Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Temperature-Controlled Free-Surface Microfluidic Devices
MEYSAM BARMI, BRIAN PIOREK, CHRYSAFIS ANDREOU, CARL MEINHART, Department of Mechanical Engineering, University of California, Santa Barbara — Free-Surface MicroFluidics (FSMF) have recently received much attention for their applications especially their ability for airborne chemical detection [Piorek, 2007]. Surface tension is generally used for fluid transport through microchannels in FSMF; however, it is not simply controllable. Thus, evaporation can be utilized for the flow control. In the current study, temperature-controlled microvalves are developed to control the fluid flow in FSMF by evaporation. The microvalve controls the flow by changing the surface temperature and requires a few tenths of a second to operate. The operating time depends on the temperature and microvalve geometry. Therefore, several configurations were fabricated and tested to find the most sensitive microvalve with the least leakage. The microchannels were fabricated on Silicon substrates with built-in heaters and RTD sensors to provide the desired temperature for microvalve operation. The high speed camera was employed to measure the operating time and velocity field. Moreover, numerical simulations were carried out by COMSOL multiphysics to find the velocity field versus the applied heat flux. They had a good agreement with the experimental results.

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Date submitted: 02 Aug 2010 Electronic form version 1.4