

Cross-polarized absorption of single-walled carbon nanotubes by photoluminescence excitation spectroscopy

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Photoluminescence excitation (PLE) spectroscopy of single-walled carbon nanotubes (SWNTs) have been extensively studied for characterization of their unique electronic properties. As we probed the excitonic phonon sideband by isotopically modified single-walled carbon nanotubes [1], undefined pure electronic peaks were observed. We ascribed these peaks to the cross polarized absorption by the polarized-PLE experiment on partially aligned SWNTs in a gelatin film. Here, we further studied polarized PLE spectra of various (n, m) nanotubes in surfactant suspension. Using a simple theory for PL anisotropy, we have obtained decomposed PL maps for parallel and perpendicular polarization from two PL maps measured by so-called L-format method [2]. Distinct absorption peaks corresponding to E_{12} and E_{21} transitions for perpendicular polarization were observed. Observed E_{12} and E_{21} energies were considerably blue-shifted compared to the qualitative values predicted within a single-particle theory. The results indicate a smaller exciton binding energy for perpendicular excitations than for parallel excitations.

References:

- [1] Y. Miyauchi, S. Maruyama, Phys. Rev. B, 74 (2006) 35415.
- [2] J.R. Lakowicz, Principles of Fluorescence Spectroscopy, Plenum Pub. Corp., New York, 1999.