Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Analysis of Drop Shapes during Electrowetting on a Dielectric

YOUSEF DANESHBOD, JAMES D. STERLING, ALI NADIM, Keck Graduate Institute — Electrowetting refers to the electrostatic control of the interfacial energy of a liquid on a solid, primarily used for the transport of micro-liter volumes of drops on surfaces with embedded electrode arrays. In the present work, the drop is modeled as a two-dimensional lens-like conductor immersed in an infinite dielectric medium slightly above a planar conductor. A matched asymptotic expansion is used to approximate the electrostatic field surrounding the drop. The outer problem models the drop as a conducting circular segment resting on the conducting plane, each maintained at a separate constant potential. The inner problem corrects the region near the edge of the drop by modeling it as an infinite planar conducting wedge lying slightly above the conducting plane. By matching the inner and outer solutions, the charge density along the entire surface of the drop can be approximated, enabling the calculation of the total capacitance of the system. An energy minimization method similar to that of Shapiro *et al.* [*J. Appl. Phys.*, **93**, 5794 (2003)] is applied to the total energy consisting of the liquid/gas, liquid/solid and solid/gas surface energies, together with the electrostatic contribution, subject to the constraint that the drop volume remains constant. A modified form of the Young-Lippmann equation is thus derived that includes the contribution from the extra capacitance of the drop obtained via matched asymptotics.

Ali Nadim
Keck Graduate Institute

Date submitted: 30 Nov 2004 Electronic form version 1.4