

Synthesis of vertically aligned SWNTs and their anomalous Raman spectra

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We review our recent studies on the synthesis of vertically aligned single-walled carbon nanotube (VA-SWNT) films by chemical vapor deposition (CVD) of alcohol. In particular, we look at how the ethanol pressure affects the growth process in real-time using an *in situ* optical absorbance measurement [1]. We find there is an optimum ethanol pressure that increases with CVD temperature [2], below which the growth reaction is governed by a first-order process (Fig. 1). The growth rate of the film is also found to be sensitive to changes in the CVD environment, and can change on short time scales. We also report preliminary results from polarized Raman spectroscopic studies that show anomalous anisotropic behavior in the radial breathing mode. A possible connection between this anisotropy and the small-bundle structure of the VA-SWNT films [3] is discussed.

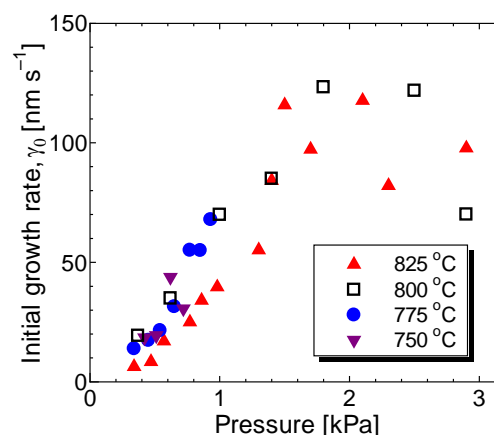


Fig. 1. Initial growth rates of VA-SWNT films synthesized at different temperatures and ethanol pressures. Correlation indicates a first-order reaction.

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

[2] E. Einarsson, M. Kadowaki Y. Murakami, S. Maruyama, *submitted to Carbon*.

[3] E. Einarsson, H. Shiozawa, C. Kramberger, M.H. Rummeli, A. Grüneis, T. Pichler, S. Maruyama, *J. Phys. Chem. C* **111** (2007) 17861.

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