

# Sub-millimeter long single-walled carbon nanotubes synthesis by alcohol enclosed catalytic chemical vapor deposition

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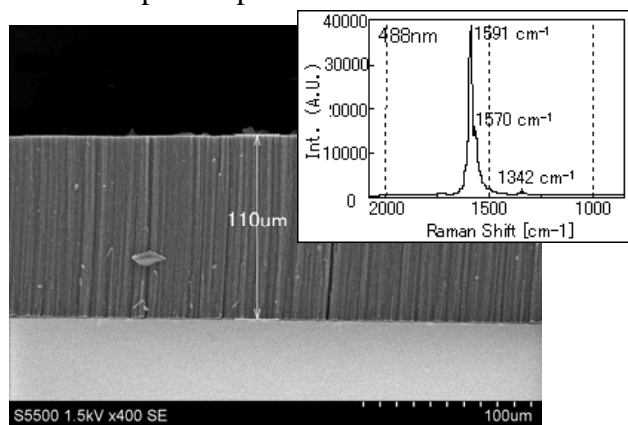
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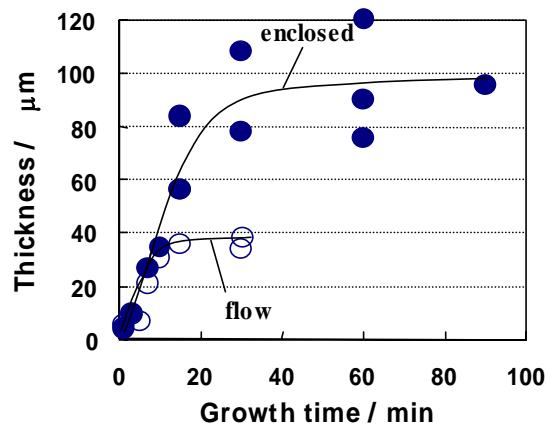
To obtain longer vertically aligned single-walled carbon nanotube films using alcohol catalytic vapor deposition (ACCVD)[1], we have developed a novel method. Using a conventional ACCVD system, ethanol vapor was filled up and enclosed in a reactor tube with Co/Mo catalysts formed on a quartz substrate during growth period.

Comparing gas flow type ACCVD, gas enclosed type ACCVD increased the film thickness up to 0.12mm for 30min growth.

Gas elements during CVD were investigated by means of Fourier transform infrared spectroscopy (FT-IR) and quadrupole mass spectrometer (QMAS). Ethanol was thermally decomposed into ethylene, water, and acetaldehyde at CVD temperature. A possible mechanism for the increase of film thickness is suppression of carbon coating on catalysts by produced water, or the efficient reaction by the decomposed species.



**Fig.1** A typical cross-section SEM image and Raman spectrum  
Growth conditions: 0.15Pa, 840°C × 30min



**Fig.2** Growth time dependences of SWNT film Thickness.  
Growth conditions: 0.15Pa, 840°C × 30min

[1] Y. Murakami, S. Chiashi, Y. Miyauchi, M. Hu, M. Ogura, T. Okubo, S. Maruyama, *Chem. Phys. Lett.*, **385**, 298 (2004)

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