

Growth of nanotubes inside eDIPS carbon nanotubes

The growth of the carbon nanotubes is a very important process. It is controlled by the synthesis parameters, such as the catalysts, the catalyst support, the carbon source, temperature, and pressure. There are the different experimental setups for this method. The results of the conducted work are the following. Here, the pristine outer single-walled carbon nanotubes (SWCNTs) are obtained by the enhanced direct injection pyrolytic synthesis (eDIPS), and they have the diameter of 1.7 nm [1]. The filling of the SWCNTs with ferrocene is made by the gas phase method at 350⁰C in a quartz ampoule sealed under an ultrahigh vacuum. The annealing of the ferrocene-filled SWCNTs leads to the growth of the inner SWCNTs with the different diameters. Therefore, the double-walled carbon nanotubes (DWCNTs) are formed. I analyze the all DWCNTs by the Raman spectroscopy method with the different laser wavelengths between 458, and 647 nm. The growth process is traced at the different annealing temperatures between 500, and 1000⁰C. The temperature difference of about 70⁰C is found for the diameter difference of about 0.16 nm.

[1] Saito T., Ohshima S., Okazaki T., Ohmori S., Yumura M., Iijima S. Selective Diameter Control of Single-Walled Carbon Nanotubes in the Gas-Phase Synthesis. *J. Nanosci. Nanotech.* 2008. V. 8. N. 11. P. 6153 – 6157.