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3D Nanoparticle Assemblies in Thin Films of Supramolecular Nanocomposites JOSEPH KAO, PETER BAI, VIVIAN CHUANG, UC Berkeley, ZHANG JIANG, Advanced Photon Source, PETER ERCIUS, National Center for Electron Microscopy, TING XU, UC Berkeley — Nanocomposite thin films containing hierarchically-ordered nanoparticle assemblies are highly desirable to modulate the collective properties of nanoparticles to meet material requirements for nanodevice fabrication. Block copolymer-based supramolecules have shown great potential in directing the assembly of ordered nanoparticle arrays for a wide range of nanoparticles in bulk. Here, I will describe systematic studies on the phase behavior of supramolecular nanocomposites in thin films using a model system that forms parallel cylindrical morphology. By tailoring the conformational entropy of the comb block of the supramolecule, a rich library of nanoparticle assemblies including 1D chains, 2D lattices, 3D arrays and networks with precisely controlled inter-particle ordering can be obtained. Furthermore, the entropic contributions in the assembly process can be tuned by varying nanoparticle size. This enables one to achieve 3D hybrid arrays of metallic and semiconductor nanoparticles in thin films. The comprehensive studies on the thermodynamics and kinetics of the nanoparticle assemblies in supramolecular nanocomposite thin films opens up a new avenue for the fabrication of next-generation nanoparticle-based devices.

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