



A SLOPE-DEPENDENT DISJOINING PRESSURE FOR LENNARD-JONES LIQUID FILMS

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ABSTRACT

A molecule in a bulk liquid is subject to intermolecular forces. A molecule in a thin liquid film may experience additional intermolecular forces. If the thin film thickness is less than roughly 100 nm. The additional forces arise from the molecule's proximity to different materials or phases sandwiching the thin film. 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, can not be applied to films that end at the substrate with non-zero contact angles. We have developed a new procedure for deriving new disjoining-pressure expressions.[1] In this approach, the total energy of a drop on a solid substrate, $E(h,h_x)$ is found by pairwise summation of van der Waals potentials. This yields $P=P(h,h_x,h_{xx})$. The current work extends the summation to the Lennard-Jones potential. We find again $P=P(h,h_x,h_{xx})$, but the new expression accepts a much larger class of equilibrium drop and meniscus shapes.(Fig. 1) According to Gennes[2] , a precursor film is a result of

balancing between viscosity and disjoining pressure. However, this film is shown in the static situation by balancing between capillary pressure and new slope dependent disjoining pressure. The last part is focused on properties of this static precursor film.

REFERENCES

1. Wu & Wong, J. Fluid Mech. 506, 157 (2004)
2. P.G. de Gennes, Rev. Mod. Phys. 57, 827 (1985)

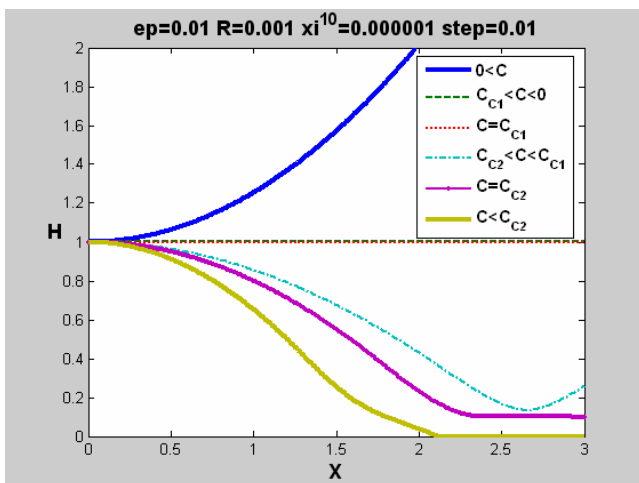


Figure 1. different shapes of liquid drop depending on capillary pressure parameter C