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Monitoring the formation of unstable finger-like water bridges between a nanoprobe and a flat substrate under the shear acoustic near-field microscope

ABSTRACT
Shear Acoustic Near-field Microscopy (SANM) is employed to monitor the viscoelastic response of water meniscus trapped between a laterally oscillating solid nano-probe and a solid flat substrate. It has been suggested that, at ambient conditions, the formation of such a meniscus suddenly and stochastically forms in the last 30 nm of the probe's approaching trip. Using tapered fiber-glass probes, with purposely fabricated flat apex (~ 1mm) geometry, we report evidence that the sudden formation of such a bulk water meniscus is preceded by the formation of unstable finger-like bridges. During this initial trip range we observe a lack of sound emission, which indeed confirm the absence of a bulk meniscus. The measurement are implemented driving the probe's lateral oscillation under constant frequency, as well as under frequency modulation feedback control where the probes is driving at resonance conditions at all times. These measurements are relevant to investigations on the dynamic behavior of fluids near hydrophobic/philic substrates, and wetting properties of solids and nanotribology phenomena in general.

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