

Meso Challenge: Multi-Valent Interactions in Polyelectrolytes

Opportunity

Highly charged polymer chains in mono-valent salt media exhibit a fairly simple range of behaviors, swelling in low salt, shrinking in high salt, due to screening of repulsive electrostatics. In the presence of *multi-valent* constituents, *attractive forces arise*. These attractive forces can be used to generate new phase behavior, leading to opportunities for new self-assembled materials.

Approach

Research is required to understanding the phase behavior, macro- and micro-, induced by interactions between oppositely charged macromolecules. Useful tools will include x-ray and neutron scattering, rheology, and surface-sensitive instrumentation such as afm and surface force measurement, as well as abundant opportunities for theory and simulation.

Meso Challenge

The meso challenge arises from the interplay of two types of long-ranged correlations. One is the connectivity and excluded volume effects coming from the polyelectrolyte chain backbone, extending over hundreds to thousands of nanometers. The second is the electrostatic interactions, which can extend over a similar range in low salt media.

Impact

Materials built on electrostatic complexation, especially, complexation in the fluid phase, that is, coacervation, can have multiple interesting new properties including encapsulation, surface spreading, underwater adhesion, salt and pH triggered self-assembly and disassembly. New adhesives, hydrogels and biomaterials are among the possibilities.