Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

**Surfactant-enhanced thermocapillary flow in two-dimensional slots.** RAM HANUMANTHU, KATHLEEN STEBE, Department of Chemical & Biomolecular Engineering; Johns Hopkins University; Baltimore, MD 21218 — An insoluble surfactant at an aqueous-gas interface can assume a variety of surface states including gaseous (G), liquid expanded (LE), and liquid condensed (LC) states. The surface pressure-surface area isotherm for such monolayers is well established; however, their thermocapillary behavior has received less attention. Recently, Nguyen & Stebe reported surfactant-enhanced Marangoni-Benard flows in evaporating aqueous drops, created by the strong dependence of surface tension on temperature in LE-LC co-existence. In this work, flow in a two-dimensional slot in the presence of insoluble surfactant is modeled. The time-dependent, incompressible Navier-Stokes equations, coupled with energy conservation and surface convection-diffusion equations are solved using Galerkin's method of weighted residuals on a finite element mesh. The model is verified against the results of Sen & Davis for steady thermocapillary flows in two-dimensional slots; and of Homsy & Meiburg for surfactant effects in a linear limit. Finally, both steady-state and dynamic flow patterns are presented that evolve when a constitutive equation that captures the full, non-linear, concentration- and temperature-dependent phase-change behavior is used. Predicted flow patterns are compared qualitatively to the experimental observations.

Kathleen Stebe

Date submitted: 06 Dec 2005

Electronic form version 1.4