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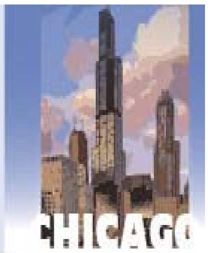

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(Invited) Post-Growth Manipulation of Horizontally Aligned Single-Walled Carbon Nanotubes

Monday, 25 May 2015: 15:00
Lake Huron (Hilton Chicago)

S. Maruyama, T. Inoue, K. Otsuka, and S. Chiashi (The University of Tokyo)

Horizontally aligned single-walled carbon nanotubes (SWNTs) are promising for electronic applications such as field-effect transistors (FETs). In addition to the density-controlled CVD growth [1,2] and chirality characterization of aligned SWNTs on quartz substrates, we will discuss two manipulation techniques of SWNT arrays. First is the full-length removal of metallic SWNTs by using organic film-assisted electrical breakdown, which gives semiconducting SWNT arrays suitable for scalable device fabrication [3]. We applied the electrical breakdown technique to SWNT array covered with organic films such as poly(methyl methacrylate) (PMMA) and realized that metallic nanotubes continues to burn as fuses for fireworks. This method yielded not only a high on/off ratio (~10,000) and fine spatial resolution (~55 nm) in the same way as in-air breakdown, but also long removal length (>10 μm) which is unattainable by conventional breakdown. Thermal calculations revealed that burned edges of a SWNT keep high temperature with oxidation heat generation of surrounding organic materials even after Joule heat stops. The second manipulation technique is the bundling of selected parts of SWNT arrays. Horizontally aligned SWNTs were peeled off from original substrates by using polymer films with lithographically-defined resist structures. Then, the resist was dissolved to give partially suspended SWNTs over trenched polymer films, and neighboring suspended SWNTs formed bundles by capillary process. Finally the structures were placed on target substrates to give partially bundled SWNTs. This technique would be available for controlling percolative transport of SWNT networks.

Reference:
[1] S. Chiashi, H. Okabe, T. Inoue, J. Shiomi, T. Sato, S. Kono, M. Terasawa, S. Maruyama, J. Phys. Chem. C, 116 (2012) 6805.
[2] T. Inoue, D. Hasegawa, S. Badar, S. Aikawa, S. Chiashi, S. Maruyama, J. Phys. Chem. C, 117 (2013) 11804.
[3] K. Otsuka, T. Inoue, S. Chiashi and S. Maruyama, Nanoscale, 6 (2014) 8831.

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