Structure Controlled Growth of Single-walled Carbon Nanotubes

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Abstract

Single-walled carbon nanotube (SWNT) is a rolled up graphene. They exhibit unique properties due to their one-dimensionality, and their properties depend on their structure. Although structure control is important for many applications of SWNTs, it is still difficult to control it in their growth stage. In this paper, we showed the diameter and direction controlled growth techniques of SWNTs.

SWNTs were synthesized by using alcohol catalytic chemical vapor deposition (ACCVD) method [1]. The CVD temperature and time were 900 °C and 10 minutes, respectively. For tube diameter control, nano-diamond particles were used as SWNT catalyst [2]. Figure 1 showed SEM image and Raman scattering spectra of the synthesized SWNTs from nano-diamond. Diamond is stable at high temperature. Therefore, it is possible that nano-diamond particles, which are controlled in diameter in advance, grow diameter-controlled SWNTs. In the case of direction control, we used R-face (101) and R-cut quartz substrates [3], which clearly exhibit step and terrace structure, as shown in Fig. 2(A). SWNTs were horizontally aligned on these substrate along the x-axis (Fig. 2(B)), which indicated that the atomic structure of (101) crystallographic surface of quartz caused the SWNTs to align.

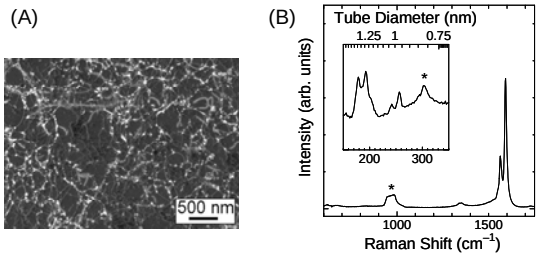

Fig. 1(A) SEM image and (B) Raman scattering spectra of SWNTs synthesized from nano-diamond particles.

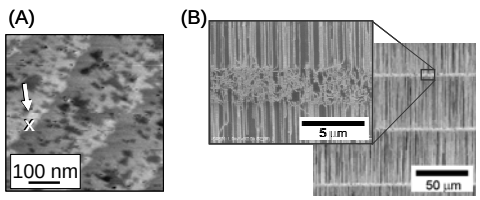

Fig. 2(A) AFM image of R-face (101) crystal quartz and (B) horizontally aligned SWNTs on R-cut quartz substrates.

[1] S. Maruyama, et al., *Chem. Phys. Lett.*, 360 (2002) 229. [2] D. Takagi, et al., *J. Am. Chem. Soc.*, 131 (2009) 6922. [3] S. Chiashi, et al., to be submitted.