Dependence of exciton transition energy of single-walled carbon nanotube on dielectric constant of surrounding material

Yutaka Ohno 1, Shinya Iwasaki 2, Yoichi Murakami 3, Shigeru Kishimoto 2, Shigeo Maruyama 3, Takashi Mizutani 2

1 Dept. of Quantum Eng., Nagoya Univ., PRESTO/Japan Science and Technology Agency
2 Dept. of Quantum Eng., Nagoya Univ.
3 Dept. of Mechanical Eng., The Univ. of Tokyo
Contact e-mail: yohno@nuee.nagoya-u.ac.jp

We have experimentally investigated the dependence of exciton transition energy of single-walled carbon nanotubes (SWNTs) on surrounding dielectric material, in the range of dielectric constant ($\epsilon$) from 1.0 to 37, by means of photoluminescence spectroscopy [1]. The sample with SWNTs bridging over trenches was immersed in various organic solvent with different $\epsilon$. With increasing $\epsilon$, both $E_{11}$ and $E_{22}$ exhibited a redshift by several tens meV and a tendency to saturate at $\epsilon \sim 5$ without an indication of significant $(n,m)$ dependence. The redshifts can be explained by dielectric screening of the repulsive electron-electron interaction [2]. We have also measured the time-resolved photoluminescence in air and solvent, respectively, by utilizing the excitation intensity correlation technique [3]. When the sample was immersed in a solvent, the correlation signal collapsed and decay time decreased drastically.