Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Elemental charge sensitivity of liquid-gated carbon nanotube transistors TAL SHARF, Oregon State University, NENG-PING WANG, Ningbo University, JOSHUA KEVEK, HEATHER WILSON, Oregon State University, STEFAN HEINZE, University of Kiel, ETHAN MINOT, Oregon State University
— Electron transport in carbon nanotubes (CNTs) is extremely sensitive to electrostatic perturbations, suggesting that CNT field-effect transistors (FETs) are promising candidates for low-power digital switches and high-performance sensors. In this work, we show that the perturbation caused by a single elemental charge strongly affects the room temperature conductance of a CNT FET. We make use of naturally occurring activated charge traps in SiO_2 to observe random telegraph signals which reach 20% of the baseline signal. Our measurements are made in a liquid-gated environment where these telegraph signals are persistent over long time scales and tunable by gate-voltage. Gate-voltage dependence is compared to non-equilibrium Greens function calculations. We verify the theoretically predicted relationship between signal magnitude and gate voltage, and show that this relationship differs dramatically from predictions based simply on transconductance. Our measurements confirm the exciting possibility of detecting elemental charges at room temperature, and verify a theoretical framework for predicting conductance changes due to motion of an elemental charge near a CNT FET.

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Date submitted: 14 Nov 2013 Electronic form version 1.4