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Seminar Presentation: 11:00am – 12:00pm
CMRR Auditorium

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Complexation Driven Self-Assembly of Block Copolyelectrolytes

Abstract:
Polyelectrolyte complexes (PEC) form when oppositely charged polyelectrolyte chains spontaneously associate and phase separate in aqueous media. Conjugating one or both the polyelectrolytes with neutral polymers restricts bulk phase separation of the PECs, and thus leads to self-assembled structures with PEC domains surrounded by neutral polymer coronae, forming micelles and hydrogels. The PEC domains in these assemblies can encapsulate hydrophilic cargo and have tremendous potential for biomedicine, chemical-sensing applications, food systems and cosmetics. This talk focuses on physical properties of model PEC hydrogel assemblies comprising oppositely charged block copolyelectrolytes. Created using a novel two-step synthesis scheme, the copolyelectrolytes self-assemble to form hydrogel structures with polyelectrolyte complex domains serving as physical crosslinks. Precise PEC domain size, morphology, spacing and ordering is achieved via tuning of the polymer architecture and loading, ideal for fundamental studies. Structural investigations employing complementary X-ray and neutron scattering elucidate the contributions of the charged and the neutral blocks in defining and directing the structure of these self-assemblies, respectively. Extending these ideas to assembly of model oppositely charged triblock copolyelectrolytes, we find that at low concentrations the materials spontaneously assemble into phase separated inter-connected networks of PEC cores, underscoring the disparity between complexation-driven assembly of triblock copolyelectrolytes and hydrophobicity driven assembly of their uncharged amphiphilic counterparts. Molecular dynamics simulations are employed to provide insights on the driving forces behind these unique assemblies and their relationships to corresponding assemblies of amphiphilic molecules.

Biosketch:
Samanvaya Srivastava is a postdoctoral scholar at The University of Chicago, where he is working with Prof. Matthew Tirrell on design, structure-properties relationships and applications of polyelectrolyte based self-assembled materials. He received his Ph.D. from Cornell University in Chemical and Biomolecular Engineering in 2014. His doctoral dissertation research under the supervision of Prof. Lynden A. Archer was focused on elucidating structure and properties of nanoparticle dispersions. Samanvaya developed strategies for achieving uniform nanoparticle dispersion in polymeric matrices and the effects of particle distribution on bulk properties in nanocomposites. Prior to this, he received his B. Tech. and M. Tech. degrees in Chemical Engineering from Indian Institute of Technology Kanpur. In his Masters research, conducted under the guidance of Prof. Ashutosh Sharma, he studied the role of physical heterogeneities on substrate surfaces as manifested in the electric force induced patterns in thin polymer films.