Materials Chemistry Seminar

Friday, February 2, 2024
11:30 a.m. ~ BRWN 4102

"Deconstructing & Reconstructing Oyster Cement to Create Inorganic Adhesives"

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Aaron Mena is a second-year chemistry graduate student. Aaron received his B.S. in Chemistry from the University of West Florida (UWF) in 2017 and his M.S. in Materials Chemistry from the University of Illinois at Urbana-Champaign in 2018. From Fall 2019 to Summer 2022, Aaron instructed General and Organic Chemistry at UWF, where he received a teaching award for the development of online labs and lectures as a response to the COVID-19 pandemic. Aaron joined the Wilker Lab in July 2022, and currently serves as the social chair for the Phi Lamba Upsilon National Honorary Chemical Society (Purdue, Nu Chapter).

Outside of chemistry, Aaron enjoys weightlifting, collecting vinyl records, and going to concerts and music festivals.

Abstract:

Oysters are a marine keystone species, in which their colony formations provide significant coastal protection from harsh waves and storms. Oyster colonies are formed by the individual secretion of an adhesive cement onto a range of underwater substrates. Capable of bonding underwater, withstanding high-energy wave impact, and enduring significant temperature change, oyster cement may be a promising inspiration for biomimetic adhesive design; however, the mechanisms responsible for oyster cement adhesion are not yet understood. Like oyster shell, oyster cement is primarily composed of calcium carbonate ($CaCO_3$); however, ~12% of the cement is organic material (such as proteins, polysaccharides, and phospholipids) and ~3% water. This unique cement composition inspires us to: 1) investigate the functionality of oyster cement proteins and 2) create our own predominantly inorganic biomimetic cements that could be used in dental/bone adherence applications.

By characterizing Eastern oyster (*Crassostrea virginica*) cement proteins' tertiary structures and functionality via mass spectrometry-based proteomics, the mechanism by which these oysters generate and secrete cement can be determined. As well, proteomics of the oyster cement may elucidate target proteins that can be recreated and modified via recombinant DNA technology. The expressed recombinant proteins will then be used in the design of cements. To create an optimal, wet-setting dental/bone cement, the composition of the glue will be varied, based on protein sequence and percent $CaCO_3$ incorporation. To test the oyster-derived cement composition effects on adhesion strength, shear adhesion tests will be carried out.