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Self-Assembly and Shear-Induced Long-Range Order of Nanorods in Wormlike Micelle Solutions. RAMONA MHANNA, Johns Hopkins University , JONGHUN LEE, SURESH NARAYANAN, Argonne National Laboratory, DANIEL H. REICH, ROBERT L. LEHENY, Johns Hopkins University — Small angle x-ray scattering was employed to study the structural properties of nanorods within wormlike micelle (WLM) solutions. The gold rods (L=75 nm, D=14nm) were dispersed at a dilute concentration (0.003 percent by volume) in WLM solutions formed by the surfactant cetylpyridinium chloride (CPyCl) and counter-ion sodium salicylate (NaSaI) over CPyCl concentrations (112 to 400 mM), placing the solutions in the semi-dilute, entangled regime. In quiescent conditions, the SAXS profiles obtained for high CPyCl concentrations (higher than 200 mM) show the formation of powder-like Bragg peaks associated with a hexagonal nanorod arrangement, which develops over the course of tens of minutes. This isotropic self-assembly remarkably evolves into an anisotropic long range order upon shearing at rates between 2 and 5 s^{-1}, indicating a further shear-induced in-plane arrangement of the rods. This ordering, extending over macroscopic scales in the solutions, persists after the cessation of shear but is destroyed by strong shear (rates higher than 50 s^{-1}). At lower CPyCl concentrations, no nanorod assembly is observed under either quiescent conditions or steady shear, indicating the significance of the micelles in the nanoparticle ordering.

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