Microphase segregation in random copolymers for fuel cell membranes

Random copolymers play an important role in a range of soft materials applications and biological phenomena. Polymer membranes for fuel cells are frequently composed of random copolymers synthesized with hydrophobic and hydrophilic monomers. Microphase segregation of these monomers results in a solid material whose mechanical integrity arises from a space spanning random arrangement of hydrophobic domains, and ion transport occurs through the corresponding hydrophilic domains. The structure of the microphase segregated domains dictates the pathways for ion transport and ultimately the macroscopic ion mobility and material performance. An individual monomer is typically a single chemical unit whose length is comparable to a Kuhn length, resulting in a monomer segment that is structurally rigid at length scales of a segregated domain. Previous work on random copolymer phase segregation addresses the impact of correlations between the chemical identities along the chains for flexible polymers; thus, a monomer block behaves as a random walk without structural correlation associated with semiflexibility. In our work, we develop a model of semiflexible random copolymers to address the thermodynamics of microphase segregation and the structure of the segregated domains. We show the onset of phase segregation and the correlation length of domains is extremely sensitive to chain rigidity and to the statistical arrangement of monomers within the copolymer chains.

Tuesday, April 25, 2017
Lecture at 4:00 p.m.
Room 1800, Engineering Hall
Refreshments will be served at 3:45 p.m.