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Channel Flow of Wormlike Micellar Solutions MICHAEL CROMER, PAM COOK, University of Delaware, GARETH MCKINLEY, Massachusetts Institute of Technology — We examine the inhomogeneous response of the VCM model (Vasquez, Cook, McKinley 2006) in steady pressure-driven channel flow. The VCM model, a microstructural network model, was developed to describe concentrated solutions of wormlike micelles. The model comprises of a set of coupled partial differential equations, which incorporate breakage and reforming of two micellar species (a long species 'A' and a shorter species 'B') in addition to reptative and Rousian stress-relaxation mechanisms. We examine pressure-driven flow in microfluidic devices with rectangular cross-sections as well as with hyperbolic converging/diverging walls. The velocity profile predicted by the VCM model in Poiseuille flow deviates from the parabolic profile expected for a constant viscosity fluid and exhibits strong shear bands near channel walls. This shear-banding is analogous to that seen in circular Taylor-Couette flow and in good qualitative agreement with experimental observations in microfluidic channels. The hyperbolic planar contraction is of special interest due to the dominant contribution of extensional flow along the centerline and the proposed use of such flows as microfluidic extensional rheometers. The model predictions are compared with birefringence measurements of the evolution in the local microstructural orientation of CTAB and CPyCl-based micellar solutions.

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