

In-situ Observation of Raman Scattering from Single-Walled Carbon Nanotubes in the Growth Stage during Alcohol Catalytic CVD Process

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In-situ observation of Raman scattering of SWNTs in the growth stage was performed using the alcohol catalytic CVD (ACCVD) method. SWNTs were generated in a vacuum chamber, which was built with AFM system and Raman scattering measurement capabilities. Fe/Co metal particles supported with zeolite were dispersed on a silicon plate, which was located inside the vacuum chamber. After evacuating the chamber, an AC voltage (about 6 V) was supplied to the silicon plate, which was heated by Joule heating ($R=5 \Omega$). Ethanol gas was then introduced into the chamber. The reaction temperature was approximately 800 deg C, and the pressure was 1.0 Torr.

Before the heating, there is only one silicon peak in the Raman scattering spectrum. This peak was shifted and decreased in its intensity, when heated. The G-band peak from SWNTs appeared around 1560 cm^{-1} , after supplying ethanol gas, and its intensity gets larger and larger, while that of silicon is almost constant. After stopping the flow of ethanol gas and cooling, the intensities of both the G-band and the silicon peak increased, and their peaks were up-shifted rapidly due to the decrease in temperature. The Growth mechanism of SWNTs will be discussed based on these in-situ measurements.