Environmental effects on photoluminescence of carbon nanotubes

○Y. Ohno, S. Iwasaki, Y. Murakami, S. Kishimoto, S. Maruyama, and T. Mizutani

Department of Quantum Engineering, Nagoya University
PRESTO/Japan Science and Technology Agency
Department of Mechanical Engineering, The University of Tokyo

In order to understand the optical properties of single-walled carbon nanotubes (SWNT), it is important to understand the environmental effects. In this study, we have studied the dielectric screening effect by the surrounding material around the nanotube. The dependence of exciton transition energy on dielectric constant of surrounding material has been investigated in the range of dielectric constant from 1.0 to 37, by means of photoluminescence spectroscopy [1].

The sample with fee-standing SWNTs (Fig. 1) was immersed in various organic solvent with different dielectric constant. With increasing dielectric constant, both E_{11} and E_{22} exhibited a redshift by several tens meV and a tendency to saturate at a dielectric constant about 5 with an indication of small (n,m) dependence (Fig. 2). The redshifts can be explained by the decrease in the electron-electron repulsive interaction which exceeds that of electron-hole attractive interaction [2]. The energy shift was larger for the nanotube with a smaller diameter.

References:

[1] Y. Ohno et al., arXiv:0704.1018v1 [cond-mat.mtrl-sci] (2007).

[2] Y. Ohno et al., Phys. Rev. B 73, 235427 (2006).

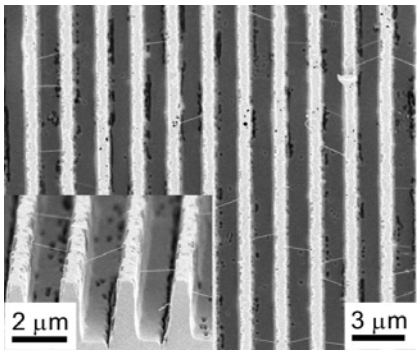

Fig. 1 Free-standing SWNTs.

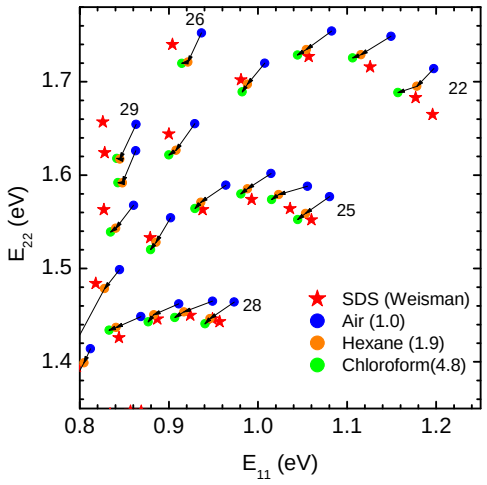

Fig. 2 E_{22}-E_{11} plots in various environmental conditions.

Corresponding Author E-mail: yohno@nuee.nagoya-u.ac.jp, Tel&Fax: 052-789-5387