Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Geometry-Influenced Slippage on a Bubble Mattress in Microfluidics ELIF KARATAY, SANDER HAASE, University of Twente, Soft Matter, Fluidics and Interfaces Group, CLAAS WILLEM VISSER, CHAO SUN, DETLEF LOHSE, University of Twente, Physics of Fluids Group, PEICHUN AMY TSAI, ROB LAMMERTINK, University of Twente, Soft Matter, Fluidics and Interfaces Group, SOFT MATTER, FLUIDICS AND INTERFACES GROUP COLLABORATION, PHYSICS OF FLUIDS GROUP COLLABORATION — Hydrodynamic slippage is advantageous for drag reduction and it has been achieved with hydrophobic microstructures. Such substrates can provide soft gas/liquid interfaces with shear-free boundary condition, thereby slippage. The establishment of stable soft-interfaces is crucial for the slippage; however, it has been a challenge. In this study, we design and fabricate hydrophobic microfluidic devices, allowing stable two-phase flow with controllable micro-bubbles at the boundary of the micro-channels. We experimentally and numerically exam the geometric effect of the micro-bubbles on the slippage. The effective slip length is measured for a wide range of protrusion angles, θ, using micro-particle image velocimetry. Our measurements reveal a maximum effective slip length approximately at $\theta = 10$ degrees. In addition, the experimental results show a decrease in slip length with increasing protrusion angles when $\theta > 10°$. The transverse laminar flow over micro-bubbles has also been numerically studied with finite element methods. The experimental results show a good agreement with the numerical results quantitatively.

Elif Karatay
University of Twente, Soft Matter, Fluidics and Interfaces Group

Date submitted: 03 Aug 2012 Electronic form version 1.4