

In-situ measurement of Raman scattering and AFM during laser-heated ACCVD growth process of SWNTs

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We have built an atomic force microscope (AFM) with Raman scattering measurement capabilities and succeeded in synthesizing SWNTs on the AFM sample stage [1] using alcohol catalytic CVD method [2].

In this experimental apparatus, in-situ measurement of Raman scattering and AFM were performed while SWNTs were synthesized by using “laser-heated” cold-wall ACCVD method. Mo/Co metal particles, which were directly loaded on the silicon substrate [3], was used as the catalyst and CW-Ar-ion laser (488.0 nm, 50.0 mW) was used as the heating and Raman excitation. Fig. 1 shows the in-situ measurement of the intensity of the G-band (a) and Raman scattering peak from the silicon substrate (b) during the CVD process. The sample temperature (c) was calculated from the temperature dependence of Raman shift of the silicon peak [4]. About 40 s after the supply of the ethanol gas (0.1 Torr), the G-band appeared at 1570 cm^{-1} . The G-band intensity increased with time, but the intensity increase stopped about 4 min after the appearance of the G-band, which indicated the inactivation of the metal catalyst particles and the stop of the SWNTs growth. In the waiting time for the G-band appearance, SWNTs could not be found by in-situ AFM measurement.

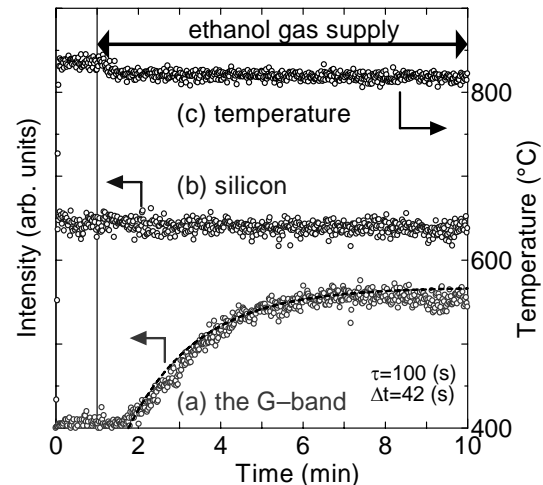


Fig. 1 . In-situ measurement of the Raman scattering intensity from (a) SWNTs and (b) the silicon substrate during the laser-heated CVD process. The sample temperature (c) was calculated from the temperature dependence of Raman shift from the silicon peak (520 cm^{-1} at 300 K).

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