Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Directional Liquid Spreading on Asymmetric Nanostructured Surfaces KUANG-HAN CHU, RONG XIAO, EVELYN N. WANG, Department of Mechanical Engineering, MIT — We investigated the ability to manipulate the directionality of liquid spreading by using asymmetric nanostructured surfaces. The nanostructures were composed of silicon pillars with diameters of 250 nm with one side coated with a gold film of thicknesses ranging from 250 nm to 400 nm. Due to the thermal expansion mismatch of the materials, the pillars deflected to angles ranging from 5 to 15 degrees, where the deflection angle was dependent on the thickness of the gold layer. We demonstrated that such asymmetrical structures allow the advancing side of the droplet to spread, while pinning the receding side of the droplet. Detailed experiments were performed to characterize the effect of material properties and nanostructure deflection angle on spreading dynamics. The surface tension of the liquid was also varied to examine the effect on spreading velocity. To interpret the data, we developed a model using an energy minimization approach, which accounted for both the effects of material properties and geometry. This work provides insight into designing asymmetric structures for controlling microfluidic systems.

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Date submitted: 05 Aug 2008 Electronic form version 1.4