Viscoelasticity of Water in Sub-nanometer Gaps

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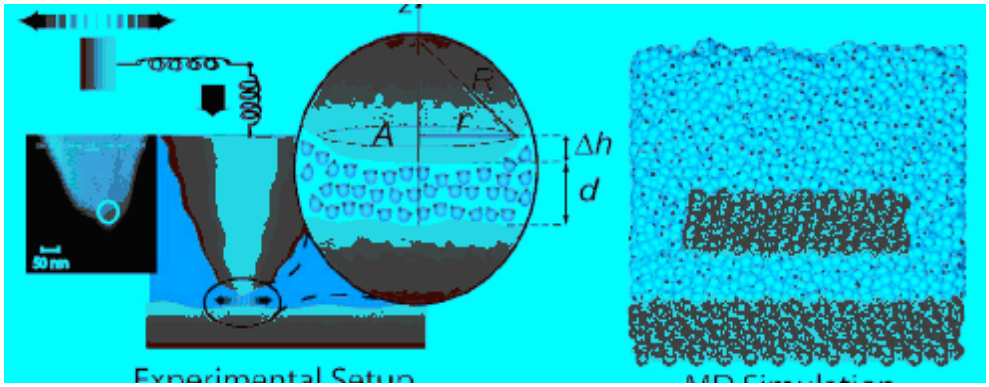
Direct and simultaneous measurements of the normal and lateral forces encountered by a nanosize spherical silicon tip approaching a solid surface in purified water are reported. For tip-surface distances, 0±0.03nm < *d* < 2nm, experiments and grand canonical molecular-dynamics simulations find oscillatory solvation forces for hydrophilic surfaces, mica and glass, and less pronounced oscillations for a hydrophobic surface, graphite. The simulations reveal layering of the confined water density and the development of hexagonal order in layers proximal to a quartz surface. For subnanometer hydrophilic confinement, the lateral force measurements show orders of magnitude increase of the viscosity with respect to bulk water, agreeing with a simulated sharp decrease in the diffusion constant. No significant viscosity increase is observed for hydrophobic surfaces.



T.-D. Li, J. Gao, R. Szoszkiewicz, U. Landman and E. Riedo, "Water in sub-nanometer gaps", *Physical Review B*,115415, vol. 75, (2007)
T.-D. Li, and E. Riedo, "Nonlinear viscoelasticity of nanoconfined water", *submitted.*