Raman Characterization of Single-Wall Nanotubes

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Raman spectroscopy has proven to be a powerful technique for characterizing carbon nanotubes. By probing the vibrational normal modes of single-walled nanotubes it is possible to determine both the diameter as well as the chirality of the tubes. However making geometrical assignments using Raman spectroscopy still often results in multiple-choice answers which calls for further work in this area.

Electric field aligned single-walled carbon nanotubes are characterized by micro-Raman spectroscopy. The nanotubes are grown directionally between electrodes onto patterned Si substrates using thermal chemical vapor deposition. Finite size effects are investigated by varying the gap between electrodes.

Electronic transport measurements on carbon nanotubes are combined in situ with micro-Raman investigations. Combining these two measurements is useful in making sure that the semiconductor/metallic regime is correctly assigned, but is also of deeper interest regarding the electron-phonon couplings in nanotubes. Since the resonant Raman effect in carbon nanotubes depends on the positions of the van Hove singularities in the electronic density of states the Raman effects of introducing a gate voltage to manipulate the position of the Fermi level will also be investigated.

The strength of the nanotube-surface interaction is of great importance for assigning correct geometrical values. The parameter α in the equation relating the nanotube diameter, d, to the radial breathing mode frequency, ω, $\omega = \alpha / d$, is studied and assigned a value based on the combined Raman transport results.