

## Optical response of single-walled carbon nanotubes in far-infrared region

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It is well-known that single-walled carbon nanotubes (SWCNTs) show various optical properties in a wide energy region. For example, the absorption in the UV region has been attributed to the  $\pi$  plasmon of the nanotubes. The interband transitions have been observed in the NIR and visible wavelength. Furthermore, in the low energy region, there is optical absorption of SWCNTs.

Although the intensity of normal Drude absorption increases to smaller energy region, there is a peak in the IR spectrum of SWCNTs. Recently, we have investigated that tube length dependence of the observed IR peak. Depending on the tube length, the peak positions of the IR signals in low-frequency were shifted, whereas those of the S1 interband transitions were not shifted. These behaviors can be reasonably explained by the antenna-effect-induced IR absorption [1].

In this talk, the detailed mechanism for the experimental observations including temperature dependence of the IR spectra will be discussed.

[1] T. Nakanishi, T. Ando, *J. Phys. Soc. Jpn.*, **78**, 114708 (2009).