MAR14-2013-000605

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Correlation between surface topography and slippage

MARCUS MUELLER[1], Georg-August University, Goettingen, Germany

Using Molecular Dynamics simulations of a polymer liquid flowing past flat and patterned surfaces, we investigate the influence of corrugation, wettability and pressure on slippage and friction at the solid-liquid interface. For one-dimensional, shallow, rectangular grooves, we observe a gradual crossover between the Wenzel state, where the liquid fills the grooves, and the Cassie state, where the corrugation supports the liquid and the grooves are filled with vapor. Using two independent flow set-ups, we characterize the near-surface flow by the slip length and the position, at which viscous and frictional stresses are balanced according to Navier's partial slip boundary condition. This hydrodynamic boundary position depends on the pressure inside the channel and may be located above the corrugated surface. In the Cassie state, we observe that the edges of the corrugation contribute to the friction. These simulation data illustrate the gradual crossover between the macroscopic behavior, where the friction is reduced in the Cassie state, and molecular scale corrugation, where the substrate roughness increases friction.

[1]In collaboration with Nikita Tretyakov, Max-Planck Institute for Polymer Research, Mainz, Germany