Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Shape Oscillations in Sessile Liquid Drops Using Electrowetting on Dielectric R. MIRAGHAIE, J.D. STERLING, A. NADIM, Keck Graduate Institute — Experimental results aimed at characterization of oscillating droplet microfluidics using electrowetting-on-dielectric are presented. The study involves shape oscillations of a microliter sessile drop positioned on an electrowetting chip with electrical grounding provided by thin gold lines patterned on the chip. This type of grounding avoids the use of the commonly used penetrating wire, resulting in more symmetric oscillations. Excitation of the droplet at different frequencies is achieved by applying electric potential to the electrowetting chip. Oscillation shape modes of the droplet are estimated using edge detection schemes and series decomposition in Legendre polynomials in spherical coordinates. For axisymmetric oscillations, one can show using potential flow theory that only even-mode Legendre polynomials arise, with the solid boundary being a plane of mirror symmetry. Power spectral densities of the time-dependent Legendre polynomial coefficients as well as droplet diameter and height signals are calculated for different frequencies of the applied voltage. Super- and sub-harmonics are evident in some of the response signals. As an application, acceleration of DNA hybridization as a result of oscillatory excitation of a 10 microliter mixture of molecular beacon and complementary DNA is presented and compared with the non- oscillatory case.

Ali Nadim
Keck Graduate Institute

Date submitted: 12 Aug 2005 Electronic form version 1.4