Summer 2022 RET Projects

1. Potentiometric Biosensors

Faculty Mentor: Dr. Eric Vogel, School of Materials Science and Engineering

Abstract: Currently, diagnosis for serological diseases such as Ebola, HIV, and Lyme disease relies on Enzyme-linked Immunosorbent Assays (ELISAs), which require centralized laboratories and several-day timescales to complete. However, emerging technologies such as potentiometric and electrochemical impedance biosensing can be developed into portable, label-free, point-of-care devices that require only hour timescales. Despite the promise of these new technologies, reliability of the chemical functionalization inhibits commercialization and adoption. *Teacher and/or Community College Faculty component:* As part of a team that includes GT and AVX, Inc., the RET participant will use micro-/nano-fabrication facilities to fabricate extended gate potentiometric biosensors. The RET participant will test the electrical performance and stability of biosensors with different functional linker groups including polymers and self-assembled monolayers. The results of physical characterization of the chemical functionalization including x-ray photoelectron spectroscopy, atomic force microscopy and ellipsometry will be correlated to the electrical results and used to further develop the chemistry. The project will provide the participant with experience in a university laboratory as well as direct industry interactions. Visit the Vogel Lab: vogellab.gatech.edu/

2. Alternative Feedstocks for Nanocellulose Fibrils

Faculty Mentor: Dr. Chris Luettgen, Chemical and Biomolecular Engineering

Abstract: My group is investigating the opportunity of using alternative feedstocks to wood and wood pulp for the manufacture of nanocellulose fibrils for the applications that require strength and bio-based replacement. Lately, we have been investigating pineapple plant harvest residues, and non-THC hemp stems. The RET participant will characterize visually and with physical testing the resultant nanocellulose fibrils. Visit the Luettgen Lab: chris.luettgen.rbi.gatech.edu

3. Investigation into Artifacts from the Hunly Submarine

Faculty Mentors: Walter Henderson and David Tavakoli

Abstract: Over the course of the project, the RET will undertake characterization of materials from the Hunly submarine (www.hunley.org/). These materials are degrading in the atmosphere. The scientists trying to preserve them wish to understand what material is forming and how the degradation can be stopped and potentially reversed. The RET will work on several characterization techniques including Scanning Electron Microscopy (SEM), Raman microscopy, and potentially others. This research is of interest for applying modern analytical techniques to materials of historical importance. Visit the Materials Characterization Facility webpage, mcf.gatech.edu/.

4. Developing 2D Piezoelectrics

Faculty Mentor: Lauren Garten, Materials Science and Engineering

Abstract: My group works on the development of piezoelectric materials. Piezoelectric materials are used to transfer mechanical inputs into electrical signals or an electrical signal into a mechanical response. Piezoelectricity is predicted to occur in specific 2D materials, but we must first create devices

in order to test the electromechanic response. The RET candidate will assist with the processing of these 2D materials and the development of electromechanical devices. Learn about Dr. Garten's research, mse.gatech.edu/people/lauren-garten.

5. Nucleation and condensation of silver nanoparticles for printed electronics

Faculty Mentor: Dr. Sourabh Saha, School of Mechanical Engineering

Abstract: Nucleation and condensation are ubiquitous in nature and are responsible for a variety of phenomena such as formation of clouds, dew drops, and fog. Controlling nucleation and condensation on the nanoscale can enable the formation of precise 2D and 3D metallic structures. The goal of this project is to apply the nucleation and condensation of silver to fabricate electrically conductive 2D silver nanostructures. These nanostructures will be used as wires in printed electronics applications. The project involves printing a variety of nanostructures using a custom-built printer and imaging these structures using high-resolution microscopes to measure their geometry and material composition. The data generated from these experiments will advance our understanding of the printing process. Learn about Dr. Saha's research, me.gatech.edu/faculty/saha.