

Growth mechanism and characterization of vertically aligned single-walled carbon nanotubes

○Erik Einarsson, Yoichi Murakami, Tadao Edamura, and Shigeo Maruyama

*Department of Mechanical Engineering, The University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-8656*

In this study we investigate the growth mechanism of vertically aligned single-walled carbon nanotubes (SWNTs). Aligned SWNT films were grown on quartz substrates using an alcohol catalytic chemical vapor deposition (ACCVD) method [1]. Mono-dispersed Co-Mo bimetal catalyst nanoparticles were deposited onto the substrates by a dip-coat method [2]. The production of SWNTs was verified by electron microscopy and resonance Raman spectroscopy. Analysis of samples at different stages of growth by SEM and TEM show vertical alignment is the result of high catalyst density on the substrate surface [3], which leads to dense vertical growth of SWNTs [4]. This high growth density creates an aligned, self-supporting structure (Fig. 1). The optical absorption of these SWNT films was also investigated. The optical absorption of the vertically aligned film was found to be strongly dependent on its thickness (Fig. 2). Use of this correlation as a quick, non-destructive characterization technique may be desirable for quality control and analysis in large-scale production of aligned SWNT films.

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- [2] Y. Murakami et al, *Chem. Phys. Lett.* **377** (2003) 49.
- [3] M. Hu et al, *J. Catal.* **225** (2004) 230.
- [4] Y. Murakami et al, *Chem. Phys. Lett.* **385** (2004) 298.

Corresponding Author: Shigeo Maruyama
E-mail: maruyama@photon.t.u-tokyo.ac.jp
Tel & Fax: 03-5800-6983

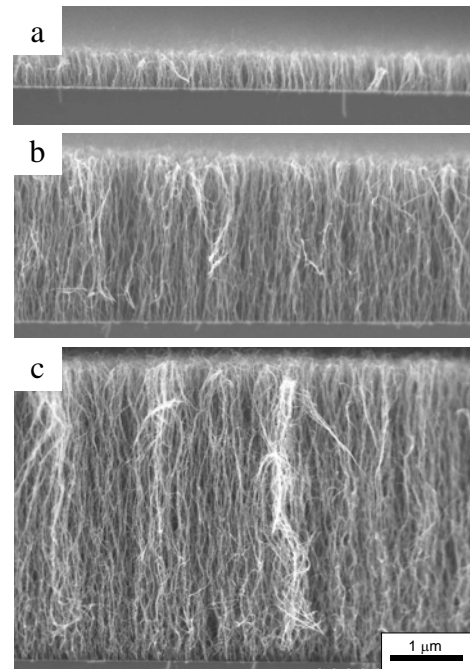


Fig. 1: Growth stages of vertically aligned SWNTs after (a) 30 sec, (b) 3 min, and (c) 10 min of growth.

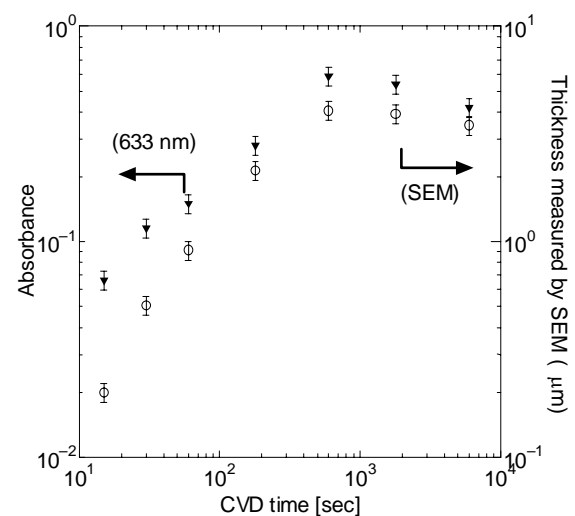


Fig 2: Thickness of a vertically aligned SWNT film (rt. axis) and its corresponding optical absorbance (left axis) with respect to CVD growth time.