Novel Behavior in Carbon Nanotube Devices

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Electronic devices based on carbon nanotubes have already been demonstrated. The interpretation has often relied on analogy with standard "bulk" devices. Our theoretical studies show that nanotubes actually behave rather differently than expected, in some cases offering dramatic new functionality. For example, a nanotube terminating at a metal contact exhibits an apparent Schottky barrier height determined by the metal workfunction, even when the Fermi level is "pinned" in mid-gap at the interface. Thus true ohmic contacts are possible. Also, the depletion length at a nanotube junction varies exponentially with inverse doping, rather than the usual weak power law. As a result, a nanotube p-n junction is poorly suited for rectification, but ideal as a negative differential resistance device (an Esaki diode). New theoretical results indicate that a nanotube FET can be scaled to 10nm and still exhibit excellent switching.

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