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Kinetic pathways to organized polymer/nanoparticle assemblies

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Processes that allow for controlled access to kinetically trapped non-equilibrium states have the potential to significantly expand the range of structures and properties that may be achieved by self-assembly. We will describe several recent examples from our group wherein new types of polymer/nanoparticle assemblies are enabled by designed processing pathways. In the first case, we study the formation of amphiphilic polymer micelles through hydrodynamic instabilities of solvent/water interfaces induced during emulsion processing. We show that this route allows for efficient co-encapsulation of multiple types of hydrophobic nanoparticles within the micelle cores. Second, we consider the influence of nanoparticles on spinodal decomposition of a polymer blend and find that the inclusion of aggregating particles provides a route to kinetically stabilize co-continuous structures through particle gelation in one of the polymer phases. Finally, we show how the structures of hybrid nanoparticle/conjugated polymer nanowires can be tuned using solution-state crystallization.