

Thesis Title Effect of Water Vapor on Synthesis of Vertically Aligned Carbon Nanotubes by Chemical Vapor Deposition Process

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ABSTRACT

In this research, vertically aligned carbon nanotubes (VA-CNTs) were synthesized by chemical vapor deposition process. Acetylene (C_2H_2) and Fe-Co nanoparticles were used as a carbon source and co-metal catalyst, respectively. The VA-CNTs were successfully synthesized on silicon substrates by adding water vapor to a tube furnace at 750 °C for 15 min. The as-synthesized CNTs were characterized by scanning electron microscope, transmission electron microscope, energy dispersive x-ray spectroscopy and Raman spectrometer. It was found that the products were vertically aligned multi-walled carbon nanotubes with a mean length of $81 \pm 16 \mu m$ and a mean diameter of 13 ± 3 nm. The length of VA-CNTs increased with the synthesis time with an initial growth rate of 17.3 $\mu m/min$ and the growth rate after 30 min of growth of 2.3 $\mu m/min$. The maximum length obtained at the synthesis time of 120 min is 723 μm . Moreover, Raman spectra show that defects of CNTs decreased with introducing a small amount of water vapor to the system.