MAR05-2004-000209

Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

Carbon Nanotubes as Schottky Barrier Transistors[1]

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Field-effect transistors (FETs) made with carbon nanotubes have many attractive features, and are being widely studied as a potential nanoscale successor to silicon FETs. Remarkably, we found that nanotube FETs generally operate by a completely different principle than ordinary Si FETs. Rather than modulate the conductance of the channel, the gate field acts to modulate the tunneling conductance of a Schottky barrier at the contact [1]. As a result, the device performance is determined by completely different factors than in familiar FETs [2-4]. In particular, the nanoscale electric field distribution near the contacts plays a crucial role. As a result, the geometry and workfunction of the contact become as important as more familiar factors like gate-oxide thickness. In addition, there are fundamental differences in the role of Fermi-level pinning at the metal-nanotube contact, compared to ordinary semiconductor interfaces [5].

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[1]In collaboration with S. Heinze, M. Radosavljevic, F. Leonard, R. Martel, J. Appenzeller, and Ph. Avouris