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Theory of slope-dependent disjoining pressure with application to Lennard-Jones liquid films TAEIL YI, Mech. Eng. Dept. Northwestern Univ., HARRIS WONG, Mech. Eng. Dept. LSU — A liquid film of thickness h < 100 nm is subject to additional intermolecular forces, which are collectively called disjoining pressure P. Since dominates at small film thicknesses, it determines the stability and wettability of thin films. Current theory derived for uniform films gives P=P(h). This solution has been applied recently to non-uniform films and becomes unbounded near a contact line as h->0. Consequently, many different effects have been considered to eliminate or circumvent this singularity. We present a mean-field theory of that depends on the slope as well as the height h of the film.[1] When this theory is implemented for Lennard-Jones liquid films, the new P=P(h,hx) is bounded near a contact line as h->0. Thus, the singularity in P(h) is artificial because it results from extending a theory beyond its range of validity. We also show that the new can capture all three regimes of drop behavior (complete wetting, partial wetting, and pseudo partial wetting) without altering the signs of the long and short-range interactions. We find that a drop with an unbounded precursor film is linearly stable.
[1] Wu & Wong, J. Fluid Mech. 506, 157 (2004)
[2] Yi & Wong, J. Colloid Inter. Sci. 313, 579 (2007)

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