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Cross-polarized optical absorption of single-walled carbon nanotubes probed by photoluminescence excitation spectroscopy, UV-Vis-IR and polarized Raman Scatterings

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Because of the depolarization effect, or so-called antenna effect, optical absorption of single-walled carbon nanotubes (SWNTs) is weak when excited by light polarized perpendicular to the nanotube axis. However, in photoluminescence (PL) excitation spectra of isolated SWNTs, PL peaks due to cross-polarized excitation can be clearly identified. By decomposing the cross-polarized component, the optical transition energy of E12 or E21 can be? measured, and the smaller exciton binding energy for perpendicular excitations is concluded [1]. Cross-polarized absorption is dominant in the absorption of a vertically aligned film of SWNTs [2] when excited from the top of the film. In our previous study, a pi-plasmon absorption at 5.25 eV was revealed in contrast to 4.5 eV for parallel excitation [3]. Resonant Raman scattering from such a film is also influenced by the cross-polarized excitation [4]. Even though a Kataura plot for the E33 and E44 range has been proposed by using such a vertically aligned film [5], polarized Raman scattering spectra reveal more complicated features in the system because of the small bundle size, typically 5-8 nanotubes [6].

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