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Detecting the mechanical vibrations of carbon nanotubes using tunnel gap modulation spectroscopy JOEL THERRIEN, NASA Institute for Nanoelectronics and Computing, Purdue University, CHUN LAN, RON REIFENBERGER, Dept. of Physics, Purdue University — The natural vibrational frequencies of multiwalled carbon nanotubes are measured as a function of length using a novel tunnel gap modulation technique. The method, which works well under ambient conditions, requires fixing one end of the nanotube to an STM tip. When the free end of the nanotube is brought within tunneling range of a conducting substrate, the nanotube's thermal vibrations modulate the size of the tunnel gap, leading to an oscillatory component in the tunnel current at the natural frequency of the nanotube. The frequency of the oscillation can be easily adjusted by tailoring the length, diameter and elastic properties of the nanotube. In principle, a spectroscopy based on tunnel gap modulation can measure the frequencies of vibrational modes of any structure in the path of the tunnel current; for the case of nanotubes attached to tips, frequencies approaching 300 GHz should be realizable using single walled nanotubes. Coupled with the high lateral resolution of STM, tunnel gap modulation spectroscopy enables a new probe of the vibrational properties of substrates with nanometer resolution.

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