Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Fano Resonances in Mid-Infrared Spectra of Single-Walled Carbon Nanotubes FRANÇOIS LAPOINTE, ÉTIENNE GAUFRÈS, ISABELLE TREMBLAY, NATHALIE TANG, Universite de Montreal, PATRICK DESJARDINS, Ecole Polytechnique de Montreal, RICHARD MARTEL, Universite de Montreal, REGROUPEMENT QUÉBÉCOIS SUR LES MATÉRIAUX DE POINTE (RQMP) TEAM — We show that optical phonon modes in single-walled carbon nanotubes (SWNTs) become observable in mid-infrared (MIR) spectroscopy by the means of Fano resonances. The scattering of a low energy electronic continuum over phonon discrete states yields anti-resonances that are recognizable in the spectra by their characteristic asymmetric line shape. Experimentally, we control the charge carrier density in SWNTs by p doping with different molecular oxidizers at saturation and compare the spectra of doped and intrinsic samples. The only measurable feature in the intrinsic state is a kink at ~ 865 cm^{-1}. Kinks at ~ 1600 and ~ 1250 cm^{-1} appear upon doping. We find no significant differences between the dopants; hence the bands belong to the SWNTs. Fitting of the band at ~ 1600 cm^{-1} yields good agreement with a phenomenological Fano resonance model. Finally, SWNTs mats are functionalized with bromophenyls, which are known to increase the number of defects. We find that upon p doping, the Fano resonances' cross sections of damaged SWNTs increase compared to that of p doped pristine SWNTs. Hence, we conclude that defects lower the symmetry of the lattice and activate optical phonon modes in MIR spectroscopy.

François Lapointe
Universite de Montreal

Date submitted: 11 Nov 2011 Electronic form version 1.4