# Multiexciton recombinations and exciton fine structures studied by a single carbon nanotube photoluminescence spectroscopy

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The electronic properties of single-walled carbon nanotubes (SWNTs) have attracted a great deal of attention. The characteristic optical properties of SWNTs are determined by the dynamics of excitons with extremely large binding energies due to the strong Coulomb interaction. It is also expected that the strong Coulomb interaction would enhance the many body effects of excitons. The spectroscopic observation of a single carbon nanotube is a useful to understand the dynamics and many body effects of excitons in SWNTs [1-3].

We studied the temperature and excitation power dependence of photoluminescence (PL) spectra from spatially isolated single SWNTs using a single nanotube spectroscopy [3]. It is found that the linewidth of the observed narrow PL spectrum corresponding to homogeneous linewidth (Fig. 1(a)) arises from the exciton-dephasing with consideration of exciton lifetime of 30 ps [4]. The PL linewidth linearly decreases with decreasing temperature, which implies that the exciton-dephasing is dominated by the interaction between the exciton and the phonon mode with very low energy. In the high excitation conditions using femtosecond laser pulses, the homogeneous linewidth broadens nonlinearly with an increase in excitation intensity as shown in Fig. 1(b). Our observation suggests that the broadening of homogeneous linewidth arises from the annihilation of excitons through a rapid Auger recombination process. The multiexciton dynamics and exciton fine structures will be discussed.

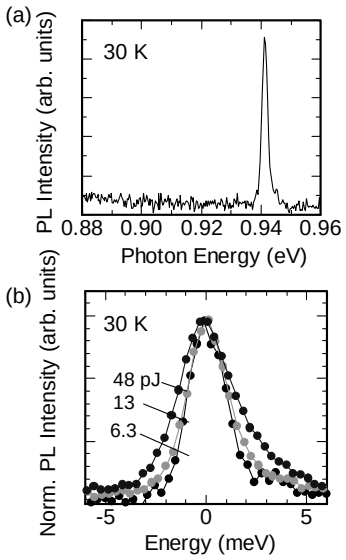


Fig.1 (a) and (b) PL spectra of a single carbon nanotube at 30 K.

**References**

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