SWNT Synthesis by Low Temperature and Low Pressure CVD

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The control technique of the detail structures of single-walled carbon nanotubes (SWNTs) is inevitable for the realization of SWNT applications, and understanding SWNT growth mechanism is important in order to improve the growth techniques. In the present study, we preformed the CVD growth experiments in wide temperature and pressure ranges, with using an ultra high vacuum CVD chamber. Especially we focused the low pressure and low temperature conditions and investigated the SWNT growth mechanism.

SWNTs were synthesized by using ethanol gas as the carbon source. As the catalyst, Co/Mo metal particles deposited on silicon substrates were used [1]. Figure 1 shows (A) CVD temperature and (B) ethanol gas pressure dependence of the G-band. Here, the G-band intensity was assumed to be proportional to the amount of grown SWNTs. The optimum CVD temperature decreased as the ethanol gas pressure decreased as shown in Fig. 1(A) and the optimum gas pressure also decreased as the CVD temperature decreased in Fig. 1(B). In the low pressure range (lower than 0.01 Pa), SWNTs were grown at only low temperature (from 400 to 600 °C). The higher growth rate and longer catalyst lifetime increased the amount of grown SWNTs and the growth rate was proportional to the gas pressure in low gas pressure range [2]. The low pressure condition elongated the catalyst lifetime, while it decreased the growth rate.

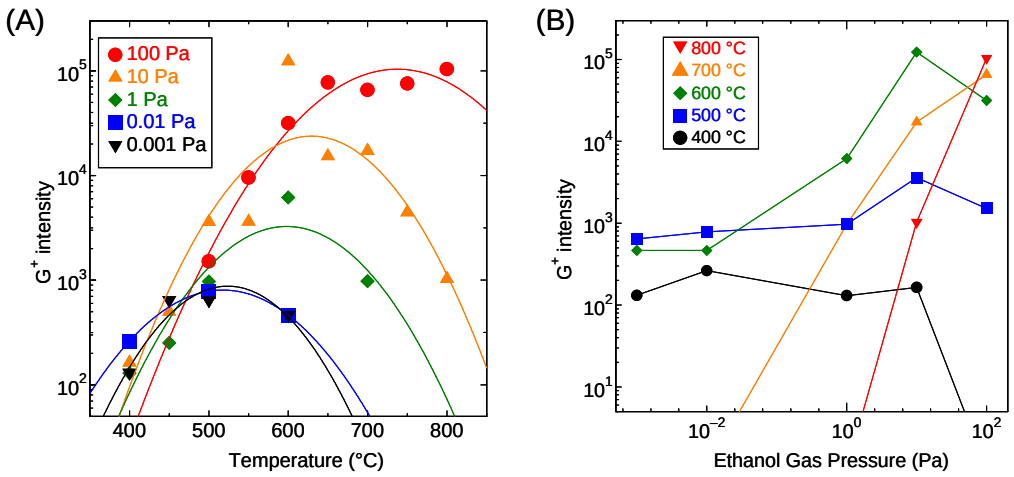

Fig. 1 CVD condition dependence of the G-band intensity.
(A) CVD temperature and (B) ethanol gas pressure.

References:
[1] Y. Murakami, et al., Chem. Phys. Lett., 377 (2003) 49-54.
[2] E. Einarsson, et al., Carbon 46 (2008) 923-930.

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