High Purity Synthesis of (6,4) Single-Walled Carbon Nanotubes with Plasma CVD

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Single-walled carbon nanotubes (SWNTs) are potential materials for future optoelectrical device applications due to their excellent optical and electrical properties. Since the optoelectrical characteristics of SWNTs strongly depend on their chirality, chirality-controlled synthesis of SWNTs still remain as a major issue in nanotube science and application community. In order to obtain SWNTs with specific chirality, our group focused on the catalyst, which plays a very important role in controlling SWNTs chirality [1,2]. We make a systematic investigation to elucidate the correlation between catalyst state and the chirality species grown by plasma CVD. Atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS), and transmission electron microscopy (TEM) are used to analyze the structures and surface states of the catalyst. It is found that the surface state of the catalyst can be controlled by a catalyst-pretreatment method, which is originally developed in this study. Furthermore, since SWNTs synthesis is carried out under very low temperature by the usage of plasma CVD, the catalyst surface state becomes very sensitive to the growth of a specific type of chiralities within similar diameter range. The dominant chirality species can be tuned from (6,5) to (6,4) SWNTs by controlling the catalyst surface state [3]. This finding is very important for the synthesis of SWNTs with desired chirality species.

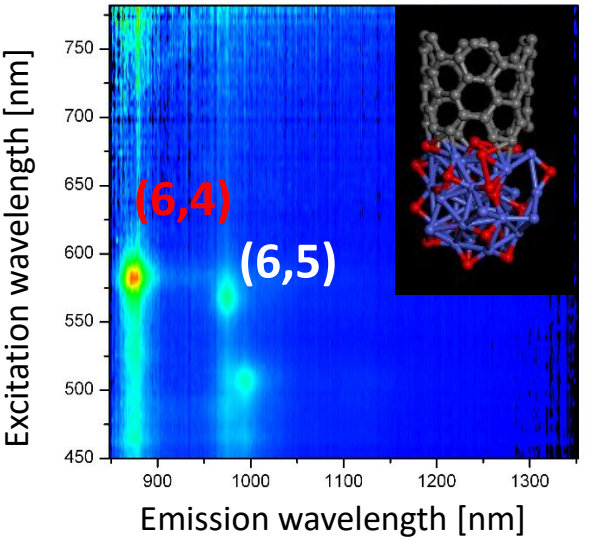

Fig. Typical photoluminessence–excitation map of (6,4) rich SWNTs.

References:

[1] Z. Ghorannevis, T. Kato, T. Kaneko, and R. Hatakeyama, J. Am. Chem. Soc. 132, 9570 (2010).

[2] T. Kato and R. Hatakeyama, ACS Nano 4, 7395 (2010).

[3] B. Xu, T. Kaneko, Y. Shibuta, and T. Kato, Sci. Rep. **7**, 11149 (2017).

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