

Photoluminescence from independently aligned single-walled carbon nanotubes by cross-polarized excitation

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Recently, photoluminescence (PL) of single-walled carbon nanotubes (SWNTs) has been intensively investigated for the characterization of semiconductor SWNTs [1,2]. By plotting PL emission intensities as a function of emission and excitation photon energy, Bachilo *et al.* obtained a two-dimensional map of relative emission intensities [1]. In a PL map, we can observe smaller-intensity unassigned peaks in addition to the bright PL peaks assigned to particular (n,m) indices [2]. Although theoretical studies have indicated that electron-phonon (exciton-phonon) interactions can be an origin of some of these unassigned peaks [3, 4], direct experimental evidence has not been reported. Since these unassigned features may overlap with other PL peaks if a measured sample is an assemble of various (n, m) structures, it is very important to understand the origins of all the features in a PL map for the accurate measurement of relative PL intensities of each (n, m) nanotube. In this report, optical transitions of (6,5) and (7,5) single-walled carbon nanotubes (SWNTs) were investigated by polarized photoluminescence excitation (PLE) spectroscopy of 2-dimensionally aligned individual nanotubes in a gelatin-based thin film. Figure 1 shows polarized PLE spectra of (7,5) nanotubes. While all PL peaks in PLE spectra were classified into either ‘pure electronic’ or ‘electron-phonon coupling’ peaks by measuring PLE spectra of isotopically modified SWNTs consisting of carbon-13 isotope [5], the observed ‘pure electronic’ peaks were assigned to electronic transitions corresponding to incident light polarized parallel or perpendicular to the nanotube axis.

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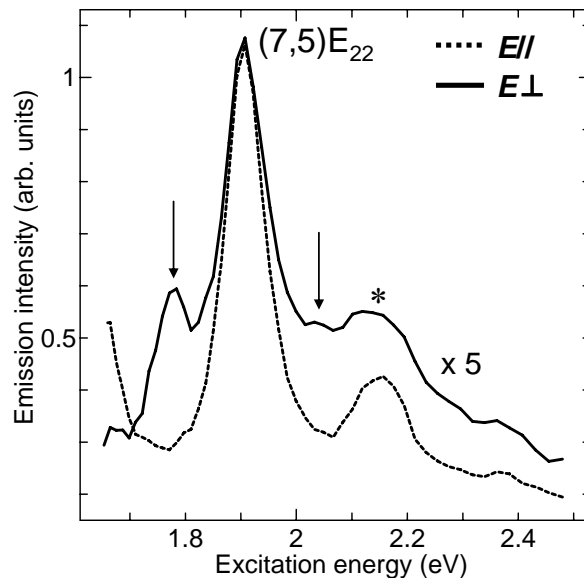


Fig. 1 Polarized PLE Spectra of (7,5) nanotubes. Peaks indicated by arrows were observed only in the case of perpendicular polarization to the nanotube axis. Peak with asterisk was assigned to phonon related excitations [5].

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