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Environmental effect on the cross-polarized optical transitions of single-walled carbon nanotubes

Yuhei Miyauchi[1] Shigeo Maruyama[1]
[1]Dept. of Mech. Eng., The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan

Optical transition energies of single-walled carbon nanotubes (SWNTs) by the incident light polarized parallel to the nanotube axis such as E11 and E22 are known to be strongly affected by the change of environment around SWNTs [1, 2], which is called environmental effect. On the other hand, there is no report about the environmental effect for the cross-polarized excitations [3] to the nanotube axis. In this study, we have investigated the environmental effect on the the cross-polarized excitations such as E12 and E21.
In our previous study [3], we found that some PL peaks for cross-polarized excitation to the nanotube axis can be clearly observed in the polarized PLE spectra of micelle-suspended SWNTs with relatively small diameters less than 1 nm. Recently, Lefebvre and Finnie [4] measured cross-polarized excitation energies of SWNTs in air with larger diameters more than 1nm. Here we have investigated the cross-polarized excitation energies of various (n, m) SWNTs with diameters more than 1 nm in a surfactant solution by polarized PLE spectroscopy. The observed excitation energies of micelle-suspended SWNTs for the cross-polarized condition are considerably red- shifted from those of SWNTs in air and the amount of the energy shift for cross-polarized excitations tended to be larger than those for parallel excitations. This result implies strong depolarization effect for cross-polarized excitations.

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