Charge Transport in Interpenetrating Networks of Carbon Nanotubes

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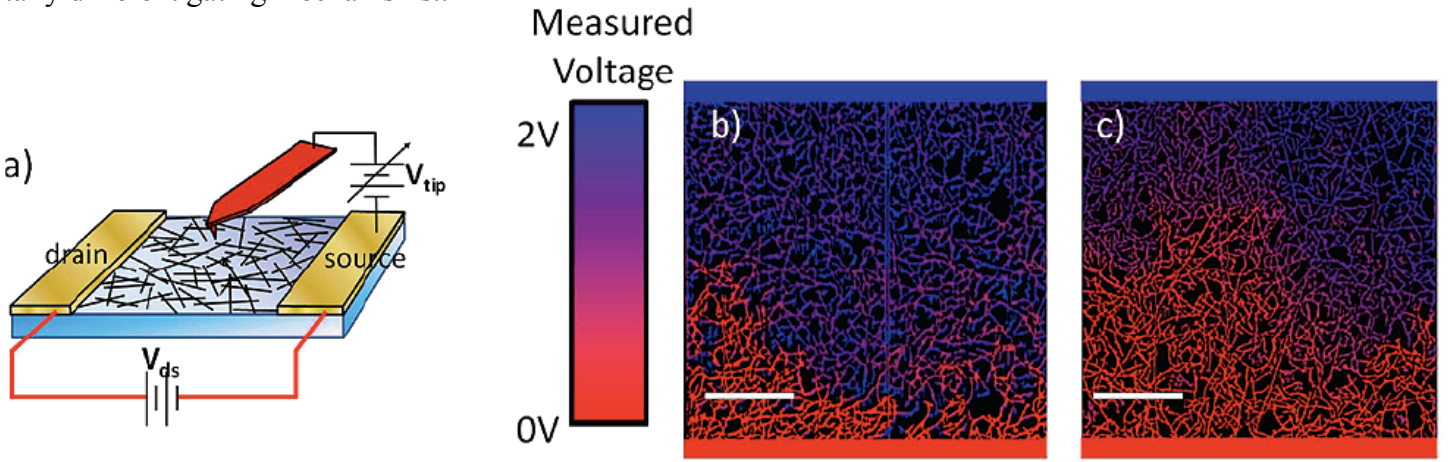
Carbon nanotube network field effect transistors (CNTN-FETs) are promising candidates for low cost macroelectronics. We investigate the microscopic transport in these devices using electric force microscopy and simulations. We find that in many CNTN-FETs the voltage drops abruptly at a point in the channel where the current is constricted to just one tube. The effect of Schottky barriers on both conductance within semiconducting tubes and conductance between semiconducting and metallic tubes results in three possible types of CNTN-FETs with fundamentally different gating mechanisms..



A voltage, V_{ds}, is applied in the electric force microscope across the device with the backgate held at a fixed voltage. The tip is then scanned over the device in surface-potential mapping mode to collect detailed information about where the voltage drops (and hence where the resistance in the film lies) through the device. (b,c) Experimental images on nominally identical devices (40 by 40 μm, same average tube length, density, diameter, and type). Panel b shows a large potential "cliff" near the bottom electrode and exhibits a relatively high resistance of 630 kΩ, while panel c displays a smooth voltage drop between drain and source and a much lower resistance of 65 kΩ.

REFERENCE:
"Charge Transport in Interpenetrating Networks of Semiconducting and Metallic Carbon Nanotubes"
M. Topinka, M. Rowell, D. Goldhaber-Gordon, M. McGehee, D. Hecht, and G. Gruner, *Nano Letters,* **9** (2009)