Photoluminescence of carbon nanotubes suspended in air

S. Iwasaki[1], Y. Ohno[1, 2], Y. Murakami[3], S. Kishimoto[1], S. Maruyama[3], and T. Mizutani[1]
[1]*Dept. of Quantum Eng., Nagoya Univ., Japan*
[2]*PRESTO/JST, Japan*
[3]*Dept. of Mechanical Eng., The Univ. of Tokyo, Japan*

The optical transition energies in SWNTs are affected by the environmental condition because the electric field contributing carrier-carrier interactions spreads out of the SWNT. SWNTs suspended in air are important to investigate the environmental effect [1]. We have measured the PL and PLE of the SWNTs suspended in air for 21 chiralities, and compared them to the results reported for SDS-wrapped SWNTs [2].

An SEM image of our sample is shown in Fig. 1. The SWNTs suspended in air were grown on a grated quartz substrate by alcohol CVD. Figure 2 shows the energy shifts of E_{11} and E_{22} from those of SDS-wrapped SWNTs, ΔE_{11} and ΔE_{22}, as a function of the chiral angle. Here, the closed circles and open squares represent type-I [$(2n+m)$ mod 3 = 1] and type-II [$(2n+m)$ mod 3 = 2] SWNTs, respectively. The E_{11} and E_{22} are mostly blueshifted by a few tens of meV, except for E_{22} of type-I SWNTs with a small chiral angle, which show a redshift. ΔE_{11} and ΔE_{22} show different dependences on the chiral angle between type-I and type-II. In the case of type-I SWNTs, ΔE_{11} is smaller for the larger chiral angle whereas ΔE_{22} is larger for the larger chiral angle. In contrast, type-II SWNTs shows the opposite dependences. The difference between type-I and type-II disappears for the SWNTs with the chirality near armchair. These results show that the environmental effect on optical transition energies depends on the chirality (n, m).

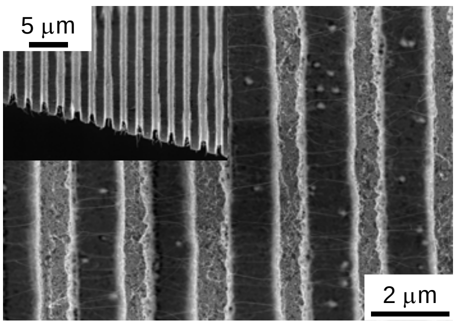

Fig.1. SEM image of sample.

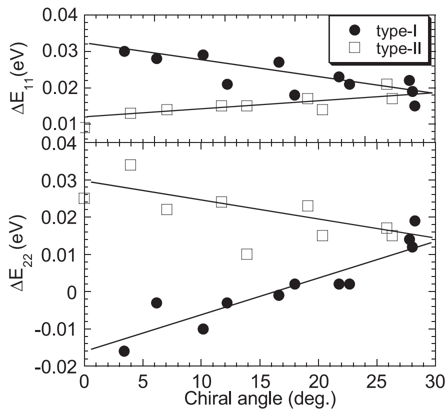

Fig.2. Chiral angle dependence of ΔE_{11}, ΔE_{22}

References:
[1] J. Lefebvre *et al*. *Phys. Rev. Lett.* **90** (2003) 217401.
[2] R. B. Weisman *et al*. *Nano Lett.* **3** (2003) 1235.

Yutaka Ohno
Dept. of Quantum Eng., Nagoya University,
Furo-cho, Chikusa-ku, Nagoya 464-8603, Japan
Tel: +81-52-789-5387, FAX +81-52-789-5232
E-mail: yohno@nuee.nagoya-u.ac.jp