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Friction and Viscous Forces in Sub-Nanometer Water Films[1]
TAI-DE LI, ELISA RIEDO, School of Physics, Georgia Tech, SCHOOL OF PHYSICS, GEORGIA INSTITUTE OF TECHNOLOGY TEAM — Water under nano-confinement is ubiquitous, with examples including clay swelling, aquaporines, ion channels, and water menisci in micro-electrical-mechanical-systems. However, the structural and rheological characteristics of nano-confined pure and ionized water continue to be the subject of discussion and debate. Here, we report an experiment in which an atomic force microscope tip approaches a flat solid surface in purified water, while small lateral oscillations are applied to the tip. Direct measurements of the lateral forces encountered by a nano-size tip approaching a solid surface in purified water are reported for tip-surface distances, 0 ± 0.03 nm $< d < 2$ nm. We find that, for hydrophilic surfaces, the dynamic viscosity is measured to grow up orders of magnitude in respect to bulk water, whereas no significant increase in the viscosity has been detected when the confining solid surface is hydrophobic. The origin of the observed different behavior is discussed.

[1]NSF, ACS Petroleum Foundation, AFOSR, and DOE

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