Photoluminescence from Single-walled Carbon Nanotubes on hexagonal Boron Nitride Substrates

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Photoluminescence (PL) spectroscopy is one of the important analysis techniques for the optical properties of single-walled carbon nanotubes (SWNTs). However, PL spectra are measured only from surfactant-wrapped SWNTs [1], suspended SWNTs [2], and vertically-aligned SWNTs [3]. For optical and opto-electronic applications of SWNTs, SWNTs which lie on substrates and emit PL signal are needed. In this study, SWNTs were directly synthesized on hexagonal boron nitride (h-BN) substrates and PL spectroscopy was performed. h-BN is a suitable substrate for SWNTs because it has large band gap and its surface is atomically flat [4]. By using mechanical exfoliation technique, multilayered h-BN was obtained on silicon substrates. Iron metal particles and ethanol were used as the catalyst and carbon source of SWNT growth, respectively. Figure 1 shows (A) PL spectrum and (B) PL map obtained from SWNTs on h-BN. Relatively sharp PL emission was measured. It is known that the optical transition energy (E_{ii}) of SWNTs depends on the surrounding conditions. The E_{11} and E_{22} of SWNTs on h-BN were almost the same as those of surfactant-wrapped SWNTs, and PL map, as shown in Fig. 1(B), exhibited that the chirality was (9,5).

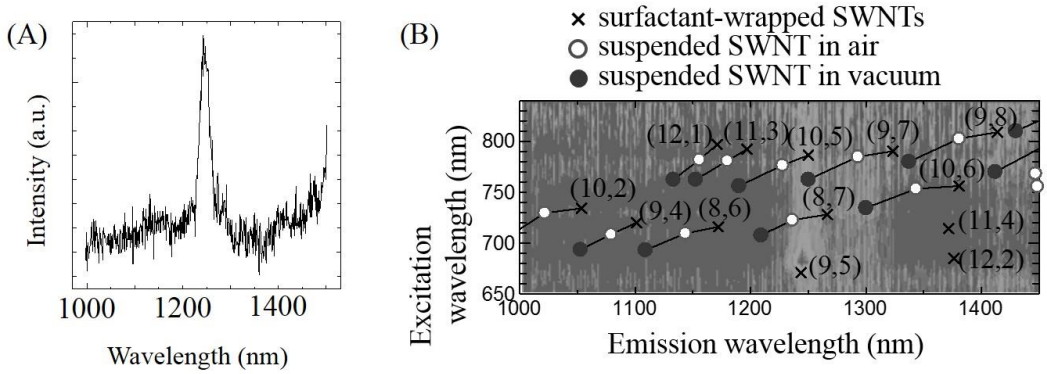

Fig. (A) PL emission spectrum and (B) PL map from SWNT on h-BN substrate. (B) Filled and opened circles correspond to the E_{ii} of suspended SWNTs in vacuum and air, respectively [5].

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