Center for Soft Matter and Biological Physics Seminar

Prof. Sarah Perry

(University of Massachusetts, Amherst)

"Molecular Engineering of Polyelectrolyte Complex Materials"

Monday, December 3, 2018

4:00pm – 5:00pm

304 Robeson Hall

Electrostatic interactions and polyelectrolyte complexation can be used in the self-assembly of a wide range of responsive, bioinspired soft materials ranging from dehydrated thin films and bulk solids to dense, polymer-rich liquid complex coacervates, as well as more complex hierarchical structures such as micelles and hydrogels. This responsiveness can include swelling and dissolution or solidification, which can be harnessed to facilitate encapsulation and the subsequent fabrication of functional materials. In particular, we draw inspiration from biomolecular condensates, or membraneless organelles, which utilize liquid-liquid phase separation to create transient compartments in cells. These condensates are commonly formed due to weak, multivalent interactions involving intrinsically disordered proteins. Furthermore, these materials have been shown to enable the selective uptake of specific enzymes. We utilize polypeptides as model sequence-controlled polymers to study how the patterning or presentation of charges and other chemical functionalities can modulate the potential for liquid-liquid phase separation via complex coacervation. We further examine how the distribution of charge on globular proteins can be used to facilitate selective uptake into coacervate phases, and how such materials can be used to stabilize proteins against denaturation. This molecular-level understanding of polyelectrolyte complexation is further enhanced by detailed rheological and thermodynamic examinations of the molecular nature of the various material transitions present in these systems. Our experimental efforts are supported by the parallel development of computational approaches for modeling and predicting the phase behavior of patterned polymeric materials. Our goal is to establish molecular-level design rules to facilitate the tailored creation of materials based on polyelectrolyte complexation that can both illuminate self-assembly phenomena found in nature and find utility across a wide range of real-world applications.