Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Electrohydrodynamic instabilities in thin bilayer liquid films
SCOTT ROBERTS, SATISH KUMAR, Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455 — When DC or AC electric fields are applied to a thin liquid film, the interface may become unstable and form a series of pillars. We examine how the presence of a second liquid interface influences pillar dynamics and morphologies. For perfect dielectric films, linear stability analysis of a lubrication-approximation-based model shows that the root mean square voltage governs the pillar behavior. For leaky dielectric films, Floquet theory is applied to carry out the linear stability analysis, and reveals that the accumulation of free charge at each interface depends on the conductivities in the adjoining phases and that high frequencies of the AC electric field may be used to control this accumulation at each interface independently. Nonlinear 1-D and 2-D simulations confirm the results of the linear stability analysis and reveal the final pillar morphology. The results presented here may of interest for the controlled creation of surface topographical features in applications such as patterned coatings and microelectronics.

Scott Roberts
Department of Chemical Engineering and Materials Science,
University of Minnesota, Minneapolis, Minnesota 55455

Date submitted: 11 Aug 2009 Electronic form version 1.4