Penn Engineering
University of Pennsylvania
Chemical and Biomolecular Engineering

Spring 2024 Seminar Series

MATTHEW TIRRELL

"Exploring the Physics, Materials Science, and Biological Implications of Polyelectrolyte Complexation"

Wednesday
April 24, 2024
3:30 PM
Wu and Chen Auditorium
Levine Hall

D. Gale Johnson Distinguished Service Professor Emeritus
Molecular Engineering
University of Chicago

ABSTRACT

The richness of liquid-liquid phase separation behavior in mixtures of oppositely-charged polyelectrolyte has been greatly illuminated recently in the polymer physics literature. Precise determinations of phase diagrams, measurements of interfacial tension, scattering measurements of chain configurations, and increasingly insightful theory are all producing a clearer understanding of these phenomena. In parallel, physics is also being brought to bear on manifestations of these behaviors in biology. Diverse biological examples related to liquid0liquid phase separation of polyelectrolyte complexes include membraneless organelles, biological condensates that enhance transcription or protect from stress shock, and other biological functions. This talk will spell out current understanding of the various contributions to the phase behavior, including the role of various entropic contributions, as well as the effects of charge density of the macromolecules. New results on asymmetric mixtures will be presented, which are more the norm in nature than the perfectly symmetrical mixtures in polymer physics studies.

BIO

Matthew Tirrell is the D. Gale Johnson Distinguished Service Professor Emeritus in the Pritzker School of Molecular Engineering at the University of Chicago, where he was the Founding Dean from 2011-23. He is also senior advisor and senior scientist at the Argonne National Laboratory, where he served as Deputy Laboratory Director for Science at Argonne from 2015-2018, and from 2022-23. Tirrell's work is in self-assembly and interfacial phenomena in polymers. This work has uncovered new physics of phase transitions and led to development of new materials, most recently, based on polyelectrolyte complexation. Tirrell's laboratory designs and synthesizes self-assembling molecules that organize into multifunctional, multivalent micelles with targeting, image contrast and therapeutic capabilities. Recent areas of concentration have been on complexes that target vulnerable atherosclerotic plaque, that disrupt intracellular protein-protein interactions, and that package nucleic acids for targeted and efficient delivery. Tirrell's work has been recognized with the American Physical Society's Polymer Physics Prize, the American Chemical Society's Colloid Chemistry Award, the Colburn, Stine, Professional Progress, and Walker Awards of AIChE, as well as by election to the National Academy of Engineering, the National Academy of Sciences, and the American Academy of Arts and Sciences.