CHEMISTRY & BIOCHEMISTRY COLLOQUIUM: Where the 4th State of Matter Meets Biomedical Devices: Using Plasma Processing to Customize Natural Polymer Surfaces

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Time:
1:30 PM- 2:50 PM

Link:
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About the Speaker:

Dr. Hawker earned her bachelors in chemistry with a minor in education from UC Santa Cruz, and went on to earn her PhD in Chemistry at Colorado State University. After this, she went to Tufts University where she was an NIH-IRACDA postdoctoral scholar. She joined the faculty at Fresno State in 2019. As a California native, she is happy to be back on the West Coast to enjoys year-round mountain activities such as skiing and hiking. In her current position, she enjoys pursuing challenges related to both teaching-as-research and research-as-teaching.

Abstract:

Naturally-derived, degradable polymers offer tremendous potential to the field of biomaterials. Indeed, the presence of degradable devices in pre-clinical/clinical trials and on the market has expanded considerably over the past decade, spanning a variety of applications from stents to suturing. Degradable devices are designed to perform their intended function for a set time, after which they break down into harmless byproducts. These byproducts are then absorbed by the body, mitigating the need for secondary removal surgery. Notably, degradable polymeric devices are typically designed for a specific application and, thus, exhibit fixed degradation kinetics. Furthermore, prior attempts to control naturally-derived polymer degradation used methods that altered the polymer's bulk mechanical properties (e.g., physical cross-linking), which can hinder the device function due to mechanical mismatch between the device and its surrounding biological environment. There is a critical need to develop a fabrication technology that results in polymeric devices with programmable degradation rates - without altering their bulk mechanical properties - for deployment over a range of intended applications.

In this seminar, I will highlight our group's recent efforts towards develop a radio-frequency plasma copolymerization approach with the potential to modulate the degradation of naturally-derived polymer materials. In this work, silk fibroin (SF) was used as a model polymer system. Naturally-derived polymers like SF are known to degrade via surface-mediated enzymatic hydrolysis, so surface properties are paramount in controlling polymer construct/enzyme interactions. As such, the objective of this work was to prepare SF films with variable surface properties. SF films were subjected to plasma treatment to customize their surface properties. Plasma feedgas composition was tuned using two unique precursors: acrylic acid, pentane, and mixed precursor conditions. Contact angle goniometry was utilized to evaluate the wettability of all plasma-modified and control SF films. Findings demonstrated that surface wettability depends not only on feedgas composition, but also on applied plasma power and substrate placement. Collectively, this plasma-based strategy is a promising method to customize naturally-derived polymer degradation for use in biomedical devices.

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