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Anharmonic decay of the Radial Breathing Mode in Suspended Single-walled Nanotubes RAHUL RAO, Dept. of Physics and Astronomy, Clemson University, JOSE MENENDEZ, Dept. of Physics and Astronomy, Arizona State University, APPARAO RAO, Dept. of Physics and Astronomy, Clemson University — The growth of isolated single-walled nanotubes (SWNTs) suspended over trenches in Si substrates makes it possible to study the Raman lineshapes of individual tubes. High-resolution room temperature resonant micro-Raman spectra from a number of suspended SWNTs exhibit very narrow radial breathing modes (RBMs), with full-width at half maximum (FWHM) values ranging from 1.3-2.5 cm^{-1}. These values are much smaller than previously reported in the literature. The observed FWHM is *not* a smooth function of the tube's radius. We note that the two-phonon density of states (2DOS) for the anharmonic decay of the RBM phonon shows many singularities whose energies depend both on the tube's radius *and* chirality. Therefore, tubes with very similar RBM frequencies, and similar radii, could have different linewidths because of a different 2DOS. The observed linewidths increase with increasing incident laser power, as expected if the origin of the linewidth is anharmonic. We analyze the RBM linewidth in terms of down-conversion and up-conversion third-order anharmonic contributions. A comparison of the temperature dependence of both FWHM and peak frequency suggest that up-conversion processes are important, as found previously for low-frequency optical phonons in semiconductors.

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