Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Using bulk convection to approach kinetic-limited surfactant dynamics LYNN WALKER, NICOLAS ALVAREZ, Carnegie Mellon University, DOUGLAS VOGUS, Bucknell University, SHELLEY ANNA, Carnegie Mellon University — Many processes involving transport of surfactants to interfaces are in the regime where kinetics, diffusion and convection are comparable. Using the principle that the timescale for diffusion depends on curvature, we previously developed a microtensiometer to accurately measure surfactant dynamics at spherical microscale liquid-fluid interfaces. In the present study, we introduce a low Reynolds number flow in the bulk solution to further increase the rate of diffusion. Dynamic surface tension is measured as a function of Peclet number and the results are put into the context of a simplified convection-diffusion model. Although a transition from diffusion to kinetic- limited transport is not observed experimentally for the surfactants considered, lower bounds on the adsorption and desorption rate constants are determined. These lower bound values are much larger than previously reported rate constants. This experimental tool and analysis allows the governing mechanisms of surfactant transport at liquid-fluid interfaces to be quantified. The addition of flow near an interface is effective in decreasing the length scale for diffusion, and shifting the relevant timescales. The results show that the detailed nature of the flow field does not need to be controlled as long as the local Reynolds number is low.

Shelley Anna
Carnegie Mellon University

Date submitted: 04 Aug 2011 Electronic form version 1.4