UMBC Department of Chemical, Biochemical and Environmental Engineering
Seminar Series presents:

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Interfacial Dilatational Rheology and the Controlled Fabrication of Surfactant and Particle-Stabilized Emulsions

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ABSTRACT

Fluid interfaces containing surfactants and particles display nonlinear rheological properties that are vital to the anticipated bulk kinetic stability of emulsions. Many practical applications of emulsions necessitate remarkable kinetic stability during storage, such as nanoemulsion-based drug delivery systems. Innovative techniques for controlling emulsion phase separation processes, which are largely governed by the rheology of interfacially-adsorbed species, are highly desired. Yet, the utility of these techniques is often limited by difficulties with measuring and interpreting the rate-dependent mechanical properties of complex fluid interfaces, leaving open questions about the relationship between interfacial rheology and bulk emulsion stability. Thus, this talk will present several fundamental investigations that provide compelling insights on the complex interplay between the interfacial dilatational rheology of oil-water interfaces laden with phospholipid surfactants and/or particles and the observed resistance of oil-in-water droplets to kinetic destabilization. The small-amplitude dilatational rheology of fluid interfaces in the presence of adsorbed emulsifiers was probed via axisymmetric drop shape analysis and bulk emulsion stability was quantified using optical microscopy, photon correlation spectroscopy, and gravitational phase separation analysis. Included in this discussion will be characterization of interfacial microstructures, as well as inherent material properties (e.g., pH responsiveness). The elastic modulus of adsorbed interfacial layers was shown to closely correlate to the bulk release profile of active payload-containing nanoemulsions and the onset of coalescence between neighboring emulsion drops with surfactant- or particle-laden interfaces, where emulsions with more elastic interfaces displayed both retarded payload release and improved resistance to droplet coalescence. The knowledge garnered from these studies is highly relevant to academic and industrial emulsion formulators who seek inexpensive, yet robust methods for predicting, characterizing and customizing the kinetic stability of emulsified systems.

BIO

Jerome is currently a PhD candidate in the School of Materials Engineering at Purdue University received his B.S. in Materials Science and Engineering from Purdue University in 2015. His current research interests include investigations related to the development of nanoscale drug delivery systems, biomolecular self-assembly, colloidal phenomena, and probing the mechanical behavior of multi-component fluid/fluid interfaces. His honors include the NSF East Asia and Pacific Summer Institutes Fellowship, the Bilisland Dissertation Fellowship, and the Estus H. and the Vashti L. Magoon Award for Excellence in Teaching. Jerome is a Purdue AGEP Scholar, an active member of the Purdue NSBE Chapter, and a dedicated mentor and advocate for graduate and undergraduate students from historically underrepresented backgrounds in STEM. Jerome is also actively involved in community STEM outreach efforts, through his roles as a teaching assistant for the Purdue EPICS Program and Purdue MSE Graduate Student Association Outreach Chair from 2015-16.