Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

The onset of microscale tipstreaming with soluble nonionic surfactants SHELLEY ANNA, NICOLAS ALVAREZ, WINGKI LEE, LYNN WALKER, Carnegie Mellon University — Surfactants play a significant role in the formation of emulsion droplets in microfluidic devices. At specific concentrations and flow rates, tipstreaming is observed and micron-scale droplets are formed. To date, the role of the surfactant itself is not well understood. The timescales for surfactant mass transport including diffusion, adsorption, and desorption can all be significant in determining the local, instantaneous surface concentration. In this talk, we present microfluidic tipstreaming experiments using nonionic CiEj surfactants in which the hydrophobic tail length varies. We show that tipstreaming occurs only when adsorption is rapid enough for surfactant to adsorb but viscous stresses are strong enough to maintain a surface tension gradient. The experiments indicate that the allowable surface coverage for tipstreaming is very small, even though the bulk concentration is greater than the critical micelle concentration. We use a one-dimensional kinetic-limited transport model to demonstrate that small surface coverages can lead to highly nonlinear effects like tipstreaming at these length and time scales.

Shelley Anna
Carnegie Mellon University

Date submitted: 06 Aug 2010 Electronic form version 1.4