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Speaker: Dr. Engin Burgaz, Materials Science and Engineering Department, Cornell University, Ithaca.

Title: Ionomer-Colloid mixtures for fuel cell electrolyte membrane and artificial muscle applications.

Abstract: The phase behavior of ionomer-colloid mixtures is studied in order to understand the depletion-induced interaction between the ionomers and nano particles. In this study, Nafion ionomer in its H+ form and sodium polystyrene sulfonate and polystyrene sulfonic acid (Na+ PSS and H+ PSS) are chosen as the non-adsorbed polymer molecules whereas montmorillonite clay in its Na+ and H+ form, Laponite RD and silica are selected as the nanoparticles. The morphology, thermomechanical behavior, dynamics, conductivity and methanol permeability of the mixtures are studied both in gel and solid state. Based upon the fundamental understanding of the phase behavior of this system, we are currently pursuing to fabricate advanced materials for proton conducting polymer electrolyte fuel cell applications. Secondly, we are using the knowledge from the phase behavior study to fabricate ionic polymer-metal composites (IPMCs) for possible applications in artificial muscles, robotic systems, and biomedical devices.