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Direct measurement of the nucleation time of a water nanobridge

Water nanocapillary bridges are predominant in nature, have a significant impact in many physico-chemical properties of surfaces and can have a severe influence on the design of nanoelectromechanical devices[1]. They have been extensively studied using nanoscale experimental tools such as the Atomic Force Microscope (AFM). However, basic characteristics such as their nucleation time are still debated. Using AFM, different approaches were followed to measure the meniscus nucleation time, but such approaches suffer from poorly defined local geometry[2] or poor time resolution[3], producing order-of-magnitude contradicting results, that raise questions on the influence of local geometry and surface roughness on the nucleation of the bridges

In this presentation we will introduce a methodology to measure both the nucleation time and the critical nucleation distance for a simplified sphere-plane geometry. This approach is based on a custom-made Force Feedback Microscope (FFM)[4] that circumvents some of the disadvantages of conventional AFM, allowing it to measure the nucleation of a nanocapillary that forms between a carbon sphere and a flat piece of muscovite mica. We will present results demonstrating that the nucleation of these bridges happens within times on the order of a few milliseconds.

References

[1] E. Charlaix and M. Ciccoti, Handbook of Nanophysics, 1 (2010)
[2] R. Szoszkiewicz and E. Riedo, Physical Review Letters, 95 (2005) 135502
[3] B. Sung et al., Applied Physics Letters, 103 (2013) 213107
[4] Rodrigues et al., Applied Physics Letters, 101 (2012) 203105