Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Theory of slope-dependent disjoining pressure with application to Lennard-Jones liquid films. TAEIL YI, HARRIS WONG, Louisiana State University — A molecule in a thin liquid film may experience additional intermolecular forces if the film thickness h is less than roughly 100 nm. The effect of these intermolecular forces at the continuum level is captured by disjoining pressure P. Since P dominates at small film thicknesses, it determines the stability and wettability of thin films. To leading order, P = P(h) because thin films are generally uniform. This form, however, cannot be applied to films that end at the substrate with non-zero contact angles. We have developed a new theory of slope-dependent disjoining-pressure.[Wu & Wong, J. Fluid Mech. 506, 157 (2004)] In this theory, the total energy of a drop on a solid substrate is minimized to yield an equilibrium equation that relates P to an excess interaction energy E = E(h, hx). By considering a fluid wedge on a solid substrate, E(h, hx) is found by pairwise summation of intermolecular potentials. This work applies the new theory to Lennard-Jones liquid films. We find a large class of equilibrium drop and meniscus shapes, including a drop with a finite precursor film.

Harris Wong
Louisiana State University

Date submitted: 05 Aug 2005 Electronic form version 1.4