**Structure- and Length-Dependent Optical Anisotropy of Single-Walled Carbon Nanotubes**

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The recent invention of a method to isolate single-walled carbon nanotubes (SWNT) in aqueous surfactant solutions [1], followed by the discovery and analysis of SWNT band-gap photoluminescence [1,2] have enabled many new studies of their spectroscopic properties. SWNT may be considered very long molecules, and this is one of the most interesting features of the material. From a spectroscopic viewpoint, the quasi-one dimensional character of SWNT must result in substantial anisotropy of optical transitions. Using powerful methods of photoemission spectroscopy, with independent control of wavelength and polarization for excitation and emission channels, we have studied the optical anisotropy of different (*n*,*m*) SWNT species. We find that second van Hove transitions are apparently not oriented precisely parallel to the tube axis, but deviate to an extent that depends of the type of nanotube.

Moreover, SWNTs are long enough that they can be efficiently aligned by simple effects, such as the velocity gradient in a tube of flowing liquid. Polarized spectroscopic measurements allow this dynamic mechanical alignment to be probed for tubes of different diameter and chirality. The resulting anisotropy is extremely sensitive to the tube length. We show how the partial alignment of a SWNT sample in a flow gradient can be used to deduce the sample length distribution through absorption or fluorescence methods. In this way, the length distributions can be compared for different SWNT (*n*,*m*) structures to give insight into correlations between length and diameter caused by sample preparation methods. Further spectroscopic studies of nanotube alignment through application of electric and magnetic fields will also be discussed.

References

1. M. J. O'Connell, et al., *Science* **297**, 593 (2002)
2. S. M. Bachilo, et al., *Science*, in press.