587a Shear-Induced Banding and Phase Separation in Solutions of Wormlike Micelles

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Surfactant solutions self-assembled into wormlike micelles exhibit linear viscoelasticity characteristic of model, entangled polymer solutions, but can exhibit unusual nonlinear responses such as shear banding and shear induced phase separation (SIPS). In this work we explore the mechanisms underlying this unusual nonlinear behavior. Model micellar solutions of identical surfactant concentration but varying salt concentration are explored by a combination of rheology, rheo-optics, particle tracking velocimetry, Rheo-SANS, and novel flow-SANS in the 1-2 plane with gap resolution to investigate the structure of the shear-banded and SIPS state. In particular, two solutions of nearly identical linear viscoelasticity are compared, where one exhibits SIPS while the other remains a single phase, shear thinning fluid. The behavior can be connected to micellar branching in proximity to an underlying thermodynamic phase transition. Flow-SANS in the 1-2 plane demonstrates morphological changes in the self-assembled microstructure in the shear-banding sample. Differences in the samples' behavior under shear flow is connected to the differences in molecular interactions due to the varying salt concentration.