Single-walled Carbon Nanotube Growth in a Wide Temperature Range

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It is important to understand the growth mechanism of single-walled carbon nanotubes (SWNTs) and control their structure in their growth stage. Especially, the growth at low temperature is inevitable for the device applications of SWNTs. In the present study, we preformed SWNT growth by a catalytic CVD method in a wide temperature range. Ethanol and dimethyl ether (DME) were used as the carbon source and Co/Mo metal particles deposited on silicon substrates were used as the catalyst. The CVD temperature ranged from 400 to 900 degree C. The optimum ethanol gas pressure was strongly depended on the CVD temperature. When the CVD temperature decreased, the optimum ethanol pressure decreased. Moreover, at low ethanol gas pressure (0.01 Pa), SWNTs were synthesized only at low CVD temperature (500 C). It indicated that the balance between the growth rate of SWNTs and the injection speed of carbon atoms to the catalyst was important. On the other hand, the gas pressure and temperature ranges were quite narrow in the case of DME. DME thermally decomposed more efficiently than ethanol during CVD process, which was one of the reasons why the growth conditions were limited.