310h Microfluidic Rheometry in Complex Fluids Using Flow-Induced Birefringence

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The rheological characterization of complex fluids in micro-scale flows presents an important technical challenge. With a view to integrate synthesis of model polymers with their physical and rheological characterization on a lab-on-a-chip platform, we present quantitative measurements of flow-induced birefringence in complex fluids undergoing planar elongational flow (PEF), produced in microchannels that are micro-analogs of cross-slot flows. These channels are produced by soft-lithography using standard photoresists, and have small (O 0.5) aspect ratios (height/width). PEF flow kinematics is verified by micro-particle imaging velocimetry (μ-PIV), and near the mid-plane the three-dimensional flow closely approximates PEF. We carefully apply the stress-optical rule and use birefringence data to measure the rheology of wormlike micellar surfactant solutions of CTAB and sodium salicylate undergoing PEF.