Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON
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Spring 2025 Seminar Series

Using Bottlebrush Polymers to Tackle Challenges in Drug Delivery and Tissue Engineering

Monica Ohnsorg, PhD
Postdoctoral Fellow
Department of Chemical and Biological Engineering
BioFrontiers Institute
University of Colorado Boulder

Macromolecular design can be a powerful tool to improve the efficacy of clinical therapeutics and develop biomaterials to support *in vitro* human cell-based models. In this talk, I will discuss two vignettes describing how bottlebrush polymers, macromolecular architectures which are composed of polymer chains covalently bound at one end to a linear polymer backbone, can be used to both improve oral drug delivery and study how cells respond to strain-stiffening microenvironments. First, I will introduce how bottlebrush copolymers can be used to non-covalently sequester and solubilize small molecule therapeutics. Specifically, by modulating bottlebrush polymer hydrophilicity using post-polymerization end-group modification techniques, the small molecule anti-seizure medication, phenytoin, was effectively solubilized at higher drug loadings with the bottlebrush polymer carrier compared to current industry standard excipients. Second, I will address how nonlinear elasticity, an understudied property of natural extracellular matrix, can be recapitulated using synthetic materials that support 3D cell culture. Bottlebrush polymer-based hydrogels can be used to decouple strain-stiffening biomechanical cues from stress-relaxation and observe how engineered strain-stiffening microenvironments regulate the initiation of cellular protrusion formation. Building upon these findings, I will discuss how bottlebrush polymer-based hydrogels can be used to mimic the biomechanical properties of non-mineralized, collagen type-1 rich bone osteoid to develop models of human osteocyte dendritic network formation and function. Together, these applications demonstrate how bottlebrush polymer-based materials hold great potential to recapitulate biologically relevant biomechanical and biochemical signals for *in vitro* cell culture, for tissue and disease modeling, and as therapeutic delivery vehicles in the future.

ABOUT the SPEAKER

Dr. Monica L. Ohnsorg is a Postdoctoral Fellow in the Department of Chemical and Biological Engineering and BioFrontiers Institute at the University of Colorado Boulder, working in the lab of Prof. Kristi S. Anseth. With support from an NSF T32 “Interdisciplinary Training in Musculoskeletal Research,” she uses nonlinear elastic biomaterials to study how strain-stiffening extracellular microenvironments influence the morphology, mechanotransduction, and differentiation of human bone marrow-derived mesenchymal stromal cells. In 2021, she earned her PhD from the University of Minnesota where she was an NSF Graduate Research Fellow in the Department of Chemistry co-advised by Profs. Theresa M. Reineke and Frank S. Bates. Her graduate work, focused on synthesizing and designing polymer excipients to improve oral drug delivery, was awarded the Eastman Chemical Student Award in Applied Polymer Science. Monica completed her ACS Certified B.S. in Chemistry at Hope College in 2016. Monica has recently been recognized by Outstanding Junior Researcher and Postdoctoral Recognition Awards through ACS and SFB. In addition, she has been named an ACS Biomacromolecules Early Career Board Member, RSC Outstanding Peer Reviewer, and Materials Science and Engineering Future Leader by Northwestern University.

Thursday, January 30 at Noon
2180 Mechanical Engineering Building