Non Contact Dynamic Atomic Force Microscopy in humid environment

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Precise knowledge and control of tip-sample interaction is fundamental for Atomic Force Microscopy to optimize data acquisition on the one hand and for correct data interpretation on the other. In ambient conditions a wealth of possible interactions may act: not only Van der Waals, elastic and electrostatic interactions, but also interactions induced by liquid menisci [1,2]. The resulting capillary interactions have both conservative and dissipative components that critically define the precise behavior of non-contact Dynamic Atomic Force Microscopy (nc-DAFM) in humid environment.

We will analyze both theoretically and experimentally the forces related to liquid necks (see Fig. 1), and how these forces define nc-DAFM operation. Moreover, precise control of tip-sample interaction allows on the one hand to minimize noise, and on the other hand access the nanoscale wetting properties in in AM-nc-DAFM [3]. We will discuss noise in tip-sample interaction and show that in humid environment it is possible to acquire "noise" images with a well-defined pattern, different from topography or other acquisition channels. This noise is attributed to the interaction induced by liquid necks forming between tip and sample. While previous analyses identified thermal noise as the dominant contribution to frequency fluctuations (see, for example, [4]), experimental evidence reveals the presence of an additional and significantly stronger source when operating in humid environment in nc-DAFM regime.

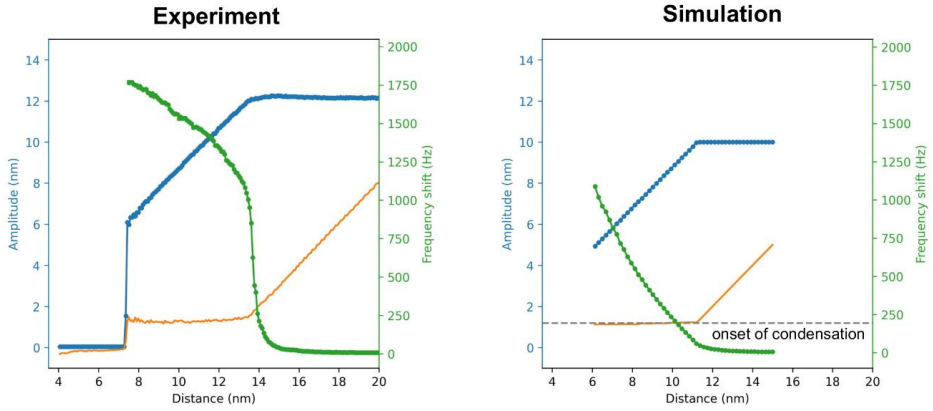

Figure 1 – Experimental vs simulated interaction-distance curves on mica. Orange curves show that the tip-sample distance at the lower turning point of oscillation is not zero in the "non-contact" regime.

References

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