Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

The Effective Slip Length of a Flow of a Fluid in Cassie State along a Structured Surface CLARISSA SCHÖNECKER, TOBIAS BAIER, STEFFEN HARDT, Institute for Nano- and Microfluidics, Center of Smart Interfaces, TU Darmstadt, Germany — Microstructured surfaces, like for example superhydrophobic surfaces, can possess a significant apparent slip. This is usually due to a fluid entrapped in the roughness features of the surface. When a second, immiscible fluid flows over such a surface, the presence of the entrapped fluid may lead to a remarkable reduction of drag. So far, the effective slip length of such a flow was only known for a completely dissipation-free fluid being enclosed in the roughness features or for an entrapped fluid which presents a constant local slip length to the outer flow. While the first case completely neglects the viscosity of the enclosed fluid and the geometry of the roughness, the second case lacks the knowledge of the size of the local slip length, besides it being non-constant along a finite interface. We present an analytical expression for the flow field over a surface patterned with rectangular grooves, taking into account dissipation as well as the dimensions of the grooves. This leads to an expression for the effective slip length, which incorporates not only the influence of the viscosity but also provides a direct link between the geometry of the surface structure and the slip length. The results may be of great help for understanding and designing microstructured surfaces.

Clarissa Schönecker
Institute for Nano- and Microfluidics,
Center of Smart Interfaces, TU Darmstadt, Germany

Date submitted: 01 Aug 2012 Electronic form version 1.4