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Four-Wave Mixing Spectroscopy of Aqueous Suspensions of Single-Wall Carbon Nanotubes in the Ranges of 0.1-10 and 100-250cm(-1)

Source

PHYSICS OF WAVE PHENOMENA vol.19 no. 3 165-170 DOI: 10.3103/S1541308X11030022 SEP 2011

Abstract

Distinctive optical properties of single-wall carbon nanotubes (SWNT) are highly sensitive to variations in the environment. Here, we have studied SWNT in aqueous suspensions at a low (less than 0.1 mu gml(-1)) concentration by four-wave mixing (FWM) spectroscopy in the spectral bands of 0.1 to 10 cm(-1) (approximate to 300 GHz) and 100 to 250 cm(-1) (3 to 7.5 THz). We directly investigated the hydration layers around SWNT. A comparison of the FWM spectra of an SWNT aqueous suspension and Milli-Q water shows a considerable increase in the intensity of low-frequency Raman modes, which are attributed to the rotational transitions of H(2)O(2) and H(2)O molecules. We explain the observed phenomenon by the hydrogen peroxide production and formation of a low-density depletion layer at the water-nanotube interface. We have observed several SWNT radial breathing modes omega(RBM) = 118.5, 164.7, and 233.5 cm(-1) in an SWNT aqueous suspension and estimated the corresponding SWNT diameters as approximate to 2.0, 1.5, and 1 nm.