

Chirality-dependent environmental effect on photoluminescence of SWNTs

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Optical transition energies in SWNTs are affected by environmental condition because the electric field regarding carrier-carrier interactions spreads outside the SWNTs. The SWNTs suspended in air are important samples as a reference to investigate the environmental effect [1]. We have investigated the PL and PLE map of SWNTs suspended in air for 21 chiralities, which is compared with 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} of air-suspended SWNTs from those of SDS-wrapped SWNTs as a function of chiral angle. Here, the closed circles and open squares represent type-I [$(2n+m) \bmod 3 = 1$] and type-II [$(2n+m) \bmod 3 = 2$] SWNTs, respectively. The E_{11} and E_{22} are mostly blueshifted by a few tens meV except for E_{22} of type-I SWNTs with small chiral angle (near Zigzag). The amounts of energy shifts, ΔE_{11} and ΔE_{22} , show different dependence on chiral angle between type-I and type-II. In the case of type-I SWNTs, ΔE_{11} is smaller for larger chiral angle whereas ΔE_{22} is larger for larger chiral angle. In contrast, type-II SWNTs shows opposite dependences. These results clearly show that the environmental effect on optical transition energies depends on the chirality (n, m).

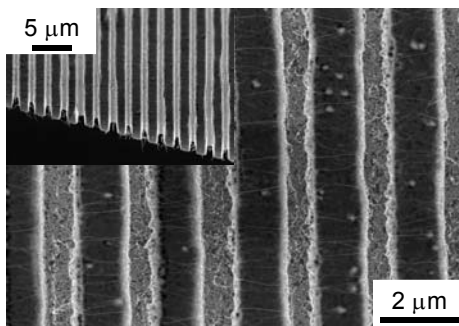


Fig. 1 SEM image of sample.

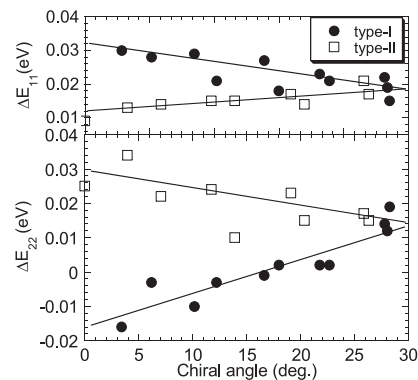


Fig. 2 Chiral angle dependence of ΔE_{11} , ΔE_{22} .

[1] J. Lefebvre *et al.*: Phys. Rev. Lett. **90** (2003) 217401

[2] R. B. Weisman *et al.*: Nano Lett. **3** (2003) 1235

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