DENIN Environmental Scholars Internships

Dates of internship: June 10, 2019 – August 16, 2019
Location: Harker ISE Lab and E.S. DuPont Hall, University of Delaware, Newark, DE 19711
Number of positions available: 1-2

Faculty Mentors: John F. Rabolt/Richard Martin
Graduate Student Mentor: Reva Street (New Postdoc)
Professional Staff Mentor: Sheldon Hewlett

Project Title: A Smart, Piezoelectric Sensor for Detecting Toxins in the Environment

Research Description:
Polymers have 4 levels of structure: chemical, conformational, crystal and morphological, the latter of which can induce special properties like piezoelectricity. The first 3 structural levels are usually reversible if you recast in another form for investigation but the morphology is NOT and depends on how the polymer was originally processed. Hence how a polymer is processed does play a role in how it performs in specific applications.
As a goal for a Smart Sensor Platform, a new piezoelectric, biodegradable polymer, poly(hydroxybutyrate) random copolymer (PHBHx) will be used as a universal sensor. If used in a nanofiber or thin film form, for example, any change in dimension caused by, e.g., temperature, salinity, bacteria or virus infusion, metalloid attachment, etc. will create a potential difference (electrical voltage) which can be detected either across its ends (nanofibers) or across a cross section in the case of a thin film. This will give rise to a signal that can be detected remotely. Such a multi-purpose sensor ***does not exist*** and would have many uses.
This project will involve processing PHBHx into nanofibers and thin films and then determining the crystalline structure and morphology using xray diffraction, electron microscopy, thermal analysis and vibrational spectroscopy. Finally the piezoelectric coefficient will be evaluated and optimized.

Research Questions:
Under what processing protocols is the piezoelectric, beta crystalline modification produced in PHBHx?
When a PHBHx sensor is operational, what is its sensitivity to humidity, temperature, salinity, bacteria or virus infusion, metalloid attachment, etc.?

Student Learning Objectives: Professional and Research Skills
This internship focuses on the development of the following professional and scientific skills.

Broad Professional Skills	Specific Skills
Planning and time management	Ability to set and complete specific goals of varying scope
Work independently	Independent work ethic - work independently to problem-solve
Collaborative skills	Learning to complete tasks efficiently and effectively with others
Express ideas in writing and verbally	Communicate with diverse audiences - Development of impactful poster and oral presentations. Honing ability to deliver scientific results/impacts to people of interdisciplinary background.
Broad Scientific Research Skills	**Specific Skills**
Critical Thinking	Being able to evaluate data for reproducibility and accuracy
Literature analysis	Ability to effectively find and utilize scientific papers related to polymer characterization and processing
Use scientific tools	X-ray adiffraction, Infrared and Raman spectroscopy, scanning electron microscopy, thermal analysis and other additional advanced physical and chemical techniques
Recognize simple patterns in research data	Understand Structure-Processing-Property relationships in thin films.
Apply research tools and techniques in research experiments	Electrospinning of fibers, solution casting of thin films, spin casting films
Analyze research data	MATLAB, R, Excel, Plotly, Origin, and instrument-specific software utilization to form effective figures and tables.
Understand, apply, and explain scientific concepts and theories	Freedom to form questions and plan methods for addressing challenges. Learning to effectively communicate results through oral presentations and the development of manuscripts.

Prerequisites:
Introductory experience with chemistry and/or in engineering.

Work Environment and Expectations:
Laboratory environment: Harker ISE 151 and Dupont Hall (home of Materials Science and Engineering). Hours are flexibly determined between student and mentor. Students will work full time during Summer, 2019. Students will also participate in a retreat, communications workshop and end of internship spring symposium.

Stipend:
$3,500 Direct deposit is required.

Funding Source:
National Science Foundation, Delaware EPSCoR Track I

How to apply: https://ugresearch.udel.edu/PUB_Program.aspx