Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Direct measurements of DNA-laden flows in microfluidic devices

SHELLY GULATI, SUSAN J. MULLER, DORIAN LIEPMANN, University of California, Berkeley — The characterization of flows containing macromolecules such as DNA is critical for the optimal design of microfluidic systems for biochemical analyses. The effects on λ-DNA transport in microscale flows are significant because the flow behavior may be influenced by molecular interactions, both viscous and elastic forces dominate inertial forces at this length scale, and the macromolecular length scale L approaches the device length scale D. Planar micro-contraction geometries (gradual and 2:1 abrupt) are used as test structures because they are canonical microfluidic components and a viscoelastic benchmark. The DNA solution is subjected to regions of elongation along the channel centerline and shear at the walls and L/D ~ 0.12 and ~ 0.22 for the 2:1 abrupt and gradual contraction, respectively. Digital Particle Image Velocimetry (DPIV), pressure measurements, and flow visualization are used to characterize the flows of water and semi-dilute DNA solutions over the range $0.5 < \mathrm{De} < 180$ and $0.0001 < \mathrm{Re} < 0.9$. Recirculation regions observed upstream of the contraction for semi-dilute DNA flows indicate strong elastic flow behavior. Conformational studies of DNA flows in these geometries relate molecular conformation to the velocity fields across a similar parameter range.

Shelly Gulati

Date submitted: 10 Aug 2005 Electronic form version 1.4