Recent advances in growth of vertically aligned SWNT films by ACCVD

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In a previous study, we showed that the thickness of vertically aligned (VA) SWNT films produced by the alcohol catalytic CVD method [1] can be determined during growth by *in situ* optical absorbance measurements [2]. This was achieved by exploiting the relationship between the optical absorbance of a VA-SWNT film and its thickness [2]. An analytical description of the growth was developed based on these measurements [3], which shows the catalyst activity decreases exponentially with increasing CVD reaction time. Thus, the final film thickness is largely determined by the initial catalyst activity; however, the factors affecting the catalyst activity are not yet well understood.

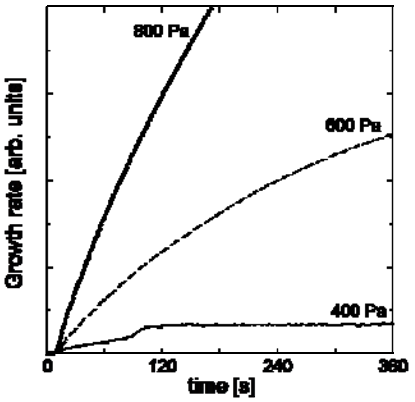

Fig. 1: Pressure dependence of the initial growth rate of VA-SWNT films

In the current study, we observed that the initial catalyst activity is sensitive to the ambient chamber pressure at which VA-SWNT growth occurs. This is shown in Figure 1 for three separate cases. In the 600 Pa case a film with a thickness of 6 μm was grown, as shown in Figure 2a, whereas the 800 Pa case (Fig 2b) produced a film 21 μm thick. The enhanced growth may be attributed to an increase in the ethanol dissociation rate, or the pressure change may have altered the flow dynamics inside the reaction chamber. Further studies are underway to clarify the underlying mechanism.

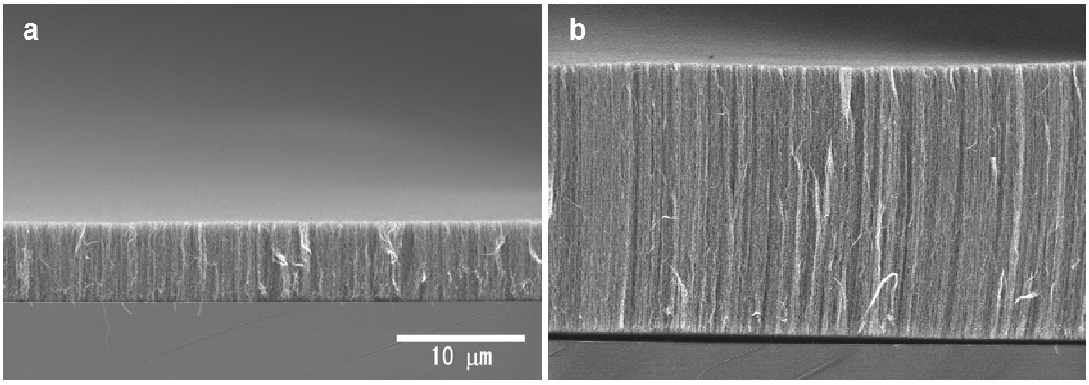

Fig. 2: (a) VA-SWNTs grown at an ambient ethanol pressure of 600 Pa. The film is approximately 6 μm thick. (b) Growth at an ethanol pressure of 800 Pa resulted in VA-SWNT films with thicknesses greater than of 20 μm. The scale bar applies to both images.

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

[2] S. Maruyama, E. Einarsson, Y. Murakami, and T. Edamura, *Chem. Phys. Lett.* **403** (2005) 320.

[3] E. Einarsson, Y. Murakami, and S. Maruyama, in preparation.

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