

Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Competitive Displacement of Thin Liquid Films on Chemically Patterned Substrates RICHARD D. LENZ, SATISH KUMAR, University of Minnesota — The displacement of one liquid film by another on a chemically patterned substrate is a process potentially important to lithographic printing and microfluidic flows. In order to gain a fundamental understanding of the film rupture associated with this process, the lubrication approximation is applied to obtain a one-dimensional nonlinear evolution equation for the position of the liquid-liquid interface. Chemical patterning of the substrate is incorporated through the use of a spatially varying van der Waals potential. Both linear stability analysis and numerical simulations are performed to study the behavior of the evolution equation over a wide range of parameters. When one liquid film rests on a substrate containing a chemical pattern that it does not preferentially wet, an overlying liquid film which does wet that pattern can displace the film adjacent to the substrate and cause it to rupture. The location and speed of the rupture are found to depend on a competition between the width of the chemical pattern and the wavelength of the most dangerous mode associated with a chemically homogeneous substrate. The results also show that rupture can occur in multiple places almost simultaneously, which suggests a possible mechanism for emulsification of one of the liquids into the other.

Satish Kumar
University of Minnesota

Date submitted: 24 Jun 2005

Electronic form version 1.4