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Tuning the Assembly of Spherical Nanoparticles in Semicrystalline Polymers DAN ZHAO, Columbia Univ, JACQUES JESTIN, Laboratoire Lon Brillouin, CEA Saclay, LONGXI ZHAO, SANAT K. KUMAR, Columbia Univ, MOHAMMAD MOHAMMADKHANI, BRIAN C. BENICEWICZ, University of South Carolina — We propose a simple, novel strategy to controlling nanoparticle (NPs) dispersion states in a semi-crystalline polymer matrix exploiting the kinetics of polymer crystallization. The system consists of poly(methyl methacrylate) grafted spherical silica NPs and poly(ethylene oxide) matrices, which are thermodynamically miscible in the melt. We first show that no remarkable change was observed in the spatial dispersion of NPs upon fast crystallization. However, for slow crystallization, both TEM and X-ray/neutron scattering reveal that the system starts to be organized in a "layer-by-layer" architecture, where the NPs are aligned in the amorphous phases intercalated by the crystalline lamellar phases. More importantly, we have found that the resulting "sheet-like" NP morphology gives rise to a 2-fold increase in the storage modulus but without compromising the fracture toughness of the neat polymer. These results open pathways for creating in-situ biomimetic hierarchical structures with improved mechanical properties through a simple, single-step crystallization processing, which could lead to new applications for this largest class of commercially relevant polymeric materials.

Dan Zhao
Columbia Univ

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