Partnership for Research and Education in Materials (PREM) Program
2024 Summer Internships at University of Texas at El Paso

Sponsored by the Materials Research Laboratory (MRL)

The Program:

The UTEP PREM program sponsors 9-week summer research internships at the University of Texas at El Paso for UCSB undergraduate science and engineering students. Interns will be matched with a research project, a faculty supervisor and graduate student mentor. Interns will receive a stipend of $4500 for the 9-week internship, up to $600 in travel support and housing in shared apartments on the UTEP campus.

In addition to their research responsibilities, interns will give presentations based on their work and participate in career development activities.

Internship Dates

June 17 to August 16. Students are expected to arrive in El Paso Sunday June 16 and depart on Saturday August 17.

Internship Awards:

Up to 4 internship awards will be given each summer. Applications from UCSB undergraduates in any area of science or engineering are encouraged to apply.

Eligibility:

US citizen or permanent resident

UCSB undergraduate: students must be enrolled as an undergraduate in the Fall of 2024 to be eligible.

APPLICATION DEADLINE: February 12, 2024

Notifications will be made by April 15, 2024.

To apply please submit all application materials below to Dr. Julie Standish, MRL:

1. A completed application form (attached)
2. A 1-page resume with a history of all your work and laboratory experience. Please be sure to include any lab or course work that you feel is relevant to your proposed research work.
3. A 1-page statement of your research interests. The statement should include a specific discussion of which research area(s) you are interested in participating in and why. For more information about the available research projects see the UTEP PREM Research Areas pdf (http://www.mrl.ucsb.edu/UTEP-PREM.pdf).

Return 1-3 by email to standish@mrl.ucsb.edu

4. An unofficial transcript. This can be sent by email to standish@ucsb.edu .
5. A letter of recommendation from a course instructor/TA or employer (preferably one who is familiar with your scientific skills). Letters can be sent by email to standish@ucsb.edu

Questions or concerns? Dr. Julie Standish; standish@ucsb.edu MRL room 2061

More Info on Research

For more information about the available research projects at the University of Texas El Paso please see the UTEP PREM Research Areas pdf (http://www.mrl.ucsb.edu/UTEP-PREM.pdf).

Partnership in Research and Education in Materials (PREM)

UTEP PREM Application 2024

Name (last, first middle): ______________________________

E-mail Address: ___________________________

Please Check One: ☐ US Citizen ☐Permanent Resident
(Only US citizens or permanent residents may receive funding through MRL)

Current School Year Address:
Street:__________________________________
City, State:___________________
Zip:_____ Cell:_____________ Phone (if different):________

Permanent Address:
Street:____________________________________
City, State:__________________
Zip:_____ Phone:_____

Field of Study:____________ Expected Graduation Date_____

Class: ☐Freshman ☐Sophomore ☐Junior ☐Senior

Please list the person/people from whom you have requested a letter of recommendation:
Name:________________ e-mail:________________

Please list the UTEP PREM faculty/research areas you are most interested in working with:

1.____

2.____

Are you a community college transfer student? ☐Yes ☐No
If yes, community college attended: _______________________

The following information is optional, but is requested by the National Science Foundation

Gender: ☐ Female ☐Male
Ethnicity: ☐ African-American ☐Asian ☐ Caucasian ☐Latino
☐Native American/Alaskan ☐ Pacific Islander
☐Other, please specify:________________________
Do you have any disabilities of special needs? If yes please explain:_____
Will you be the first in your family to graduate from college? ☐Yes ☐No

The following projects are available for Summer 2024. Please refer to the two UTEP Faculty/Project/Research areas that are you most interested in working with during the summer in your application and statement of research interest

Project-1: Magnetic field and chirality to control spin polarization in materials and its impact on energy-relevant electrochemical reactions

Faculty: Sreeprasad T Sreenivasan

Department of Chemistry and Biochemistry, The University of Texas at El Paso, El Paso, Texas 79968, USA

Electrochemical energy devices, encompassing technologies like water-splitting devices, metal-air batteries, and fuel cells, hold immense promise for generating renewable energy. A catalyst that speeds up a chemical reaction without being consumed plays a crucial role in these devices. However, their widespread use is impeded by the reliance on costly platinum group metals (PGM), particularly in essential oxygen electrocatalytic processes such as the oxygen reduction reaction (ORR) and the oxygen evolution reaction (OER). During oxygen electrocatalysis, the transformation of non-magnetic oxygen species (OH- or H_2O) into magnetic oxygen molecules is quantum mechanically restricted. This restriction necessitates additional energy, resulting in elevated overpotentials, and diminishing the overall efficiency. Recent studies indicate that when subjected to an applied magnetic field, magnetic catalysts can demonstrate spin polarization, significantly improving OER efficiency. However, prevailing research in this domain predominantly focuses on large-scale ferromagnetic catalysts, posing challenges in modification and limiting insights into molecular-level mechanisms. In contrast, coordination complexes present a versatile and uniform alternative, with catalytic activity dependent on the coordination environment. When positioned on a diverse substrate, coordination complexes can function as single molecular catalysts (SMCs), similar to single-atom catalysts. In SMCs, each metal atom actively participates in the reaction, contributing to their catalytic efficiency. These catalysts comprise diverse transition metals supported on conductive matrices, as efficient magnetic catalysts, as evidenced in our recent paper[1]. Our ongoing research plans to expand on this success by employing various transition metals and diverse conductive matrices, including graphene acid, MXene, and MoS_2. Furthermore, our project aims to investigate the combined effects of the magnetic field and chirality-induced spin potential, offering additional enhancements in catalytic activity against reactions including oxygen reduction, nitrogen reduction, and carbon dioxide reduction reactions. Our earlier work with Fe_xO_y nanoparticles[2], exhibiting magnetic properties and catalytic responses to external magnetic fields, has influenced our continued exploration. The primary objective of our projects is to unveil the intricate molecular-level details of spin-selective catalysis, deepening our understanding of sustainable energy conversion technologies. By emphasizing the development of a cost-effective and adaptable catalyst design, our research aims to significantly contribute to the overarching goal of advancing efficient and environmentally friendly energy solutions.

(1) Saini, K.; Nair, A. N.; Yadav, A.; Enriquez, L. G.; Pollock, C. J.; House, S. D.; Yang, S.; Guo, X.; Sreenivasan, S. T. Nickel-Based Single-Molecule Catalysts with Synergistic Geometric Transition and Magnetic Field-Assisted Spin Selection Outperform RuO2 for Oxygen Evolution. *Advanced Energy Materials* **2023**, *13* (42), 2302170.

(2) Nair, A. N.; Fernandez, S.; Marcos-Hernández, M.; Romo, D. R.; Singamaneni, S. R.; Villagran, D.; Sreenivasan, S. T. Spin-Selective Oxygen Evolution Reaction in Chiral Iron Oxide Nanoparticles: Synergistic Impact of Inherent Magnetic Moment and Chirality. *Nano Letters* **2023**, *23* (19), 9042-9049.

Project-2: Magnetic nanoparticles

Faculty: Ahmed El-Gendy

Department of Physics, The University of Texas at El Paso, El Paso, Texas, 79968, USA

The students in this project will study synthesis and characterization of different types of magnetic nanoparticles (metals, alloys and oxide ceramics) using arc-melting and high energy ball milling. Then, investigation of the phase structure and morphology as well as magnetic properties will be done. The primary goal of the project is to understand the structure-property correlation in the materials synthesized.

Student who is interested is welcome to join our lab during summer. All the students expected to work with graduate students and other PREM faculty collaborators with excellent hands-on experience for experimental research.

Project – 3: Synthesis and Characterization of Oxide Thin Films for Energy Applications

Faculty: Ramana Chintalapalle

Department of Mechanical Engineering, The University of Texas at El Paso, El Paso, Texas 79968, USA

This project work will explore multilayer stacks (≤100 nm) of dielectric(D)/metal(M)/dielectric(D) films with controlled interfacial structure and chemistry. Specifically, efforts will be focused on utilizing WO_3, HfO_2 and MoO_3 for D-layers while M-interlayers will be either Ag or Al. TCOs transport photo-generated current from the active layer(s) of a device to an external load play a key role in optoelectronics (EO) and LEDs in addition to photovoltaics. Tin-doped indium oxide (ITO) is the current standard TCO for all practical applications in EO, PV and LED technologies. However, there has been much recent interest in finding indium-free TCOs and even better performing alternative candidates to substitute ITO. The driving factors, which are mainly associated with In metal, are: 1) scarcity, (2) rapid price increase, (3) unintended interfacial phenomena and (4) global politics. In addition, the poor mechanical flexibility and inevitable high deposition temperatures limit potential application of ITO in flexible and/or organic-based PV, EO and LED technologies. A large number of materials, such as metal nanowires, doped oxides, and graphene, have been extensively studied in recent years. However, none of them were found to adequately replace ITO. Recently, the concept of D/M/D multilayers has emerged as a highly promising strategy for efficient TCO design that overcomes many of the problems associated with ITO. However, the fundamental science, especially the underlying mechanism of component layers' interfacial microstructure and charge injection mechanisms are not well understood at this time. In this context, the project will investigate the fundamental science and engineering aspects of TCOs based on D/M/D multilayer films. The technical merit of the project is to use an asymmetric configuration, where the top and bottom D-layers are materials with different refractive index (such as WO3 and HfO2), which is expected to significantly improve the electronic behavior to meet the ideal requirements of TCOs. Therefore, experiments will be performed to understand the effect of various morphologies on the DMD-TCOs performance. D/M/D as well as other transparent oxide materials will be deposited using standard physical vapor deposition methods, such as sputtering, electron-beam deposition, and pulsed-laser deposition, under variable conditions of temperature, oxygen reactive pressure and D/M-layer thickness. The samples will be characterized by studying their crystal structure, surface/interface structure and morphology, chemical composition, and optical and electrical measurements. The structural and chemical characterization of the samples will be performed employing X-ray diffraction (XRD), X-ray reflectivity, scanning electron microscopy (SEM), and X-ray photoelectron spectroscopy (XPS) measurements. The electrical properties of D/M/D samples will be measured employing the van der Pauw method while the optical properties will be probed employing spectrophotometry and spectroscopic ellipsometry (SE). The REU students will gain hands-on experience for experimental research and expected to work with postdocs, graduate students, and other PREM faculty collaborators.