

Confined Glassy Properties and Constrained Volume Processing of Polymer Nanoparticles



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[Physics Astronomy Building \(PAA\)](#) A118

Reception at 3:30 p.m. PAA A118

Abstract

In this talk, we discuss two important themes in contemporary polymer science: nanoscale confinement effects on polymer properties and new routes of processing nanomaterials, i.e., nanoparticles. Concerning the former, significant effort has been devoted to pursuing an understanding of the glass transition temperature of polymers confined to the nanoscale. Much of our understanding has been obtained via studies on thin polymer films. Here, we show the glass transition temperature of polymer nanoparticles can deviate significantly from the bulk value. Our work suggests a common origin of size effects of the glassy properties of confined polymers, irrespective of geometry, that is, interfacial effects. We also discuss the influence of surfactants and the dispersing media on the glass transition temperature and fragility of polymer nanoparticles as well as make a connection between size effects on fragility and a characteristic lengthscale. With regards to the later theme, we will demonstrate a strategy for the self-assembly of multi-faced nanoparticles through the precipitation-induced, rapid spinodal-decomposition of polymer phases within a confined solution volume. Using a two-faced Janus particle assembled from two simple homopolymers as a model system, we demonstrate the ability of the method to provide simultaneous control over particle size, surface functionality, and compositional anisotropy as the assembly process is scaled. Furthermore, we illustrate that tuning the molecular weight of the homopolymers and increasing the number of polymer components in the system can facilitate the formation of multi-faced and protruded nanoparticles, respectively. Our results demonstrate that incompatible polymers with different properties can be self-assembled into nanoparticles with controllable surface topology by simultaneously reducing the timescale and solution volume over which they undergo self-assembly.

Speaker Biography

Rodney D. Priestley is an Assistant Professor in the Department of Chemical and Biological Engineering at Princeton University. He obtained his Ph.D. in Chemical Engineering from Northwestern University in 2008. He completed a NSF/Chateaubriand postdoctoral fellowship at Ecole Supérieure de Physique et Chimie Industrielles de la Ville de Paris. His research interests include polymer glasses, nanoconfined polymer dynamics, polymer thin film and nanoparticle formation, MAPLE and responsive polymers. He is the recipient of numerous awards including the Quadrant Award, ACS New Investigator Grant, 3M Non-Tenured Faculty Grant, NSF CAREER Award, AFOSR YIP, Presidential Early Career Award for Scientist and Engineers, Alfred P. Sloan Fellowship and Camille Dreyfus Teacher-Scholar Award. Most recently he was named to The Root 100 list of most influential African American in 2014.