CNTs ATTACHED TO AFM AND STM TIPS

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A number of experiments have been performed to investigate the unique advantages realized when carbon nanotubes are attached to either AFM or STM tips. For the case of AFM, an attached multi-walled carbon nanotube (MWNT) allows a study of the non-linear dynamics of the microcantilever and provides insight into the behavior of the MWNT when interacting with a substrate. The nonlinear frequency response of the MWNT-tipped cantilever is investigated in the tapping mode and shows several unusual features that distinguish it from more conventional scanning probe tips. An interaction model is found to predict several unusual features of the measured nonlinear response. For the case of STM, a novel technique called tunnel gap modulation spectroscopy (TGMS) has been developed. A unique feature of the TGMS technique is the direct measurement of the natural vibrational frequencies of nanoscale objects. The technique is successfully implemented by studying the vibrational frequencies of MWNTs anchored to STM tips as a function of their length. Calculations suggest that vibrational frequencies over 100 GHz can be accurately measured in this way. Most importantly, TGMS should have the sensitivity to measure the vibrational resonances of many nanostructures forming a tunnel gap in an STM junction.