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

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Optical transition energies of single-walled carbon nanotubes (SWNTs) by the incident light polarized parallel to the nanotube axis such as E\(_{11}\) and E\(_{22}\) 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 cross-polarized excitations such as E\(_{12}\) and E\(_{21}\).

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 1 nm. 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.


