Tailoring Structure and Assembly in Ionic Microgels through Electric Fields

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Ionic microgels are highly responsive materials whose structure, interactions, and self-assembly can be tuned by external stimuli. Among these stimuli, electric fields provide a powerful route for directing particle organization and creating non-equilibrium structures. However, understanding how individual microgels respond to external fields in concentrated suspensions remains a significant experimental challenge. In this talk, I will demonstrate how small-angle neutron scattering (SANS), particularly under zero-average contrast (ZAC) conditions, can reveal particle-scale structural changes that govern macroscopic assembly behavior. Using ionic poly(N-isopropylacrylamide-co-acrylic acid) microgels with different crosslinking densities, we investigate the interplay between particle softness, concentration, and applied AC electric fields. For highly crosslinked microgels, SANS measurements provide evidence for field-induced particle deformation from initially spherical to anisotropic shapes. These structural changes correlate with the emergence of unusual self-assembled morphologies, including strings, body-centered-tetragonal clusters, and tubular structures (typically associated with anisotropic particles). In contrast, loosely crosslinked microgels exhibit a markedly different response: neutron and X-ray scattering measurements reveal substantial field-induced particle compression while maintaining isotropic particle symmetry and unchanged interparticle spacing. The results of these studies will be presented.