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Viscoelastic Flow Instabilities of Worm-like Micellar Solutions in Microfluidic Devices THOMAS OBER, GARETH MCKINLEY, Massachusetts Institute of Technology — Worm-like micellar (WLM) fluids are a unique class of complex fluids whose large deformation rate rheology is not fully understood. By combining mechanical pressure measurements, μ-PIV and spatially-resolved measurements of flow-induced birefringence, we study the behavior of WLM solutions undergoing large deformation rates in microfluidic rectilinear and converging geometries, whose small characteristic dimensions facilitate experiments at high elasticity number (i.e. low inertia). In our experiments, we observe the extensional flow of a shear-banding WLM fluid in a planar hyperbolic contraction. We classify the flow regimes and observe the onset of spatio-temporally unsteady flow often referred to as "elastic turbulence." We use pressure drop measurements to calculate the apparent extensional viscosity of both Newtonian fluids and WLM fluids. We also investigate the onset of elastically driven instabilities in flows nominally without streamwise curvature in a high aspect ratio straight channel. These latter experiments are aimed at determining if elastically-driven turbulence in dilute polymer solutions can be initiated and sustained in pressure-driven rectilinear flows.

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