Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Quantitative Kelvin Probe Force Microscopy of a Single-Walled Carbon Nanotube Transistor ELLIOT FULLER, BRAD CORSO, TOLGA GUL, PHILIP COLLINS, University of California at Irvine, UNIVERSITY OF CALIFORNIA AT IRVINE TEAM — Kelvin Probe Force Microscopy (KPFM) is well-suited to measuring the surface potentials of nanoscale devices, including organic thin film, graphene, and silicon nanowire field effect transistors (FETs). However, a primary limitation of KPFM is long-range capacitive coupling of the probe to parts of the sample that are distant from the immediate vicinity of the probe tip. This coupling complicates quantitative measurements and limits most KPFM work to qualitative observations of work function variations. Here, we address these problems to extract potentials along current-carrying, single-walled carbon nanotube (SWNT) FETs. As a low carrier density channel only 1 nm in diameter, SWNTs have extremely weak coupling to a KPFM probe tip, and therefore they provide a unique, limiting geometry that tests the resolving power of KPFM. By directly measuring this SWNT coupling and other, spatially-varying capacitive couplings to the probe tip, we have developed a robust and quantitative method for separating the desired signal, the local surface potential, from other electrostatic effects. The technique can be readily applied to other nanoscale devices to correctly extract work functions, potential gradients, and inhomogeneities in electrochemical potential.

Elliot Fuller
University of California at Irvine

Date submitted: 08 Nov 2012

Electronic form version 1.4