Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Variational Approach to Modeling Droplet Spreading/Recoiling and Comparison with Experiments MANISH TIWARI, ILKER BAYER, CONSTANTINE MEGARIDIS, University of Illinois at Chicago — The dynamics of droplet spreading and recoiling on a flat substrate is modeled through the variational approach, based on the work of Kim and Chun (2001). The geometry of the droplet after impact is modeled separately as either a cylinder or a truncated sphere. The effect of variation of dynamic contact angle with contact line velocity is included. The molecular kinetic theory by Blake and Haynes (1969), and the hydrodynamic theory by Cox (1998) have been adopted to model wetting dynamics. Systematic parameter studies are carried out to demonstrate the effect of substrate surface energy, liquid surface tension and other rheological properties. The droplet wetting and dewetting dynamics is observed to be very sensitive to the specific dynamic contact angle relationship. The parametric values are tuned to match the experimental data, thus producing molecular kinetic and hydrodynamic parameters for different substrate/liquid combinations. The parameters so obtained compare well with data published in the literature. The experimental data seem to be bounded between the cylindrical and truncated sphere model results and appear to provide a convenient tool for understanding the physics of competition among kinetic, potential and viscous dissipation of energy when a droplet strikes a substrate.

Manish Tiwari
University of Illinois at Chicago

Date submitted: 12 Aug 2005 Electronic form version 1.4