Polymer Nanocomposites Using Dopamine-Modified Polymers at Nanoparticle Surfaces in Very Low Molecular Weight Polymers

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While incorporation of nanoparticles in a polymer matrix generally enhnaces the physical properties, effective control of the nanoparticle/polymer interface in often challenging. HEre, we report a dramatic enhancement of the mechanical properties of polymer nanocomposites (PNCs) using a simple physical grafting method. The PNC consists of low molecular weight poly(ethylene glycol) (PEG) and silica nanoparticles whose surfaces are modified with dopamine-modified PEG (DOPA-mPEG) brush polymers. With DOPA-mPEG grafting, the nanoparticle surface can be readily altered, and the shear modulus of the PNC is increased by a factor of 10^5 at an appropriate surface grafting density. The detailed microstructure and mechanical properties are examined with small-angle X-ray scattering (SAXS) and oscillatory rheometry experiments.