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Anisotropic Self-Assembly of Nanoparticle Amphiphiles[1]

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It is easy to understand the self-assembly of particles having anisotropic shapes or interactions, such as Co nanoparticles or proteins, into highly extended structures. However, there is no experimentally established strategy for creating anisotropic structures from common spherical nanoparticles. We demonstrate that spherical nanoparticles, uniformly grafted with macromolecules, robustly self-assemble into a range of anisotropic superstructures when they are dispersed in the corresponding homopolymer matrix. This phenomenon is driven by the microphase separation between the inorganic nanoparticles and the (organic) polymeric chains grafted to their surfaces in a fashion similar to block copolymers. This microphase separation driven particle self-assembly provides a unique means of controlling the global nanoparticle dispersion state in polymer nanocomposites. The relationship between the state of particle dispersion and nanocomposite properties can thus be critically examined, and in particular we focus on the mechanical reinforcement afforded when particles are added to polymers. Grafted nanoparticles are thus versatile building blocks for creating tunable and functional particle superstructures with significant practical applications. With Pinar Akcora, Hongjun Liu, Yu Li, Brian Benicewicz, Linda Schadler, Thanos Panagiotopoulos, Jack Douglas, P. Thiyagarajan and Ralph Colby.

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