Biomaterial Interfaces Division
Room Exhibit Halls A-B Booth 1003 - Session BI-WeA

Biointerphases: Emerging Young Scientists Focus Session (ALL INVITED)

Moderators: Caitlin Howell, University of Maine, **Tobias Weidner**, Aarhus University, Denmark

2:20pm **BI-WeA-1 Mycelium's Dynamic Functionality Across Material Systems: Insights and Research Challenges***, **Wenjing Sun**,* EPFL, Switzerland
The surge in using fungal mycelium as a sustainable material aligns with global sustainability goals. Mycelium exhibits diverse functionality that varies across different forms of materials. This presentation explores past research, emphasizing differences in mycelium's roles and properties based on material types, fungal species, hypha types, and growing conditions. We also address research challenges in this domain.

2:40pm **BI-WeA-2 Breaking Protein-Membrane Chemistry to Understand the Molecular Origins of Adult-Onset Muscular Dystrophies***, **Andrew Carpenter**, J. Baio,* Oregon State University
Dysferlinopathies are a class of adult-onset muscular dystrophies related by a similar disruption to the dysferlin mediate membrane repair of damaged muscle sarcolemmas. Dysferlin possesses a modular structure with 7 C2 domains, where the N-terminal C2A domain is believed to carry out the initial steps of the membrane repair process. Missense mutations within the C2A domain, as well as outside the domain, have been identified in patients with dysferlinopathies suggesting these mutations are disrupting the proper membrane repair function of dysferlin. In this talk we describe our recent progress towards understanding of how dysferlin interacts with cellular membranes and the impact missense mutations exert on this normal function. We utilize vibrational sum-frequency spectroscopy to identify several dysferlin C2A binding mechanisms at biomimetic membrane surfaces and test how missense mutations alter the normal membrane binding function. Further work that will be discussed extends our studies beyond the C2A domain to study how interactions between multiple C2 domains at membrane surfaces contributes to the full-length dysferlin-membrane membrane repair function.

3:00pm **BI-WeA-3 Understanding Adsorption, Adhesion, and Cohesion Phenomena at the Solid/Liquid Interface***, **Pierluigi Bilotto**,* Centre for Electrochemistry and Surface Technology GmbH, Austria*; D. Barragan,* University of Calabria, Italy*; L. Mears, M. Valtiner,* TU Wien, Austria*; B. Zappone,* CNR/University of Calabria, Italy
Marine invertebrates such as mussels and barnacles exhibit an impressive ability to adhere in sea water onto wave-swept rocks, moving ship hulls, submerged metal infrastructures and even anti-adhesive Teflon coatings. On one hand, marine biofouling is a concern for maritime industries, aquaculture, water, and waste treatment industries, as it increases the weight and drag of ships and infrastructures and accelerates surface degradation (corrosion). On the other hand, biofouling is a source of inspiration to solve an outstanding challenge in surface and material science: How to control adsorption (on one surface), adhesion (between two different surfaces) and cohesion (between two equal surfaces) underwater. A large body of literature has been devoted to the aromatic amino acid 3,4-dihydroxy-L-phenylalanine (DOPA), which is exceptionally abundant in mussel adhesive proteins. DOPA is able to bind to a wide variety of substrates and create protein cross-links in salty water using a diverse array of molecular interactions. However, it is becoming increasingly clear that DOPA is neither necessary nor sufficient to ensure underwater surface-attachment and tissue cross-linking. [1] Surface forces apparatus (SFA) and atomic force microscopy (AFM) are preferential tools to investigate forces at the solid/liquid interface when electrolytes are in play. [2] During this talk, I will review our current understanding on the role of DOPA in mussel adhesion, [3] and show our preliminary results in employing tropocollagen type I and type III nanofibrils as model systems to reveal adhesion, adsorption, and cohesion of macromolecules on different substrates. The expected outcomes of this project will shed light on a possible collagen-based biocompatible and biodegradable adhesive.

[1]P. Bilotto, C. Labate, M. P. De Santo, K. Deepankumar, A. Miserez, and B. Zappone, *Adhesive Properties of Adsorbed Layers of Two Recombinant Mussel Foot Proteins with Different Levels of DOPA and Tyrosine*, Langmuir **35**, 15481 (2019).

[2]P. Bilotto, A. M. Imre, D. Dworschak, L. L. E. Mears, and M. Valtiner, *Visualization of Ion|Surface Binding and In Situ Evaluation of Surface Interaction Free Energies via Competitive Adsorption Isotherms*, ACS Phys. Chem. Au **1**, 45 (2021).

[3]L. L. E. Mears, J. Appenroth, H. Yuan, A. T. Celebi, P. Bilotto, A. M. Imre, B. Zappone, R. Su, and M. Valtiner, *Mussel Adhesion: A Fundamental Perspective on Factors Governing Strong Underwater Adhesion*, Biointerphases **17**, 058501 (2022).

3:20pm **BI-WeA-4 Plasma and Beyond: Expanding the Horizons of Naturally-derived Polymers as Biomaterials Through Surface Modification***, **Morgan Hawker**,* California State University Fresno **INVITED**
Naturally-derived polymers hold important utility in biomedical materials, ranging in applications from suturing to biosensors to tissue engineering scaffolds to drug delivery vehicles. Naturally-derived polymers are advantageous for use in biological settings owing to their non-immunogenic nature and favorable mechanical properties. Several naturally-derived polymers also degrade via enzymatic hydrolysis into non-toxic byproducts in vivo. All biomedical applications, however, require specific interactions between the naturally-derived polymer and biological species. These polymers universally lack the necessary surface cues required to facilitate such precise interactions. Thus, further modification is required to tailor naturally-derived polymer surface properties and enhance their applications as biomaterials. Although synthetic wet-chemical approaches have been used to this effect, these strategies introduce complex processing conditions that pose challenges to naturally-derived polymers (e.g., high temperatures and solvents).

Plasma treatment represents a promising alternative to control how naturally-derived polymer constructs interact with biological environments. This talk will highlight several recent thrusts toward better understanding fundamental interactions between plasma and three different naturally-derived polymers. In the first thrust, we seek to evaluate water vapor and nitrogen gas plasma-treated silk fibroin stability upon aging to better understand the shelf life of plasma-modified silks. Water contact angle goniometry findings demonstrate remarkable stability of modified silk materials after aging for 42 days under both ambient and elevated temperatures. In the second thrust, we explore immobilizing three different antioxidants on chitosan films via plasma activation. This thrust aims to target oxidants in burn wounds to enhance healing, and 2,2-diphenyl-1-picrylhydrazyl assay results demonstrate promising antioxidant activity for all modified surfaces. In the final thrust, we describe efforts in coating commercially-available wound dressing materials with an antibacterial film using plasma-enhanced chemical vapor deposition (contrasting pulsed and continuous power conditions). Surface analyses reveal differences in surface chemistry and wettability for plasma-treated dressings compared to untreated dressings. Collectively, these projects demonstrate how plasma modification can be harnessed to enhance the utility of naturally-derived polymers in the biomedical space.

Author Index

Bold page numbers indicate presenter