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Self-Assembled Nanorods and Nanoplates in Polymer Nanocomposite Films[1]

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Polymer nanocomposite (PNC) films combine the processibility of polymers with the functional properties, such as electrical conductivity, toughness and transparency, imparted by the type and dispersion nanoparticle. In this work we investigate the assembly of polymer grafted gold nanorods (NRs) in homopolymer and block copolymer films. By tuning brush and matrix molecular weight, the dispersion and alignment (side by side versus end-to-end) of NRs is tailored to control the optical properties, such as a blue or red shift in the surface plasmon resonance (SPR). Simulations to predict thermodynamic conditions for dispersion/aggregation are presented. Moreover, mixed brushes and bimodal brush lengths grafted to NRs are shown to improve dispersion and self consistent field calculations provide insight into the thermodynamic driving force for this behavior. The dispersion of upconverting nanoplates in homopolymer films is also presented. Using cylindrical block copolymer films, NRs locate at the surface and span neighboring vertical domains. Simulations provide a thermodynamic explanation for the preferential location of NRs as a function of length. Finally, a short discussion of nanoparticle dynamics in crowded and confined systems concludes this presentation.

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