab Link

CS-02: DEFEATING THE DARK TRIAD IN CYBER SECURITY USING GAME THEORY

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Students should have a background in computer science (or a closely related field like mathematics), or psychology. Strong math skills and/or programming skills are desirable.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Computational game theory is a key tool for improving cybersecurity using artificial intelligence. It provides the capability to model interactions between multiple decision-makers, and solution concepts to analyze these models to predict likely outcomes, or evaluate courses of action. We will expand the capabilities of game theory for cybersecurity by developing and validating solution concepts based on richer concepts of human decision-making, both individually and in groups. We will conduct pilot studies to identify promising factors that are predictive of behavior, and then integrate these factors into game-theoretic models for making decisions related to cyber security. We will validate these models and the decisions they suggest using a combination of controlled experiments with human participants and analysis of data from behavioral observations of real-world users making security decisions.

RESEARCH QUESTION(S)

The broad hypothesis of our research is that integrating findings from psychology on the influences of personality, society, and culture on decision-making into game-theoretic solution concepts will improve the ability of game theory to predict and exploit human behavior patterns in cybersecurity games.

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

This interdisciplinary project brings together research on psychology (particularly on dark triad personality traits) and working in computer science on computational game theory applied to cybersecurity decisions. Depending on the background of the student, they may be involved in mathematical modeling/analysis, programming, laboratory studies with human participants, and/or data analysis.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Christopher Kiekintveld

Department of Computer Science

Faculty Profile Link

Research Lab Link

CS-03: TRADING AGENT DESIGN FOR SMART GRID ENERGY MARKETS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Students should have strong background in programming in Java, as well as strong math skills. Students should be majoring in computer science or a closely related field such as mathematics.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Power systems and energy markets are quickly evolving due to new generation and storage technologies, as wells as the integration of new "smart" technologies to monitor and control distribution and consumption activities. One challenge is how to design better energy markets, including better strategies for agents who trade in the markets. This project seeks to design improved automated intelligent trading strategies for agents participating in energy markets. We are competing in the annual Power TAC competition, which is an international competition in which automated trading agents compete to maximize profits in the realistic simulation of an energy market integrating smart grid elements. There are many challenging research problems in implementing an agent for this competition, including improving price and demand predictions using machine learning, designing new bidding strategies for participating in complex auctions, and designing strategies for issuing and updating tariffs to present to potential consumers.

RESEARCH QUESTION(S)

We are working to find ways to improve the performance of automated trading agents in energy markets, including improvements to both market predictions and trading strategies in multiple types of complex auctions.

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

We will program novel agent designs using the Java programming language, and may use a variety of techniques in artificial intelligence including machine learning and optimization.

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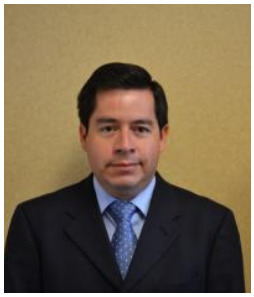

Dr. Oscar Mondragon

Department of Industrial, Manufacturing & Systems Engineering

Faculty Profile Link

INDUS-01: TESTING AND COMPARING MULTIMEDIA AND INTERACTIVE TOOLS THAT INCREASE ONLINE STUDENT ENGAGEMENT.

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

- ability to play and use new technology
- ability to conduct independent study
- knowledge of social media tools and multimedia editing software
- written and oral skills

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Online education is a new venture that has evolved in the last two decades. Online education was initially targeted to remote locations with no schools. Classes were recordings of delivered courses with no synchronous communications. Now, online education has more needs to cover and more demands to satisfy. Today's technology allows communication of data, voice, and video. Smart phones have cameras, microphones, internet access, and several programs for synchronous communications. The new generation was born with these technology and expects that the new education makes use of it. New courses are expected to be engaging and use diverse media while they challenge students and allows them to collaborate. Professionals have developed tools and methods that facilitate online education; e.g., tools that facilitate remote meetings; screen sharing; video editing; blogs; interactive webpages; learning management systems, use of short lectures, and self-managed teams. It is important to identify available tools and test them so tool recommendations can be given for specific needs or goals.

RESEARCH QUESTION(S)

1. What tools or methods characteristics are needed to engage students?
2. What tools or methods characteristics are more attractive to students?
3. What tools or methods characteristics increase student learning?
4. What criteria should be used to select a tool or method to develop online courses?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

- Multimedia tools
- Methods and tools that increase student engagement

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- Decision analysis and resolution
- Casual analysis and resolution
- Decision tables and decision trees
- Developing a plan and provide project status

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Bill Tseng

Department of Industrial, Manufacturing & Systems Engineering

Faculty Profile Link

INDUS-02: APPLICABILITY AND UTILITY OF TRADITIONAL QUALITY CONTROL TO ADDITIVE MANUFACTURING AND NANOTECHNOLOGY

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Critical thinking, logical reasoning, observation skills, creative assembly of new configurations.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Additive manufacturing and nanotechnology are among the most promising of the emergent disruptive technologies. Even though many advantages and benefits can rightfully be ascribed to these technologies, there remain several limiting factors which need to be investigated before these technologies can enjoy wider utilization and availability. One limiting factor has been the narrow selection of available materials. But also, the aspect of Quality Control (QC) and Quality Assurance (QA) application to these technologies has not been sufficiently investigated.

The research described herein is focused on understanding the applicability and utility of three specific QA/QC aspects to the processes underlying these new technologies:

- The first aspect is dimensionality, which is the basis for the seven Basic Tools of Quality.
- A second aspect involves the idea of process control as it may be applied to additive manufacturing and nanotechnology. Here we include embedded sensors in the process control feedback loops.
- Thirdly, this research will look at the aspect of testing

RESEARCH QUESTION(S)

1. What is the level of applicability of non-Cartesian measuring methods to inform dimensionality in additive manufacturing and nanotechnology?
2. Which factors support or impede the application of Statistical Process Control (SPSS) methods to additive manufacturing and nanotechnology?
3. What factors support or inhibit the application of current selection and preparation methods to additive manufactur

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

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A wide range of research techniques will be used to conduct the study, including literature reviews, design of experiments, running pilot studies, observation and recording of actual industrial processes involving additive manufacturing and/or nanotechnology. Thus, summer undergraduate students will be exposed to diverse and forward-looking techniques in the field of Industrial Engineering.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Amit Lopes

Department of Industrial, Manufacturing & Systems Engineering

Faculty Profile Link

INDUS-03: SOCIAL MEDIA APPLICATIONS IN SUPPLY CHAIN MANAGEMENT

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Industrial Engineering, Manufacturing Engineering, Social Media Proficiency, Data Mining, Basic Programming Skills

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Global manufacturing operations has mandated evolution of traditional Supply Chain Management (SCM) principles. Current SCM principles utilize methodologies and tools to predict the dynamic nature of a global supply chain, but is still room for improvement to achieve a more accurate product delivery algorithm while addressing uncertainty in the SCM. Social media applications currently utilized around the world present an intriguing possibility in the information flow aspect of global SCM modeling. Supply chain participants can utilize social media to keep track of current situations, such as a delay in shipping or a carrier failed to pick-up a shipment by monitoring supply chain events and transactions. Data mining for information relevant to the supply chain within global social media can provide timely and insightful information about risks and events and enable real-time adaptation and modification to ensure a more robust SCM model. Currently, the use of social media as a verifiable information flow artifact within a glob SCM model has not been sufficiently investigated.

RESEARCH QUESTION(S)

- Determine information flow parameters important to the development of an optimum predictive SCM model
- Determine the level of applicability of data mining methods to gather verifiable information from accessible global social media
- Adapt current SCM architectures to include real-time verifiable information from social media to potentially improve responsiveness and reduce uncertainty?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

A wide range of research techniques will be used, including literature reviews to understand global SCMs limitations, data mining tools, architecture modeling, and analysis of actual SCM process realization involving real-time information flows. Thus, summer undergraduate students will be exposed to innovative methodologies and techniques in the fields of Industrial and Manufacturing Engineering.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Amit Lopes

Department of Industrial, Manufacturing & Systems Engineering

Faculty Profile Link

INDUS-04: US MANUFACTURING CAPABILITIES: SMALL MOTORS, TOOLING, FABRIC

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Industrial Engineering, Manufacturing Engineering, Analytic skills, technical report writing skills, vendor management, survey design

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Manufacturing activities within the United States are experiencing a revival. Small and medium enterprises (SME) centered on manufacturing such as small motors, tooling, and fabric manufacturing are a significant fraction of the overall manufacturing industry in the US. The survival and growth of these SMEs depend on implementation of not only state-of-the art manufacturing methodologies but also adoption innovative technologies. The state of Texas has historically enjoyed being a SME manufacturing hub. However, there are several factors which may hamper the adoption of innovative technologies and methodologies to keep up with the challenges of the global market. The goal of this research is to investigate current state of manufacturing capabilities in the three sectors in the and propose methodologies for adoption of state-of-the-art novel technologies for improved and sustained growth. Through this project, undergraduate researchers will utilize TMAC national databases to identify and survey these industries to understand their capabilities in the in the three sectors.

RESEARCH QUESTION(S)

1. List current capabilities within the small motors, tooling, and fabric manufacturing sectors in the US using focused surveys
2. Determine which factors support or impede the adoption of state-of-the-art and novel manufacturing methodologies for the three sectors?
3. Identify strategies for closing the gaps in manufacturing capabilities for improved ans sustained growth in these sectors.

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

A wide range of research techniques will be used to conduct the study, including focused surveys, running pilot studies, observation and recording of actual industrial processes involving local small motors, tooling, and fabric manufacturers. Summer undergraduate students will be exposed to diverse and forward-looking techniques in IMSE related fields while improving technical and people skills.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Bill Tseng

Department of Industrial, Manufacturing & Systems Engineering

Faculty Profile Link

INDUS-05: DEVELOPMENT OF SUPPLIER QUALITY MANAGEMENT IN AERONAUTIC INDUSTRY USING COMPUTATIONAL INTELLIGENCE

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Programming (MATLAB, VB, etc..), Dashboard Design, all engineering majors are welcome to apply. However, prefer computer science and engineering, mechanical or industrial engineering students

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Aeronautic industries have limited resources to optimize surveillance of suppliers. As a result of that constraint, they can only audit a limited amount of suppliers during certain periods of time. The problem with choosing audits' frequency in this manner is that those risks that the company takes with the material/parts they supply are not taken into account. They neither combine such risks with quality ratings, compliance with standards such as ISO, corrective actions request, etc. Therefore, a methodology that will take into account and combine all these factors was needed in order to allocate enough future resources to audit each supplier. Such methodology is called as "Predictive Quality Management Approach." The main objective of the "Predictive Quality Management Approach" project is to develop a data-driven risk assessment of suppliers and to determine surveillance frequencies based on computational intelligence. Deliverables will be focused on a recommendation of set surveillance frequencies for each supplier based on risk and the approach for future resource allocation.

RESEARCH QUESTION(S)

The main objective of this proposed project is to be able to develop an effective predictive quality management approach to evaluate supplier's performance particularly to significantly reduce the cost of poor quality related to suppliers in aeronautic industry. The proposed approach will conduct a risk assessment of current suppliers and determine surveillance frequencies.

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

The approach that will be used during the research is:

- Identification of characteristics of the supplier in aeronautic industry
- Literature review on quality control and computational intelligence techniques
- Development of the predictive quality management approach
- Implementation of the predictive quality management approach

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- Validation and verification of the proposed approach

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COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Eric Smith

Department of Industrial, Manufacturing and Systems Engineering

Faculty Profile Link

INDUS-06: TECHNOLOGY MANAGEMENT FOR DMSMS (DIMINISHING MANUFACTURING SOURCES AND MATERIAL SHORTAGES)

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

- Engineering, Science or Mathematics majors.
- Ability to research literature and synthesize findings.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Technology Management (TM) is an emerging field in nearly every industry. The global market demands a steady provision of new products, services and innovative ideas that call for increased functionality, quality, reliability, and capability.

The concept of Technology Management and the satisfaction of underlying customer needs centers around best practices, like Systems Engineering, which must be exercised within industry to tackle demanding challenges that are posed by Product Obsolescence, Diminishing Manufacturing Sources (DMS) and Material Shortages (MS). Any system that is subject to improvements must be adaptive to different criteria over time. Recurring improvements to systems include: accommodating evolving customer needs, modifications, technology insertions, components obsolescence and requirements evolution, as well as changes in funding, scheduling and risk constraints.

Historical data and current literature indicate that the problem of obsolescence is a serious threat to the many industries, and that obsolescence poses a critical issue for many large projects.

RESEARCH QUESTION(S)

1. In the face of DMSMS, how can Technology Management Analysis Processes best optimize: DMS Avoidance, Mitigation Strategies, Extended Production, Alternative Sources, and Substitute Components?
2. How can engineering practices help: such as Die Replacement, Ruggedization, Bridge Buying, Life Time Buying, Reverse Engineering and Rapid Prototyping?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

There are a variety of Technology Management and DMSMS Analysis Tools which will be applied, including: DMSMS Alert & Prediction, Technology Readiness Levels, Decision Support for Logistics and Supply Chain Management, and Technology Road Mapping.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Devesh Misra

Department of Metallurgical, Materials & Biomedical Engineering

Faculty Profile Link

Research Lab Link

MATLS-01: SYNTHESIS OF NANOMATERIALS FOR BIOMEDICAL APPLICATIONS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

We will train the students in different characterization methods.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

The capability of synthesizing and processing biomaterial surfaces with tailored surface morphology and consequently control assembly of proteins, provides the possibility of eliciting specific, timely, and desirable response from the surrounding cells and tissues necessary for implant efficiency. Other broader impacts are: (a) Protein adsorption is relevant to fields such as tissue regeneration, prosthetics, and drug delivery because in each of these cases protein adsorption is the primary event. The study of adsorption behavior of protein on stainless steels is practically relevant to stent applications, where stainless steel and NiTi alloys are used. (b) The insights acquired from the proposed research using stainless steel, is directly applicable to other metals (e.g. titanium alloys), ceramics, and nanoscale structure of polymers because of similarity in the relationship between surface morphology, protein adsorption and cellular activity. (c) Understanding of protein adsorption at biointerfaces impacts interfacial processes in neurobiology and bio-nanotechnology. In neurobiolog

RESEARCH QUESTION(S)

The research addresses following issues: (a) what is the origin of differences in protein adsorption at biointerfaces and the mechanisms involved, (b) how do the differences in protein adsorption at biointerfaces influence osteoblasts functions, and (c) what are the mechanisms that govern protein-cell interactions

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Task 1. Study the relationship between self-assembled structure of pre-adsorbed protein and physico-chemical properties of surface.

Task 2. Study the dependence of cellular and molecular activity on self-assembled structure of pre-adsorbed proteins

Task 3. Study the organization of key proteins involved in cellular activity and biological functions

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Ramana Chintalapalle

Department of Mechanical Engineering

Faculty Profile Link

MECH-01: SYNTHESIS AND CHARACTERIZATION OF LEAD-FREE CALCIUM (CA) AND CERIUM (CE) CO-DOPED BARIUM TITANATE

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Materials Science and Engineering or Mechanical Engineering

Note to International Students: Due to U.S. Department of Defense (DoD) projects national origin is restricted to Mexico and Canada.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Dr. Ramana's research program at the University of Texas at El Paso (UTEP) is focused towards the fabrication, testing, property measurement and evaluation of novel, cost effective lead-free perovskite based materials for piezoelectric energy harvesting devices. The challenging goal of the project is to understand the fundamental scientific merits and to realize the new lead (Pb) free piezoelectric ceramics based on $Ba(1-x)CaxCe(1-y)Ti_yO_3$ (BCCT). Interest in lead-free ferroelectric piezoelectric materials has surged over the years owing to the need to find a potential replacement of the commercial piezoelectric-lead zirconate titanate (PZT) based sensors and actuators, which is facing global restrictions due to toxic lead. Perovskite lead-free piezoelectrics are potentially safe and environment friendly. Thus this project is tailored to design efficient BCCT ceramics for enhanced energy harvesting by utilizing the key idea of co-doping to modify the Ba-titanate. Improved piezoelectric response is expected with calcium (Ca) and cerium (Ce) co-doping in $BaTiO_3$ lattice.

RESEARCH QUESTION(S)

1. What are the structural and chemical changes associated with Ca and Ce co-doping into perovskite $BaTiO_3$?
2. What is the effect of Ca and Ce content on mechanical and electrical properties of BCCT piezoelectric sensors?
3. The scientific question in this case is whether the Ca and Ca co-doping can be a Curie temperature modifier or not?
4. What is the optimal composition for improved performance.

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

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Students will use a wide range of experimental methods and analytical techniques; they will be trained to synthesize ceramics and to characterize the microstructure of BCCT samples through X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), and Raman spectroscopy. Students will also learn the methods for electrical characterization.

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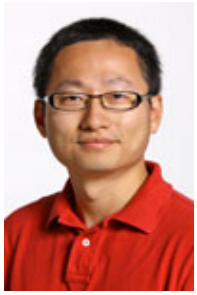
SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES



Dr. Yirong Lin

Department of Mechanical Engineering

Faculty Profile Link

Research Lab Link

MECH-02: WOVEN FABRIC COMPOSITES WITH EMBEDDED TEMPERATURE SENSING AND ENERGY HARVESTING

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Any major in Science or Engineering. Materials synthesis or characterization skills are a plus.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Dr. Lin's research program is focused on the design, fabrication, and characterization of multifunctional materials for applications such as sensing, energy storage, and multifunctional structures that are environmentally friendly.

In the last two decades, the use of composite materials in structural applications ranging from aircraft and space structures to automotive and biomedical as well as ballistic armor applications has been growing interest [1]. These polymer based composites are being used due to their higher stiffness and strength per unit weight in comparison with aluminum and titanium alloys.

Additionally, the environmental energy harvesting to power low-energy consumption systems is becoming a growing topic for the large deployment of wireless sensor networks and increase of integration and functional density of electronics. The inclusion of pyroelectrics in woven fabric composites would allow low-energy harvesting in different applications such as the construction, aircraft, and automobile industry. This energy would allow the development of more intelligent systems

RESEARCH QUESTION(S)

This project will address the following questions:

1. What is the proper fabrication method to embed pyroelectric ceramics in cabon fiber composites?
2. What is the optimal location of the pyroelectric ceramic in carbon fiber composites?
3. How to improve the energy harvesting efficiency of the hybrid camposites?
4. How to achieve electrical properties of the composites without compromising mecha

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

The students will be familiar in each stage of the research process, fabrication of woven fabric composites, composites fabrication using vacuum bagging technique, synthesis of inorganic nanowires on carbon substrates,

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materials characterization using scanning electron microscopy, and X-ray diffraction measurement (XRD), data acquisition and analysis using NI DAQ board, processing of experimental

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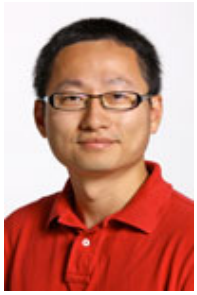
SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES



Dr. Yirong Lin

Department of Mechanical Engineering

Faculty Profile Link

Research Lab Link

MECH-03: ADVANCED HYBRID NANO MATERIALS FOR ENERGY STORAGE DEVICES

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Any major in science or engineering, prefer with wet lab skills but not mandatory.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

This project aims at synthesis, characterization, fabrication and testing of modified graphene based electrode materials for high energy density lithium ion battery for energy storage. A low temperature hydrothermal method will be utilized for growing metal oxide nanowires on graphene surface resulting higher surface area for electrode electrolyte interaction which improves the lithium ion diffusion rate. Therefore, this new nanowire/graphene hybrid anode material could enhance the specific capacity and charge-discharge rate of lithium ion battery.

RESEARCH QUESTION(S)

1. What is the optimized hybrid material geometry for maximum energy density?
2. How does the inorganic vs organic materials interface affect charging/discharging rate?
3. Whether there is any feasibility of integrate energy storage devices in structural materials without sacrificing structural integrity.

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Wet lab nano mateirals synthesis, hydrothermal, centrifuging, filtering. SEM, XRD, electrochemical testing.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Ramana Chintalapalle

Department of Mechanical Engineering

Faculty Profile Link

MECH-04: INVESTIGATION OF ENGINEERED CERAMICS FOR HIGH TEMPERATURE OXYGEN SENSORS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Mechanical Engineering; Materials Science & Engineering

Note to International Students: Due to U.S. Department of Defense (DoD) projects national origin is restricted to Mexico and Canada.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

High-temperature oxygen sensors are needed for a wide range of technological applications in energy and automotive industry. While cost effective metal oxide semiconductor based resistive oxygen sensors have attracted much attention, their functionality is dependent on the oxygen partial pressure and temperature. On the other hand, if a temperature independent sensor can operate in a thermally fluctuating environments, especially those encountered in power generation systems, and can improve the efficiency dramatically. However, such materials for sensing are not readily available. In this project, we propose to engineer the ceramics based on ABO3 type perovskites. Specifically, the challenging goal of the project is to understand the fundamental scientific merits and to realize novel ceramics based on Barium-Tantalum with suitable dopants to obtain the temperature independent sensing behavior. Efforts will be directed to synthesize and evaluate $Ba_{(1-x)}La_xFe_{(1-y)}Ta_yO_3$ (BLFT) ceramics.

RESEARCH QUESTION(S)

1. What is the effect of lanthanum (La) and tantalum (Ta) content on the structure and chemistry of BLTO ceramics?
2. How much of La and Ta co-doping is needed to tailor the sensing characteristics?
3. What is the effect of La and Ta to obtain p-type versus n-type electrical conduction?
4. What is the temperature range that the BLTO ceramics can function effectively?
5. What is the role of La and Ta?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Students will use a wide range of experimental methods and analytical techniques; they will be trained to synthesize ceramics and to characterize the microstructure of BCCT samples through X-ray diffraction (XRD), and X-

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ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), and Raman spectroscopy. Students will also learn the methods to evaluate sensors.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Calvin Stewart

Department of Mechanical Engineering

Faculty Profile Link

Research Lab Link

MECH-05: INTEGRATED HIGH TEMPERATURE THREE-DIMENSIONAL DIGITAL IMAGE CORRELATION SYSTEM

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Microsoft Excel, MathCAD, Labview, Feedback Controls, Structural Mechanics Background.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

The purpose of this research project is to develop a three-dimensional digital image correlation (3D DIC) technique that is capable of testing Nickel-based superalloys, among other materials, in order to study their strain displacement fields as high temperatures. Nickel-based superalloys are of particular importance to the Materials at Extremes Research Group (MERG) because they exhibit a remarkable combination of high-temperature strength, toughness, and resistance to degradation in corrosive or oxidizing environments.[2] Because of their superior properties, Nickel-based superalloys are widely used in the aerospace field as materials in gas-turbine engines; thus, fully understanding the deformation and failure characteristics of these materials is crucial to developing predictive models and making stronger materials. In order to meet our objective of developing a 3D DIC technique, we propose modifying existing equipment at the MERG laboratory to conduct mechanical testing experiments on Nickel-based superalloys.

RESEARCH QUESTION(S)

It is hypothesized that using the research equipment in the MERG lab that a Integrated High Temperature 3D Digital Image Correlation System can be created.

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

The student involve in this project will learn how to operate a universal testing machine, configure a high temperature split tube furnace, and perform HT 3D DIC using UTEPs world class structural mechanics facilities.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Calvin Stewart

Department of Mechanical Engineering

Faculty Profile Link

Research Lab Link

MECH-06: AN INTEGRATED MECHANICAL TESTING AND CHARACTERIZATION SYSTEM FOR THIN-ENGINEERED MATERIALS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Mechanical testing experience, Microsoft office, SolidWorks or other CAD software, MathCAD

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

The objectives of this interdisciplinary research project is to develop an integrated mechanical testing and characterization system for investigations into thin- engineered materials including metals subjected to environment assisted cracking, thin film photovoltaics, and hydrogel biomaterials. In 2009, a Bose Biodynamic 5160 test instrument ($40k+) was procured by the UTEP Department of Mechanical Engineering. This 200 Newton machine, based on ElectroForce technology, is capable of applying millions of mechanical cycles into small specimens at a high frequency. A bioreactor environmental chamber was also procured that enables testing in a physiologically-relevant environment where a flow rate controlled aqueous and/or gas solution is circulated within a chamber enclosing the specimen. These unique abilities, enable the characterization of the ultra-high-cycle properties of materials under various mechanical-chemical environments.

RESEARCH QUESTION(S)

Can an integrated mechanical testing and characterization system be developed that will enable the study of environment assisted cracking, thin film photovoltaics, and hydrogel biomaterials?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Task 1. Integration of the Test Instrument
Task 2. Service and Training by TA Instruments
Task 3. Bioreactor Upgrade for Temperature Control
Task 4. Testing and Characterization
  a. Environment Assisted Cracking
  b. thin-film photovoltaics
  c. hydrogel biomaterials

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Calvin Stewart

Department of Mechanical Engineering

Faculty Profile Link

Research Lab Link

MECH-07: MECHANICAL TESTING AND CHARACTERIZATION OF SUPERALLOYS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Microsoft Excel, MathCAD, CAD Software, Structural Mechanics Background.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

The purpose of this research project is to develop a three-dimensional digital image correlation (3D DIC) technique that is capable of testing Nickel-based superalloys, among other materials, in order to study their strain displacement fields as high temperatures. Nickel-based superalloys are of particular importance to the Materials at Extremes Research Group (MERG) because they exhibit a remarkable combination of high-temperature strength, toughness, and resistance to degradation in corrosive or oxidizing environments. Because of their superior properties, Nickel-based superalloys are widely used in the aerospace field as materials in gas-turbine engines; thus, fully understanding the deformation and failure characteristics of these materials is crucial to developing predictive models and making stronger materials. In order to meet our objective of developing a 3D DIC technique, we propose modifying existing equipment at the MERG laboratory to conduct mechanical testing experiments on Nickel-based superalloys.

RESEARCH QUESTION(S)

It is hypothesized that an Integrated High-Temperature 3D Digital Image Correlation System can be created by the MERG Team.

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

The student involved in this project will learn how to operate a universal testing machine, configure a high temperature split tube furnace, and perform HT 3D DIC using UTEP's world class structural mechanics facilities.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Calvin Stewart

Department of Mechanical Engineering

Faculty Profile Link

Research Lab Link

MECH-08: FATIGUE TESTING OF ALUMINUM FOIL IN FLOW-ASSISTED STRESS CORROSION CRACKING ENVIRONMENT

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Microsoft Excel, MathCAD, CAD Software, Structural Mechanics Background.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

In this study, a universal testing machine will be used to investigate the flow-assisted stress corrosion cracking of Aluminum alloys subject to fatigue. Stress-corrosion cracking (SCC) describes the service failures of engineering materials that are caused by slow, environmentally induced crack propagation in the presence of stress. Fatigue is the cyclic application of load or displacement until fracture of material.

In 2010, the Office of Naval Research (ONR) launched a program targeted towards mitigating the stress corrosion cracking of aluminum alloys. Aluminum sandwich structures are used in ship hulls to minimize weight, provide high impact resistance, and provide good flexibility. It is hypothesized that the testing of metal foils can act as a surrogate for the mechanical behavior of individual cell walls in sandwich structures and enable a better understanding of the SCC susceptibility of Aluminum sandwich ship hulls.

RESEARCH QUESTION(S)

1) What are the fatigue properties of Aluminum foil?
2) How does flow-assisted stress corrosion cracking influence the fatigue properties?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

The student involved in this project will learn how to operate a universal testing machine, configure a bioreactor/environmental chamber, and perform fatigue tests at UTEP's world-class structural mechanics facility.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

NATURAL & PHYSICAL SCIENCE PROJECTS

Dr. Jianjun Sun

Department of Biological Sciences

Faculty Profile Link

Research Lab Link

BIOL-01: MOLECULAR PATHOGENESIS, PREVENTION AND DIAGNOSIS OF MYCOBACTERIUM TUBERCULOSIS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Any students who have learned biology, chemistry, physics and mathematics in college are welcome to join the lab. Students with lab experience and biochemistry/microbiology background are preferred.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Mycobacterium tuberculosis is one of the world's leading infectious agents. It is estimated that M. tuberculosis infects one-third of the world's population and kills 2-3 million people each year. China has the second highest "tuberculosis (TB) burdens" in the world after India. The extreme success of M. tuberculosis as a bacterial pathogen is attributed to its remarkable ability to modulate and evade a variety of host defense mechanisms. Understanding the details how M. tuberculosis manipulates host defense will help develop novel therapeutics and vaccines for treatment and prevention of TB. Failure to control the TB epidemic is largely due to lack of effective vaccines and diagnosis approaches. Dr. Sun's laboratory is devoted to understand the molecular and cellular mechanisms of TB infection and develop novel therapeutics, vaccines and diagnosis against TB. Currently, Dr. Sun's lab focuses on ESAT-6 and CFP-10, the two important virulence factors of TB, which are the major targets for understanding of TB pathogenesis and for development of novel vaccines and diagnosis against TB.

RESEARCH QUESTION(S)

1) What are the roles of ESAT-6 and CFP-10 in Mtb infection?
2) How does ESAT-6 interact with the host membrane?
3) What is the structure of ESAT-6 pore?
4) What is the best ESAT-6 mutant for developing novel TB vaccines?
5) How does ESAT-6 separate from CFP-10?
6) How to develop ESAT-6/CFP-10 into novel diagnostic tools for TB?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Dr. Sun's lab is specialized in analysis of protein structure and function using advanced techniques in biochemistry, biophysics and cell biology. Students will learn various techniques and operate state-of-art instruments, including

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but not limited to: mutagenesis, protein expression and purification (FPLC), protein fluorescence, bacterial infection, confocal fluorescence microscopy, etc.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Jianjun Sun

Department of Biological Sciences

Faculty Profile Link

Research Lab Link

BIOL-02: ROLES OF ANTHRAX TOXIN RECEPTOR 2 IN ANTHRAX TOXIN ACTION AND SCREENING OF ANTHRAX TOXIN INHIBITORS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Students with knowledge of biology, chemistry, physics and mathematics at college level are all welcome to join the lab. Students with lab experience and biochemistry/microbiology background are preferred.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Dr. Sun's lab focuses on how bacterial pathogens cause human diseases. One of our research interests is to investigate the function of anthrax toxin receptor on anthrax toxin action and develop anthrax inhibitors from natural products. Bacillus anthracis is the causative agent for anthrax and can be used as a potential biological weapon. The symptoms of anthrax are mainly attributed to the action of anthrax toxin. Anthrax toxin binds to cell surface receptor and traffics into the endosome, where anthrax toxin forms a protein-conductive pore on the endosomal membranes and translocate toxic enzymes into the cytosol to disrupt cellular function. Our recent study has suggested that anthrax toxin receptor plays an essential role in the anthrax toxin action. Disruption of the disulfide bonds in the anthrax toxin receptor inhibited the anthrax toxin action. Thus, our lab is investigating the mechanism of the disulfide-mediated inhibition of the toxin action and screening natural antioxidants that block anthrax toxin action through disrupting the receptor disulfide bonds.

RESEARCH QUESTION(S)

1) What is the cellular redox regulator of anthrax toxin receptor?
2) What are the active components in rosemary that inhibit anthrax toxin function?
3) Which natural antioxidants disrupt the disulfide bonds of anthrax toxin receptor?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Dr. Sun's lab is specialized in protein biochemistry, protein-membrane interaction and cell biology. Students will learn cutting-edge techniques for characterization of protein structure and function and protein-membrane interaction. Students will also learn to use anthrax toxin to challenge human cells and perform high-throughput screening of natural antioxidants that inhibit anthrax toxin action

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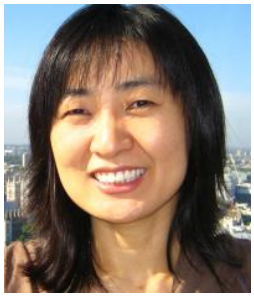
SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES



Dr. Kyung-An Han

Department of Biological Sciences

Faculty Profile Link

Research Lab Link

BIOL-03: NEURAL, CELLULAR AND MOLECULAR BASIS OF BEHAVIORAL PLASTICITY

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Biology, Biochemistry, Bioinformatics, Chemistry, or Comuter sciences; no skills required

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Dr. Han's lab research currently focuses on monoamine systems (e.g. dopamine and octopamine) and investigates the molecular and cellular mechanisms crucial for distinct behavioral plasticity including learning, memory and drug addiction, and underlying neural circuits. Abnormal dopamine functions underlie ADHD, autism, schizophrenia, Parkinson's disease and drug abuse/addiction. Han lab research contributes to better understanding of the pathogenesis mechanisms and interventions for dopamine-related disorders.

RESEARCH QUESTION(S)

1) How are natural stimuli (e.g. food)- and drug-induced (e.g. alcohol) memories formed and maintained?
2) What are the distinct features of reward vs. aversive memories?
3) Are active vs. passive memories formed by similar mechanisms?
4) Do the memories of olfactory vs. visual information involve distinct players?
5) Why does alcohol intake cause cognitive and motor impulsivity?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Dr. Han's lab uses molecular, immunohistochemical, pharmacological, genetic, optogeneitc, transgenic, behavioral, and statistical analyses in the fruit fly Drosphila as a model system, offering excellent multidisciplinary learning, training and education. Drosophila is a powerful model organism due to its well-characterized genetics, fully sequenced genome, and sophisticated nervous system and ge

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Luis Echegoyen

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-01: NOVEL CARBON COMPOUNDS (FULLERENES) FOR EFFICIENT SOLAR CELLS AND AS ANTI-HIV AND ANTI-CANCER AGENTS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

- No restriction, but prefer chemistry background, or physics and engineering.
- Previous research experience in organic or physical chemistry desirable.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Novel carbon-based compounds are designed, synthesized and characterized to be used as acceptors in OPV devices. Many of these are totally new fullerene cages and derivatives, including endohedral compounds containing encapsulated clusters inside carbon cages. Aspects of interest include the preparation of totally unprecedented Uranium endohedrals exhibiting unique U-U bonding and electronic properties. Some of the compounds are evaluated in Bulk Heterojunction (BHJ) solar cells and as electron extracting layers in perovskite solar cells, to increase the photoconversion efficiencies. Unique regiochemical reactions are designed in order to prepare well-defined and unprecedented compounds for improved solar cells. Several new compounds are designed to inhibit different stages of HIV infectivity, mainly the virus' protease. These studies are done in-vivo. Structure-function correlations based on the multiple compounds being prepared and studied are used in conjunction with theoretical calculations in order to elucidate the anti-viral mechanisms at the molecular level.

RESEARCH QUESTION(S)

1. Can novel fullerenes and derivatives act as efficient electron acceptors in BHJ solar cells?
2. Can they act as selective and efficient electron extracting layers in thin-layer perovskite solar cells?
3. Can new Triphenylamine-based compounds extract "holes" (positive charges) from perovskite cells?
4. Can appropriately designed fullerenes show selective anti-HIV and anti-cancer properties?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Arc reactor technology; automated extractions; HPLC, (specialized columns and recycling systems); Matrix Assisted Laser Desorption Ionization Mass Spectrometry (MALDI MS); electrochemistry (several techniques, like cyclic and square voltammetry); Nuclear Magnetic Resonance Spectroscopy (NMR); device frabrication; solar simulator; Raman spectroscopy; FT-IR Spectroscopy; Profilometry; TGA; others.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Chuan Xiao

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-02: STRUCTURAL STUDIES OF MAMMALIAN CIRCADIAN CLOCK PROTEINS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

- Major in biology, biochemistry, or chemistry will be preferred.
- Previous lab experiences is highly favorable.
- Good working ethics, team work spirit and good English communication skills are required.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Circadian rhythm is an intrinsic and roughly-24-hour biological clock embedded within most living organisms. In mammals, circadian rhythm coordinates sleep-wake cycles,blood pressure,body temperature and liver metabolism in a daily cycle. Disruption of the clock will lead to sleep loss and many other health problems. In the past two decades,many intrinsic clock related genes have been identified. Some of these genes encode for proteins,which form complexes that bind DNA and control the biological clock at the transcriptional level. However,science lacks the structural information needed to understand the detailed mechanisms that can explain how these clock proteins establish cellular cycles or oscillation rhythms in order to anticipate change in their environment. Dr. Xiao's research group combines the use of X-ray crystallography and cryo-electron microscopy to study the structures of the mammalian clock proteins and their complexes. This structural information will deepen our understanding of circadian rhythm and will help develop new therapeutic strategies for certain diseases.

RESEARCH QUESTION(S)

Structural studies in Dr. Xiao's research will address the following questions:

1. What are the atomic structures of core circadian proteins?
2. How do core circadian proteins interact each other?
3. What is the mechanism of the transcriptional control of circadian rhythm?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

The student will engage in hands-on activities to over-express circadian proteins for structural studies. The student will learn molecular biological skills such as DNA/protein electrophoresis, PCR, DNA ligation, protein expression, and protein chromatography. The student will obtain knowledge about start-of-the-art technology such as X-ray crystallography and cryo-electron microscopy.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Chuan Xiao

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-03: STRUCTURAL AND FUNCTIONAL STUDIES FOR A VIRAL GLOBAL SUMOYLATION INHIBITOR GAM1

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

- Major in biology, biochemistry, or chemistry will be preferred.
- Previous lab experience is highly favorable.
- Good working ethics, team work spirit and good English communication skill are required.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

In order to ensure their replication and survival, viruses must control host machinery. SUMOylation is a protein post-translational modification in which Small Ubiquitin like Modifier (SUMO) peptides are attached to target proteins with the purpose of altering their locations and final functions. Gam1,an early gene product of an avian adenovirus,is the first and by far the only viral protein found to globally inhibit cellular SUMOylation. However, the detailed mechanism by which Gam1 does so has yet to be elucidated. The objective of the project is to crystallize Gam1 and determine its three-dimensional atomic structure, which will shed light on the mechanism how Gam1 performs its function. The long term goal include study Gam1's interactions with its cellular target molecules. These results will deepen our understanding of Gam1's roles in viral replication and facilitate future usage of Gam1 as a cellular SUMOylation inhibitor.

RESEARCH QUESTION(S)

Structural studies of Gam1 in Dr. Xiao's research will address the following questions:

1. What are the structures of Gam1 look like?
2. How do Gam1 interact with its cellular target protein such as EloB/C and SAE1/E2?
3. What is the detailed mechanism by which Gam1 globally inhibits cellular SUMOylation?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

The student will engage in hands-on activities to express and purify Gam1, carry out its structural and functional studies. The student will learn molecular biological skills such as protein electrophoresis, protein expression, protein chromatography, western blot, and other biochemical experiments. The student will obtain knowledge about state-of-the-art technology such as X-ray crystallography.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Chuan Xiao

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-04: UNRAVEL THE ASSEMBLY OF THE GIANT MARINE VIRUS CROV

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

- Major in biology, biochemistry, or chemistry will be preferred.
- Previous lab experience is highly favorable.
- Good working ethics, team work spirit and good English communication skill are required.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Microorganisms produce 90% of the marine biomass and about half of the earth's oxygen. Every day, viruses kill approximately 20% of the ocean's biomass. This viral carnage not only controls the nutrient cycles of the oceans,but it also helps to sustain marine biodiversity. Despite their importance in marine microecology,the majority of marine viruses have not been studied. The project studies the the assembly of an important giant marine virus,Cafeteria roenbergensis virus(CroV). By killing a major predators of marine microorganisms,CroV has a significant impact on the oceans' ecosystem and biodiversity and thus the overall health of the ocean. The studies of CroV will facilitate future investigations of other marine viruses that impact marine micro-ecology. With virion sizes and structural complexity approaching the level of small cells, giant viruses like CroV pose a challenge but also an opportunity to current structural biology. Understanding the self-assembly of CroV-sized supramolecules will facilitate the bioengineering of large delivery vesicles with wide applications.

RESEARCH QUESTION(S)

Structural analysis of CroV and its structural proteins in Dr. Xiao's research will address the following questions:

1. What is the overall structure of CroV look like?
2. What is the individual structural proteins (building blocks) of CroV virion look like?
3. How do individual structural proteins (building block) interact each other to assemble into the giant virus?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

The student will engage in hands-on activities to obtain CroV, express CroV capsid proteins. The student will learn molecular biological skills such as protein electrophoresis, protein expression, protein chromatography as well as cell culture and virus purification. The student will obtain knowledge about state-of-the-art technology such as X-ray crystallography and cryo-electron microscopy.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Xiujun (James) Li

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-05: 3D PAPER-BASED MICROFLUIDIC LAB-ON-A-CHIP DEVICES FOR LOW-COST DISEASE DIAGNOSIS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

No specific majors or skills required

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Foodborne and infectious diseases from microorganisms become a serious public health concern throughout the world. Therefore, pathogen detection in plant, animal, food, and infectious diseases attracts significant interest. A great variety of pathogen detection has benefited from DNA testing using microarray. However, it usually requires expensive instruments and cumbersome procedures for DNA probe immobilization. Therefore, the goal of this project to develop a simple low-cost 3D paper-based microfluidic biochip integrated with DNA testing techniques for infectious disease diagnosis, especially in resource-poor settings.

RESEARCH QUESTION(S)

Specifically our research will address the following questions:

1. How to integrate DNA amplification on the chip?
2. How to minimize DNA no-specific binding on the paper substrate?
3. Will our paper-based microfluidic lab-on-a-chip biochips allow for sensitive pathogen detection in resource-poor settings?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

The microfluidic lab-on-a-chip technique (also called micro total analysis system (μTAS)), a contemporary multidisciplinary platform developed in the 1990s, offers a unique opportunity for various biomedical applications and bioanalysis methods, e.g. DNA amplification.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Xiujun (James) Li

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-06: LOW-COST AND SENSITIVE MULTIPLEX DNA DETECTION ON 3D PAPER-BASED MICROFLUIDIC BIOCHIPS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

No specific majors or skills required

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Plant and animal diseases from fungal, bacterial, and viral organisms have caused serious economic losses annually. In addition, foodborne and infectious diseases from microorganisms become a serious public health concern throughout the world. Therefore, pathogen detection in plant, animal, food, and infectious diseases attracts significant interest. A great variety of pathogen detection has benefited from DNA testing using microarray. However, it usually requires expensive instruments and cumbersome procedures for DNA probe immobilization. Therefore, the goal of this project to develop a simple low-cost paper-based microfluidic biochip integrated with DNA testing techniques for multiplexed pathogen detection.

RESEARCH QUESTION(S)

- How to immobilize DNA codes on the paper substrate easily?
- How to minimize DNA no-specific binding on the paper substrate?
- Will our paper-based microfluidic lab-on-a-chip biochips allow for sensitive pathogen detection in resource-poor settings, such as field detection or in developing countries?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

- The microfluidic technique developed in the 1990s (also called Lab-on-a-chip, or micro total analysis system (μTAS)) offers a unique opportunity for various biomedical applications.
- Electrochemical detetection, and fluorescence detection.
- Different bioanalysis methods.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Skye Fortier

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-07: SYNTHESIS, CHARACTERIZATION, AND STUDY OF MOLECULAR, LOW-VALENT EARLY METAL COMPLEXES

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Chemistry major required and knowledge of basic organic chemistry is necessary, familiarity with inorganic chemistry is preferred but not essential.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Low-valent early-metal complexes are well-known for their ability to perform the reductive cleavage of strong chemical bonds, such as those found in N2 and CO. However, these compounds suffer from the major drawback of being challenging to synthesize and having chemistry that is difficult to control or predict. Our proposed research directly addresses these problems through the study of a kinetically stabilized Ti(II) synthon that models the structural and chemical behavior of coordinatively unsaturated low-valent early-metal complexes. Our Ti(II) synthon is readily synthesized on multigram scales and can be easily stored and handled.

RESEARCH QUESTION(S)

- With our low-valent early metals, can we perform challenging chemical transformations?
- Can we use our system to mimic precious metal type, two-electron chemistry?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Our target molecules are anticipated to be highly air and water sensitive. Thus, air-free synthetic methods, including Schlenk techniques and glovebox manipulations, will be employed. Isolated molecules will be fully characterized by spectroscopic techniques such as NMR and IR spectroscopies, amongst other analytical methods. Solid-state characterization will be conducted through XRD.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Dino Villagran

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-08: COORDINATIVELY UNSATURATED BIMETALLIC UNITS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Synthetic inorganic chemistry, glove box techniques, electrochemistry. Understanding of electronic and molecular structure.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

My research group targets problems of energy, environmental chemistry, and magnetism primarily focusing on physical measurements and computational and theoretical studies. We utilize advanced synthetic techniques to prepare novel inorganic compounds based on transition metals that target the activation of small molecules. We build synthetic PCET models, bimetallic units with open coordination sites, and try to manipulate the redox chemistry of metal center through non-innocent metaloligands.

RESEARCH QUESTION(S)

1. We first need to choose the identity of the metal center appropriately according to the desired characteristics of bimetallic compounds.
2. Can we synthesize the appropriate bulky bidentate organic ligand that will force the bimetallic to be coordinatively unsaturated
3. Can we utilize these compounds to activate small molecules and mechanistically understand the process?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

This research project will provide training of air-sensitive synthesis using Schlenk line and glove box techniques. Once the compounds are synthesized, characterization techniques, NMR, x-ray crystallography, mass-spectrometry will be utilized to ascertain the nature of the novel compounds. we will utilize electrochemical and spectroscopy methods (UV-vis, EPR) to study electronic structure.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Katja Michael

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-09: SYNTHESIS OF A TRISACCHARIDE NATURAL PRODUCT

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

chemistry major, basic organic chemistry skills in theory and practice

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

The trisaccharide alpha-Galp(1,6)alpha-Galp(1,3)beta-Galf exists on the cell surface of the protozoan parasite Leishmania major, which causes the disease leishmaniasis in humans. The disease is difficult to diagnose, because other diseases can cause similar symptoms. Since the cell surface saccharides of the parasite are foreign to humans, they are highly immunogenic. This causes an antibody response in leishmania patients. If we had the trisaccharide at hand, it could be immobilized and the disease could be unambiguously identified by ELISA using patient sera. Since the saccharide is not commercially available it must be generated by chemical synthesis. We collaborate with Dr. Igor Almeida at UTEP's Department of Biological Sciences, who will conduct the ELISA studies once the trisaccharide is synthesized.

RESEARCH QUESTION(S)

Can we synthesize the trisaccharide alpha-Galp(1,6)alpha-Galp(1,3)betaGalf in a short and efficient manner using the di-tert-butylsilyl moiety in an orthogonal protecting group strategy?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

State of the art carbohydrate synthesis, reactions at low temperatures and an argon atmosphere, thin layer chromatography, silica column chromatography, mass spectrometry, NMR spectroscopy

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Juan Noveron

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-10: SELF-ORGANIZED MATERIALS FOR MOLECULAR ELECTRONICS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

- General Chemistry
- Organic Chemistry
- Any major in STEM will be accepted.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

The rapidly growing area of self-organized materials, where directional non-covalent interactions are used to build extended networks with fascinating complexity, is in the dawn of its potential as a producer of new functional advanced materials. Currently, hydrogen bonding, metal-ligand coordination, and pi-pi stacking interactions are currently used as synthetic vectors that drive the self-assembly of new molecular architectures at the nanoscale. We found a new methodology to form nanowires driven by pi-pi stacking interactions that may be used in molecular electronics and nanostructured solar cells.

RESEARCH QUESTION(S)

What is the supramolecular structure-function relationship of pi-pi stacking networks with respect to their potential to serve as charge carriers in heterojuction organic solar cells?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

- Synthesis of small molecules.
- Crystal growth and design.
- X-ray crystallography.
- Atomic Force Microscopy.
- Spin coating.
- Photovoltaics device fabrication.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Ricardo Bernal

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-11: BIOCHEMICAL AND BIOPHYSICAL CHARACTERIZATION OF NOVEL CHAPERONIN PROTEIN FOLDING MECHANISMS.

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

Other than basic computer skills and having "good hands":

- an overwhelming desire to learn science and
- a willingness to work hard far outweigh any kind of previous lab experience or skill set.

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

The process of protein folding is one of the most important and challenging research topics of contemporary biochemistry and in spite of its central role in life, it is one of the least understood biophysical processes. In principle, a protein's final three-dimensional structure and function is dictated by the amino acid sequence. However, proper protein folding into the correct three-dimensional structure is influenced by a number of intracellular factors including biophysical phenomena induced by the polar solvent, molecular chaperones and by specialized macromolecular complexes termed chaperonins.

Errors in protein folding can lead to significant aggregation and severe neurodegenerative disorders such as Alzheimer's disease, Parkinson's disease, Huntington's disease and Amyotrophic lateral sclerosis (ALS). Therefore, it is crucial that we understand the fundamental process of protein folding in order to make significant progress into the treatment of debilitating neurodegenerative disorders.

RESEARCH QUESTION(S)

Research Questions.

1. What are the various conformational changes that a chaperonin goes through in the process of folding a protein?
2. What are the triggers for conformational changes in chaperonins?
3. Do chaperonins have other activities other than the folding of proteins?
4. Can we alter the conformational changes and therefore the the activity of the chaperonin via targeted mutations?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

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Computational cryo-EM reconstruction methods, dynamic light scattering (DLS) analysis, protein overexpression and purification, various chromatographic methods for protein purification, protein quantitation and analysis methods, light and electron microscopy, mass spectroscopy and various biochemical and enzymatic activity assays.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Wen-Yee Lee

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-12: DEVELOPMENT OF A NOVEL NON-INVASIVE DIAGNOSTIC METHOD FOR EARLY DETECTION CANCERS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

- Quantitative Analytical Chemistry - calibration, basic statistics
- Computer Skills - Words, Excel

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Since President Richard Nixon declared war on cancer in 1971, the US spends billions of dollars to develop better drugs and chemotherapies that might kill cancer cells, but it has yielded insufficient results: the overall cancer mortality rate in the US has fallen by a scant 8 percent since 1975 as heart disease deaths have dropped by nearly 60 percent in that period, by comparison. While the cure-driven approach has dominated the cancer research, a largely under-examined approach, finding and treating cancers early, present a great research opportunity for the science community. A long quest has been undertaken in searching for tumor markers for early diagnosis of cancer to increase the curative success rate of this disease. Unfortunately these attempts have limited specificity for the early detection of cancer. To search for other biomarker, research has shown promising evidences using specific volatile organic compounds (VOCs) as an invaluable screening method for early detection of cancer. Further research is needed to identify cancer specific VOCs for cancer diagnostics.

RESEARCH QUESTION(S)

1. Are VOCs in urine specific to cancer stages?
2. Are VOCs in urine specific to cancer types?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

Quantitative and qualitative analytical techniques will be used to conduct the study. Thus, summer undergraduate students will learn about sampling, sample preparation using Stir Bar Sorptive Extraction, chemical analysis using Gas Chromatography/Mass Spectrometry, and data analysis including internal standard quantitative technique.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Katja Michael

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-13: PHOTOCHEMICAL SYNTHESIS OF ORGANIC COMPOUNDS – A METHOD DEVELOPMENT PROJECT

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

chemistry major, basic organic chemistry skills in theory and practice

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

In synthetic organic chemistry, most of the already existing photoreactive compounds are used as protecting groups that can be cleaved with UV light to liberate alcohols, carboxylic acids, and amines. Unlike ordinary photoreactive protecting groups, N-acyl-nitroindolines are a special group of photoreactive compounds that are capable of an acyl transfer to a variety of nucleophiles, such as amines, aminals, hydrazine, alcohols, and thiols (see for example two publications from our research group: Kaneshiro & Michael, Angew. Chem. Int. Ed. 2006, 45, 1077; and Pardo et al., ChemBioChem 2015, 16, 1884). These photochemical acylation reactions produce amides, oxoesters, thioesters, and hydrazides under mild conditions, and are therefore very useful synthetic tool. There are a number of nucleophiles that have never been explored in this acyl transfer photochemistry, e.g. organometallic reagents, enolates, and azides. Based on the published photolysis mechanism of N-acyl-nitroindolines (Morrison et al., Photochem. Photobiol. Sci. 2002, 1, 960) we expect that the illumination of N-acylnitroindolines in the presence of these nucleophiles can produce aldehydes, ketones, acylazides, and dicarbonyl compounds.

RESEARCH QUESTION(S)

- Can photochemistry be used to produce aldehydes, ketones, acylazides, and dicarbonyl compounds from N-acyl-nitroindolines with organometallic reagents, azides, and enolates?
- What are the best solvents for these reactions?
- Are any catalysts or auxiliary nucleophiles, such as N-hydroxybenzotriazole or N-hydroxysuccinimide, required?
- Do these reactions result in significant amounts of undesired by-products?
- What kind of acyl residues on the N-acyl-nitroindolines are suitable?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

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The undergraduate student will receive training in the laboratory techniques required for the synthesis of small organic molecules, in synthetic photochemistry, in compound purification by chromatography, and in compound analysis by mass spectrometry, infrared spectroscopy, and 1H and 13C nuclear magnetic resonance spectroscopy.

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SUMMER UNDERGRADUATE RESEARCH MENTORED EXPERIENCE

COURI CAMPUS OFFICE OF UNDERGRADUATE RESEARCH INITIATIVES

Dr. Xiujun (James) Li

Department of Chemistry

Faculty Profile Link

Research Lab Link

CHEM-14: INNOVATIVE NANOTECHNOLOGY FOR BIOMEDICAL AND ENVIRONMENTAL APPLICATIONS

PREFERRED MAJOR FIELD OF STUDY OR MINIMUM REQUIRED SKILLS

You should have at least some basic knowledge either in chemistry, or biochemistry, or biology. Students will coauthor papers in our group. Check our web for more information http://li.utep.edu

SCHOLARLY SIGNIFICANCE/INTELLECTUAL MERIT

Over the past two decades, nanoscience and nanotechnology has been one of the most active research fields, resulting in significant impact on advances of analytical chemistry. For instance, gold nanoparticles, carbon nanotubes, graphene, quantum dots, semiconductor nanowires, nanofluidics, and so on, have been widely used in numerous detection strategies.

The research in Dr. Li's research group is centered on the development of innovative nanotechnology and microfluidic lab-on-a-chip for biomedical and environmental applications, with the emphasis on infectious disease and cancer diagnosis in low-resource settings. We for the first time developed nanoparticle-mediated photothermal immunosensing for quantitative biochemical analysis using a thermometer (Nanoscale 2016, 8, 5422-5427).

RESEARCH QUESTION(S)

- How to achieve quantitative biochemical analysis using a thermometer?
- How to improve detection sensitivity by using nanomaterials?
- How to simply immobilize nanosensors on a microfluidic biochip?
- How to achieve point-of-care biomarker detection?

METHODS/TECHNIQUES/INSTRUMENTS TO BE LEARNED/UTILIZED

This project focus on nanotechnology, one of the most hot research fields. You will learn how to use different instruments to characterize nanomaterials and nanosensors, and then apply the nanotechnology for biological or environmental sensing. Some instruments include: UV/VIS microplate reader, spectrometers, electrochemistry analyzer, fluorescence microscopy and so on.

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