

The diameter and density control of single-walled carbon nanotubes using the diffusion mechanism of iron catalysts

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Since electrical properties of single-walled carbon nanotubes (SWCNTs) are primarily determined by its diameter and chirality[1], the diameter control is the crucial issue for application of CNTs-based electronic device. Thus, the preparation of catalysts with uniform and small size is essential factor to grow SWCNTs with a narrow diameter distribution.[2]

In this work, we investigate the growth of SWCNTs with a narrow diameter distribution using a sandwich-like structure (Al/Fe/Al) deposited on Si substrate by DC magnetron sputter. The iron catalyst layer is 1 nm and the aluminum top-layer has the various thickness from 1 nm to 10 nm. All samples are pre-annealed at 800 °C in Ar ambient. Then, CNTs are grown by thermal chemical vapor deposition with C₂H₂, H₂ at 850 °C for 10 min. The morphology and diameter distribution of synthesized SWCNTs are determined by Scanning Electron Microscopy(SEM), Transmission Electron Microscopy(TEM) and Raman spectroscopy. After the pre-annealing, the diffusion mechanism of iron catalysts with the aluminum top-layer is confirmed by X-ray photoelectron spectroscopy(XPS). This results show that the density and diameter of SWCNTs are correlated with the thickness of the aluminum top-layer and pre-annealing conditions.

[Reference]

- [1] R. Saito, G. Dresselhaus, M. S. Dresselhaus, *Physical Properties of Carbon Nanotubes* Imperial College, London (1998).
- [2] Ali Javey, Hongjie Dai, J. AM. CHEM. SOC., 127, 11942-11943 (2005).