Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Individual carbon nanotubes on trench vs. substrate: A Raman study MATHIAS STEINER, MARCUS FREITAG, JAMES TSANG, AGEETH BOL, PHAEDON AVOURIS, IBM T. J. Watson Research Center, Yorktown Heights, NY 10598 — Raman excitation spectroscopy is a powerful tool for characterizing the electronic and phononic structure of single-wall carbon nanotubes (SWNTs). The transitions associated with Raman-active phonon modes in SWNTs, e.g. the radial breathing mode (RBM), the defect-induced mode (D) and the tangential modes (G), carry unique information regarding both electron-phonon interactions in SWNTs and phonon-specific non-radiative coupling to their nano-environment. We study individual, spatially isolated SWNTs grown by chemical vapor deposition across micron-wide trenches etched in a silicon dioxide substrate. Using an optical microscope, we spatially address parts of the same SWNT that are either supported by the substrate or freely suspended across a trench. In a first step, we probe a specific electronic level of a SWNT by monitoring the intensities of different Raman bands, i. e. RBM, D and G, as a function of the laser excitation wavelength. In a second step, taking advantage of the resonance Raman condition, we demonstrate how the positions, widths and shapes of the spectral bands associated with individual Raman transitions of the same SWNT are modified if brought into contact with the substrate. We discuss the results in the context of performance limits of optoelectronic devices based on SWNT.

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Date submitted: 27 Nov 2007 Electronic form version 1.4