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Contact-resonance (CR) atomic force microscopy (AFM) is becoming increasingly popular for the determination of the mechanical properties of surfaces of very diverse origins, including biological samples. With its ability to provide quantitative information, CR-AFM measurements are notably of great interest and very valuable for a deeper understanding of the mechanics of soft materials, common in biological systems. However, the surface preparation of such soft materials is delicate. The need to prevent significant alteration of the material properties limits the production of flat enough surfaces. Consequently, the surfaces present a high topography range with significant local slope changes. The non-linear correlation between surface slope and CR-frequency hinders a straight-forward interpretation of CR-AFM contact modulus measurements on such samples.

We aim to evidence the influence of surface slope on the CR-frequency caused by the local angle between sample surface and the cantilever (Fig.1) and to develop a correction method for CR-AFM measurements. The effect of a constant angle of 10 – 15° between tip and surface, due to the AFM set-up's intrinsic inclination of the cantilever towards a flat sample surface, has already been investigated through simulations [1, 2], but the local slope of the surface itself has not been taken into account to correct experimental measurements. Moreover, the local angle on typical samples with a topography peak to peak level in the range of one micrometer can be as large as ±50◦. Based on the previous works, we predicted the non-linear variation of the resonance frequency modes with changing surface-tip angle and confronted the numerical results to CR-AFM experiments performed on micro-sized silica spheres, which constitute a well-defined, curved, homogeneous surface (Fig.2). The method was then used to correct mechanical measurements on cut starch granules.

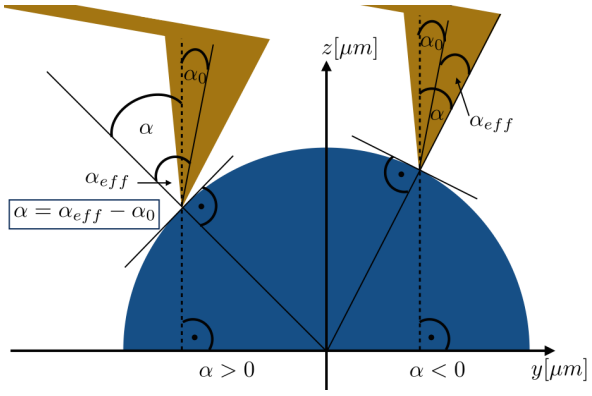

Figure 1 : Schematic of the definition of angle α between the AFM tip and a curved surface. A constant cantilever inclination of α0 is intrinsic to the AFM setup.

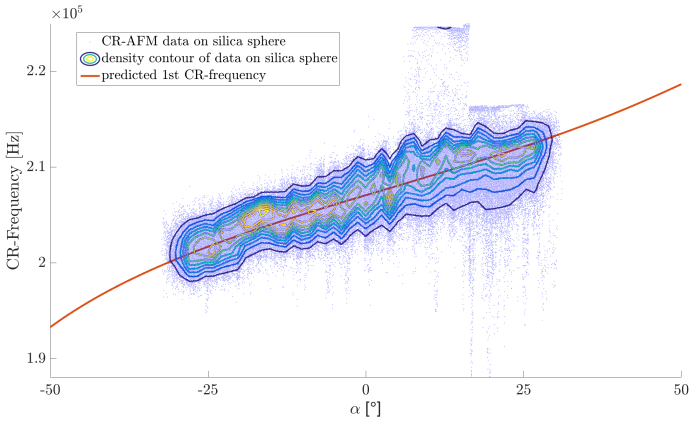

Figure 2 : The dependency of the first CR-frequency on the tip- surface angle α is shown as determined experimentally on a silica sphere (scattered data and density contour). The first CR- frequency was predicted numerically (line).

References

[1] Passeri, D.; Rossi, M.; Vlassak, J. ; *Ultramicroscopy* **2013**, *128*, 32
[2] Rabe, U.; Turner, J.; Arnold, W. ; *Applied Physics A* **1998**, *66*, S277