Description of a CNT tip touching a surface: elastic rod vs sticks model

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Carbon nanotubes (CNT) have been found for long as a perfectly adapted materials as tips for Atomic Force Microscopy. Most of the studies speak highly of the exceptional mechanical properties, their diameter and high aspect ratio of the CNTs. However, their use in AFM remains a challenge and not has been developed as fast as expected [1,2].

When a high aspect ratio object is squeezed between an AFM tips and a surface it will bend sideways and provide mechanical response that depends on the contact situation of this object on the surface. We will compare two descriptions of a CNT: One is considering a CNT as an elastic rod and another considers a CNT as a system of two sticks (Fig. 2). This theoretical works is compared to a previous experimental work described in figure 1 and réf. [3].

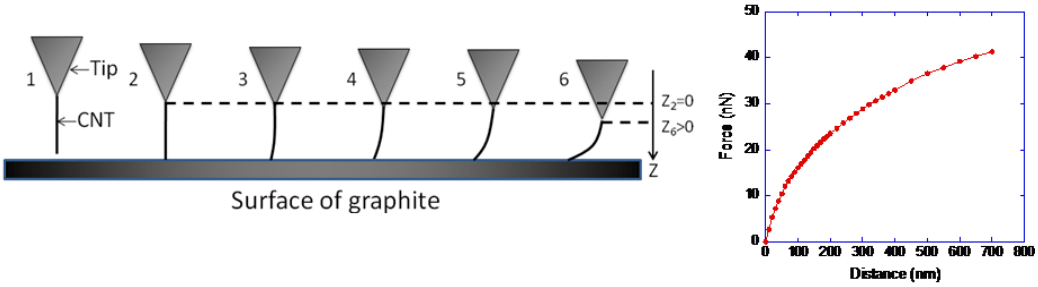

Figure 1: Sketch of thermal noise experiments (left) with an example of an experimental force – distance curve (right).

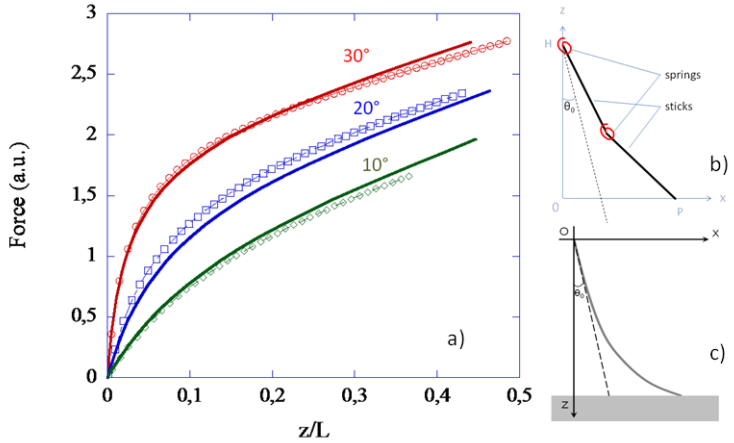

Figure 2: Theoretical force-distance curves (a) computed using two models; in continuous line the elastic rod model (c) and in circles the two sticks model (b). The three angles correspond to different angle of clamping (θ_0 in sketches b and c).

[1] S. Marsaudon, et al « Applied Scanning Probe Methods », Chapter 4, Vol 8-10, Springer Verlag, Heidelberg 2008.

[2] D. Dietzel, et al, Physical Review B (2005) 72, 35445, p.1-5

[3] J. Buchoux, et al, Nanotechnology 20 (2009) 475701