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Relating shear banding and orientational order in wormlike micellar solutions MATTHEW HELGESON, MATTHEW REICHERT, University of Delaware, ERIC KALER, Stony Brook University, NORMAN WAGNER, Unviersity of Delaware — Shear banding has been observed in a variety of complex fluids, including polymer solutions, colloidal suspensions and, most prominently, wormlike micelles (WLMs). However, accurate modeling of shear banding fluids remains a challenge, due to the inability to identify the mechanism(s) leading to banding. Using a novel approach that combines measurements of phase behavior, rheology, and spatially-resolved microstructure on model WLMs, we present the first complete study of local rheology and microstructure through the shear banding transition for model WLMs in the vicinity of an equilibrium isotropic-nematic transition (I-N). The rheology of such fluids is well-described by the Giesekus constitutive equation with incorporated stress diffusion, which allows simultaneous description of rheology, flow kinematics, and spatially-resolved microstructure under shear. The results show that shear banding coincides with a first-order, shear-induced transition to a paranematic state at critical values of micellar orientation and alignment, which can be related directly to a non-monotonic constitutive relation. Furthermore, the model allows for the construction of non-equilibrium state diagrams that elucidate a number of experimental observations in shear banding fluids.

Matthew Helgeson
University of Delaware

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