

“Thermodynamics of Sequence-defined Polyelectrolyte Complexes”

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3:00 pm

Wu and Chen Auditorium
Levine Hall



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Abstract

Charged polymers known as polyelectrolytes have been studied for decades, however, understanding their physical properties remains a persistent challenge for polymer scientists. This difficulty stems from the intricate interplay between length scales spanning as much as 3-4 orders of magnitude, which has stymied our understanding of a truly important class of polymers; polyelectrolytes are widely used in applications ranging from food additives to paints, and most biopolymers (proteins, DNA, polysaccharides) are also polyelectrolytes. However, the complexity of charged polymers can be harnessed for molecular-level materials design. To demonstrate this, we study a class of polyelectrolyte materials known as complex coacervates. Complex coacervates are aqueous solutions composed of oppositely-charged polyelectrolytes and salt that undergo an associative phase separation process. We use simulation and theory, along with close experimental collaboration, to demonstrate that coacervates are highly sensitive to precise charge patterning. We elucidate the key molecular features that play a large role in coacervate thermodynamics. Building upon these insights, we demonstrate how coacervate phase behavior can be strongly tuned via specific charge sequences. We will show how the physical principles governing the thermodynamics of sequence-defined polyelectrolytes provides the foundation to study coacervate-driven assembly on length scales ranging from monomer-level structure to block copolymer nano-phase separation.

Bio

Charles Sing is an Assistant Professor of Chemical and Biomolecular Engineering at the University of Illinois at Urbana-Champaign. He received his BS and MS in polymer science from Case Western Reserve University in 2008, and his PhD in materials science from MIT in 2012. Prior to starting at Illinois in 2014, Charles was a postdoctoral fellow at Northwestern University. His research interests are broadly in the area of computational and theoretical polymer physics; current projects focus on molecular and sequence properties of polyelectrolyte solutions, out-of-equilibrium rheology of semidilute polymers, and polymers with nonlinear architectures. He was recognized as one of Forbes' '30 Under 30 in Science' in 2015, and the recipient of an NSF CAREER Award in 2017.

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