Abstract for an Invited Paper
for the SES09 Meeting of
The American Physical Society

Optical and Electronic Properties of Doped Carbon Nanotubes[1]

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A carbon nanotube is an ideal prototype for probing the role of defects in nanoscale systems. Improved methods permit the synthesis of carbon nanotubes with controlled dopant (e.g., boron, nitrogen) concentrations. Raman spectroscopy has been widely used to study defects in sp2 carbon materials, including doping. Defects usually break the selection rules, so that broadening and new peaks can be observed in the Raman spectra mostly related to specific phonons in the interior of the Brillouin zone that are enhanced by a double-resonance process. Besides usual symmetry breaking effects, the presence of charged defects will renormalize the electron and phonon energies. We find that near a negatively charged defect the electron velocity is increased, which influences the atomic vibrations locally. Furthermore, Meissner effect exhibiting a Tc = 12 K is found in thin films consisting of assembled boron-doped single-walled carbon nanotubes (SWNTs). Superconductivity in boron-doped SWNTs and its correlation with dopant concentration will be presented. The first-principles electronic-structure study of boron-doped SWNTs strongly supports these results.

[1]This work is supported by NSF and jointly performed with Profs. Ado Jorio and Junji Haruyama.