P1-53

垂直配向単層カーボンナノチューブ応用の実現に向けて

Toward the realization of single-walled carbon nanotube applications

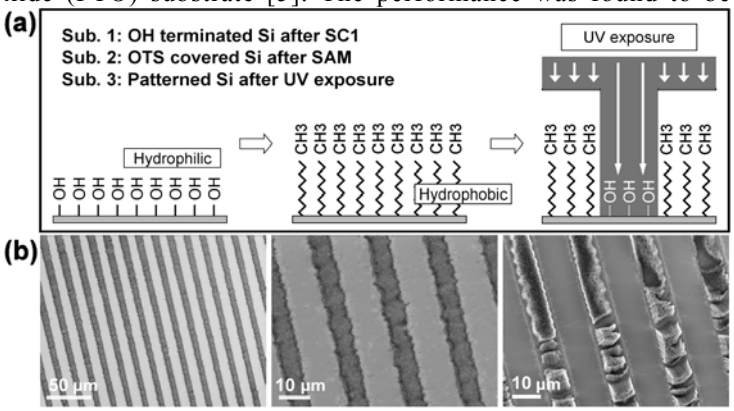
Erik Einarsson, Rong Xiang, Jun Okawa, Shigeo Maruyama
（東京大学・工学系研究科）

We demonstrate patterned synthesis of single-walled carbon nanotubes (SWNTs) by a simple surface treatment process, and utilize SWNTs as the counter-electrode is a dye-sensitizd solar cell.

The unique physical properties of single-walled carbon nanotubes (SWNTs) have generated considerable interested in various scientific fields, as well as high expectations for novel applications. However, few applications have thus far been demonstrated due to difficulties in controlling SWNT morphology, electrical character, etc. We present some of our recent activities related to applications of SWNTs, particularly patterned synthesis and the use of SWNTs as the counter-electrode in a dye-sensitized solar cell (DSSC).

The SWNTs used in this study were synthesized by the alcohol catalytic chemical vapor deposition (ACCVD) method [1], in which SWNTs are formed via the reaction between ethanol and metallic catalyst nanoparticles. The catalyst is deposited on quartz or silicon substrates by a liquid-based dip-coat method [2]. By treating the substrate surface prior to the dip-coating process (Fig. 1), we show we are able to predetermine the regions where catalyst will be deposited (hydrophilic regions) and the areas that will remain catalyst-free. This surface treatment consists of forming a self-assembled monolayer (SAM) on the surface, then selectively removing portions of the SAM either by UV light or electron beam exposure [3].

A vertically aligned SWNT array [4] was also employed as the counter-electrode in a DSSC by transferring the array onto a fluorinated tin oxide (FTO) substrate [5]. The performance was found to be comparable to industry-standard platinum thin films, but had slightly lower efficiency. This was attributed primarily to high resistance at the SWNT-substrate interface. Depositing a gold thin film onto a silicon substrate produced a flatter surface, and resulted in an increase in performance due to the better contact between the substrate and the SWNT array.



(a) procedure to obtain hydrophobic and hydrophilic surface regions using SAM patterning; (b) patterned synthesis of SWNTs.

[1] S. Maruyama, R. Kojima, Y. Miyauchi, S. Chiashi, M. Kohno, *Chem. Phys. Lett.* **360** (2002) 229.
[2] Y. Murkami, Y. Miyauchi, S. Chiashi, S. Maruyama, *Chem. Phys. Lett.* **377** (2003) 49.
[3] R. Xiang, T. Wu, E. Einarsson, Y. Suzuki, J. Shiomi, S. Maruyama, *submitted*.
[4] Y. Murakami, S. Chiashi, Y. Miyauchi, M. Hu, M. Ogura, T. Okubo, S. Maruyama, *Chem. Phys. Lett.* **385** (2004) 298.
[5] J. Okawa, E. Einarsson, K. Ogura, S. Shiomi, S. Maruyama, *in preparation*.

Dept. of Mechanical Engineering, The University of Tokyo, Tokyo 113-8656