Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Observation of Optical Phonon Emission Threshold in the Current-Voltage Characteristics of Suspended Carbon Nanotubes MOH AMER, University of southern california, ADAM BUSHMAKER, The Aerospace Corporation, IKAI HSU, STEVE CRONIN, University of southern california — Electrically-heated suspended, nearly defect-free, carbon nanotubes (CNTs) exhibiting negative differential conductance in the high bias regime experience a sudden drop in current (or "kink"). The bias voltage at the kink (V_{kink}) is found to depend strongly on the applied gate voltage, substrate temperature, pressure, and gas environment. After subtracting the voltage drop across the contacts, however, the kink bias voltages converge around 0.2V, independent of gate voltage and gas environment. Due to the ballistic nature of these defect free carbon nanotubes, this bias voltage of 0.2V corresponds to the threshold energy of optical phonon emission. This phenomenon is corroborated by simultaneously monitoring the Raman spectra of these nanotubes as a function of bias voltage. At the kink bias voltage, the Gband Raman modes experience a sudden downshift, further indicating threshold optical phonon emission. A Landauer model is used to fit these kinks in various gas environments where the kink is modeled as a sudden change in the optical phonon lifetime, which corresponds to a change in the non-equilibrium factor that describes the existence of hot phonons in the system.

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Date submitted: 03 Nov 2011 Electronic form version 1.4