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Closing the loop in the boundary layer: water slippage, interfacial viscosity and wettability[1] ELISA RIEDO, School of Physics, Georgia Institute of Technology, DEBORAH ORTIZ-YOUNG, School of Chemistry, Georgia Institute of Technology, HSIANG-CHIH CHIU, School of Physics, Georgia Institute of Technology, KISLON VOÏTCHOVSKY, Institute of Materials, Ecole Polytechnique Fédérale de Lausanne, SUENNE KIM, School of Physics, Georgia Institute of Technology — Understanding and manipulating fluids at the nanoscale is a matter of growing scientific and technological interest. Here, we present experiments showing that the interfacial viscosity of water depends drastically on the wetting properties of the confining surfaces. By using an atomic force microscope (AFM), we have measured the lateral viscous force experienced in water by a nano-size AFM tip while it is sheared in parallel to a smooth solid surface, as a function of the tip-surface distance. The viscous force curves, FL(d), have been measured for five surfaces with various wettabilities. In particular, the experiments indicate that in water lower forces are required to shear a tip very close to a slippery non-wetting surface, yielding to a lower effective viscosity. A modified form of the Newtonian definition of viscosity, which includes slippage, is used to successfully predict the measured shear forces in the boundary layer as a function of surface wettability, and slippage. We prove that this effect is general and can be applied in different contexts such as in explaining the relationship between dissipation and surface wettability for a nano-tip vibrating in proximity of a surface in water.

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