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Nonisotropic Assembly of Single-Component Hairy Nanoparticles R. VAIA, H. KOERNER, L. DRUMMY, AFRL-WPAFB, B. BENICEWICZ, Y. LI, U of South Carolina, AFRL-WPAFB TEAM, U OF SOUTH CAROLINA COLLABORATION — Solvent-free assemblies of hairy nanoparticles (HNPs) are providing avenues to avoid issues of mixing, agglomeration and limited inorganic content that plague traditional nanocomposites that are based on polymer-nanoparticle blending. We demonstrate that for a range of graft densities, depletion forces acting on high molecular weight poly(styrene) (120kDa) grafted to SiO_2 (r0 = 8nm) lead to non-isotropic organization of the nanoparticle center of mass. The order within the neat HNP assembly (aHNP) and its elongational characteristics evolve as the architecture of the polymeric corona in solution transitions from concentrated (CBP) to semidilute (SDPB) polymer brush regimes. Specifically, local HNP packing adopts a non-isotropic arrangement at intermediate graft densities (σ = 0.01 – 0.1 chains/nm^2) where the CPB-to-SDPB transition in solution is approximately r0. In concert, the neat HNP assembly responds to elongational deformation in a manner analogous to semi-crystalline elastomers. The correlation between the corona architecture of the HNP and the physical characteristics of the solvent free aHNP point toward a possible approach to tune mechanical, optical and electrical properties of single component hybrids in a manner analogous to block-copolymer mesoscale morphology.

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