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Formation of localized shear induced states in wormlike micelle solutions using magnetic nanowire probes NATHAN CAPPALLO, CLAYTON LAPOINTE, ROBERT LEHENY, DANIEL REICH, Johns Hopkins University —
Under certain conditions, surfactant molecules in aqueous suspension can form long cylindrically shaped micelles that entangle, leading to complex non-linear rheological behavior. We report the formation of spatially localized shear induced states in the wormlike micelle system, cetylpyridinium chloride/sodium salicylate (CPCl/NaSal), through the rapid rotation of colloidal wires. Ferromagnetic Ni nanowires with radius 150 nm and lengths between 5 and 50 microns suspended in the micellar fluid are subjected to magnetic torques via rotating external magnetic fields. For low rotation frequencies the nanowires unwind after removal of the field, as expected for a viscoelastic fluid. After removal of higher frequency fields, however, the wires tip rapidly out of the plane of rotation due to a torque generated by the fluid. We interpret this phenomenon in terms of the nucleation of a region of nematic order in the micelles. The temperature and frequency dependence of this behavior, as well as the use of the nanowires to monitor the transient anisotropic elastic properties of the shear-induced state, will be discussed.

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