MECHANICAL RESONANCES OF NANOTUBES AND NANOWIRES

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Nanotubes and nanowires (NNs) may be considered to be the ultimate cantilevers for active elements in nano-electro-mechanical systems (NEMS). Their small size and low weight make them highly sensitive as sensors and open new perspectives for switches, oscillators and different RF applications.

In this talk I will present the basic research our group is carrying out on the excitation and detection of mechanical resonances of individual NNs in two types of experimental environments: an ultra high vacuum (UHV) field emission (FE) system and a scanning electron microscope (see Fig. 1(a)). The resonances are mostly excited by harmonic electric fields and detected by the FE current, variations in the emitted pattern and SEM imaging. Some of the phenomena related to the nanometric scale of these objects we are exploring are tuning the resonance frequencies by electrical field pulling, detection by FE tunnel current (Fig. 1(b)), high order parametric resonances, splitting of vibrations into two polarisations by asymmetric applied fields, mode-locking, etc. Using the two environments allows understanding the complicated mix of parametric and higher order resonances that give rise to dozens of resonances. Excitation by harmonic voltages as low as 1 mV can be detected by the FE pattern and show that the Q factor of a SiC nanowire reached 40,000 at room temperature in UHV.

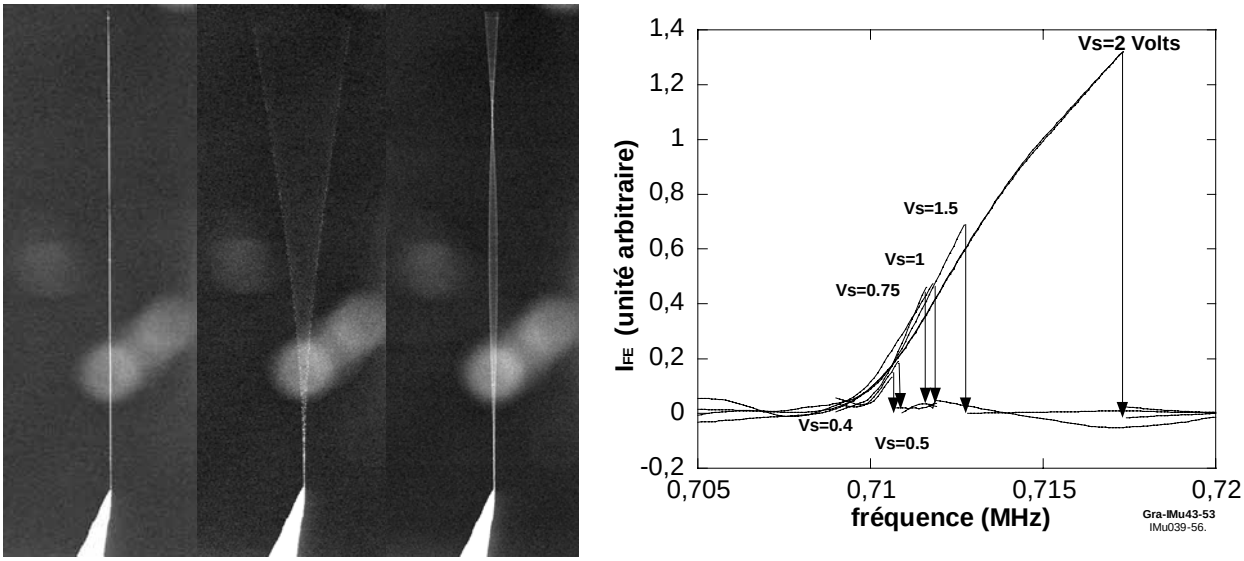

Fig 1(a). First two mechanical resonances of a SiC Nanowire. (b) Variation of the field emission current from a carbon nanotube passing through a parametric resonances for varying amplitudes of electrical excitation.