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Thin Films of Supramolecular Nanocomposites

TING XU, University of California, Berkeley

Supramolecular nanocomposites, composed of polymers, small molecules and nanoparticles, offer numerous opportunities to achieve nanoparticle assemblies with high spatial precision and to incorporate different built-in functionalities by simply varying building blocks. However, as multi-component systems, building blocks are mixed together without forming covalent bonds. There are different energetic contributions governing their phase behavior in bulk and in thin films. Energetically, these contributions are comparable, typically in the range of a few kcal/mol. This makes it feasible to access a rich library of nanostructured composites and enables one to manipulate dynamic nanoparticle assemblies. However, the rather flat energy landscape also presents challenges to precisely control the assemblies in a predictable manner. Here, we present our recent studies on the phase behavior of supramolecular nanocomposites in thin films. We qualitatively describe the effect of the particle-polymer interaction, the polymer chain conformation, the surface tension of each component and the supramolecular morphology on the nanoparticle assemblies in thin films. These basic studies led to well-defined 3-D nanoparticle assemblies of single type nanoparticle and nanoparticle mixtures in thin films. Furthermore, I will discuss our interesting explorations on the dynamics of nanoparticle assemblies in thin films of supramolecular assemblies.