

Summer 2021 NNCI RET Project Opportunities Georgia Tech Site

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:* The RET participant will collaborate with GT researchers and 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. Visit the Vogel Lab: <https://vogellab.gatech.edu/>

2. Alternative Feedstocks for Nanocellulose Fibrils

Faculty Mentor: Dr. Chris Luetttgen, 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 Luetttgen Lab: chris.luetttgen.rbi.gatech.edu

3. Understanding Crack Initiation in Aluminum Alloys

Faculty Mentor: Dr. Josh Kacher, Materials Science and Engineering

Abstract: This project seeks to understand the influence of iron-rich particles in commercial aluminum alloys on crack initiation processes. The project will involve mechanical testing to understand the strength of different alloys as a function of processing conditions followed by scanning electron microscopy (SEM) imaging of the fractured materials to better understand what features cracks are originating from. This work is supported by Novelis, Inc, a global aluminum company headquartered in Kennesaw, GA. Visit the Kacher Lab: kacherlab.gatech.edu/

4. Developing High-Energy Aqueous Batteries

Faculty Mentor: Dr. Nian Liu, School of Chemical & Biomolecular Engineering

Abstract: Compared with organic electrolyte, aqueous rechargeable batteries may provide a safer alternative for reliable, low-cost and large-scale energy storage systems. RET participants will be involved in developing high-energy aqueous batteries for applications that require ultra-high safety.

They will be involved in activities including material synthesis, characterization, and battery assembly and testing. Visit the Liu Lab: <http://liu.chbe.gatech.edu/>

5. Towards Understanding 'Plastic' Conductors

Faculty Mentor: Natalie Stingelin, School of Chemical & Biomolecular Engineering

Plastic conductors have found broad use as transparent conductors or as interlayers for organic light-emitting diodes, photovoltaic cells and photodetectors. More recently they have attracted interest as key components in new, emerging applications, from biosensors (e.g. via organic electrochemical transistors), energy-efficient neuromorphic computing devices based on organic non-volatile electrochemical devices, to energy-conversion technologies such as thermoelectric transducers and heat exchangers. Despite substantial work on these interesting materials, many aspects about what makes them conductors (via doping with another molecule) are still not understood. This lack of fundamental scientific insight limits materials design to heuristic time- and labor-consuming studies. Within this research experience, we aim at providing a tentative picture of how plastic conductors function using experimental and data-mining approaches. For this, the teacher's research experience will involve exposure in how to establish temperature/composition phase diagrams via calorimetry, how to interpret these diagrams and compare them to conductivity data obtained from, e.g., 4-point conductivity measurements. He/she will also be introduced to machine learning strategies for the expedited design of materials with high electrical conductivities. Visit the Stingelin Lab: <http://stingelin-lab.gatech.edu/>

Note: While the teaching experience will predominantly take place in the Stingelin laboratories (MSE/ChBE), close interactions with the Ramprasad (MSE), Silva (Chemistry/Physics) and Marder (Chemistry) groups are foreseen.