Electrical and Electromechanical Properties of Carbon Nanotube Transistors

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High performance nanotube (NT) transistors are studied using scanned probe techniques. A metallized atomic force microscope (AFM) tip is utilized as a voltage probe to separately measure the contact and intrinsic NT resistances. Our findings show that there is no Schottky barrier between the metal electrode and the NT in the hole regime and most of the voltage drop occurs along the NT. In addition, voltage pulses applied to the AFM tip are employed to create electrical breaks, tunnel barriers, and quantum dots within nanotubes [1]. We have used also an AFM tip to simultaneously vary the strain in suspended NT and to electrostatically gate the tube. We show that strain can open a bandgap in a metallic NT and modify the bandgap in a semiconducting NT [2], in agreement with theoretical predictions. Finally, by using an electrolyte as a gate, we obtain high performance field-effect transistors from semiconducting single-walled NTs with transconductance as high as 7 μ S/nm [3]. We will discuss efforts to perform simultaneous electrical and fluorescence detection of biomolecules using NT transistors in a microfluidic channels.

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[1] Ji-Yong Park *et al.* Appl. Phys. Lett. **80**, 446 (2002).
[2] E. D. Minot *et al.* cond-mat/0211152.
[3] Sami Rosenblatt et al. Nano Letters **2,** 869 (2002).