Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

A Microfluidic Network for Investigating the Flow of Layered Liquids under Confinement SHAHAB SHOJAEI-ZADEH, SHELLEY L. ANNA, Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh, PA, 15213 — The flow response of ordered phases of layered liquids such as smectic-A liquid crystals is dominated by the driven motion of defects in these systems. Shearing motions lead to dilatation of the layers, which generates an instability that develops into defects. While this basic concept is accepted, little experimental work exists to quantify defect motion and defect-flow interactions once the instabilities have developed. We probe these motions using pressure-driven flow in PDMS-based microchannels. The microchannel surfaces are treated such that a specific molecular anchoring is imposed. Confinement, combined with specific surface anchoring, leads to the formation of well-ordered static defect textures with characteristic sizes in the tens of microns. To establish and control a known pressure difference across a microchannel filled with liquid crystal, we introduce a simple microfluidic network capable of controlling both flow rate and pressure drop across a target microchannel segment. By introducing a known input flow rate to this network, we establish a known pressure difference across the target segment. We measure this pressure difference along with the defect velocity and relate these to the initial defect size and arrangement. These results demonstrate a novel method for probing nonlinear flow behavior of microstructured liquids.

Shahab Shojaei-Zadeh
Department of Mechanical Engineering,
Carnegie Mellon University, Pittsburgh, PA, 15213

Date submitted: 06 Aug 2007 Electronic form version 1.4