Vertically aligned and almost electrically isolated single-walled carbon nanotubes

Erik Einarsson[1], Zhengyi Zhang[1], Hidetsugu Shiozawa[2], Thomas Pichler[2]*, Shigeo Maruyama[1]

[1] The University of Tokyo, Dept. of Mechanical Engineering, Tokyo 113-8656, Japan
[2]Institut für Festkörper- und Werkstofforschung Dresden, D-01171 Dresden, Germany

High-resolution electron energy loss spectroscopy (EELS) of vertically aligned (VA-) SWNT films [1, 2] showed their electronic structure is nearly the same as an isolated SWNT, rather than resembling bulk carbon material. Subsequent observation by transmission electron microscopy (TEM) revealed the VA-SWNTs consist primarily of individual nanotubes and small (approx. 10 nm) SWNT bundles. These bundles are sufficiently small that the 1-D nature of the SWNTs remains, thus the 3-D film formed by the VA-SWNTs retains the 1-D electrical properties of the isolated nanotubes which comprise the film. This is indicated by preliminary EELS data indicating the overall electronic properties of the film are dominated by individual SWNTs rather than bulk SWNT bundles. Furthermore, high-resolution resonance Raman spectra show excitations for perpendicularly polarized light that should only be observable for isolated SWNTs. These experimental findings are very interesting and promising for future studies on the 1-D properties of SWNTs, as well as showing macro-scale materials (i.e. the VA-SWNT films investigated here) can retain nano-scale properties.

In the presentation, we will show various experiments carried out on these VA-SWNTs which reveal the internal isolated structure.

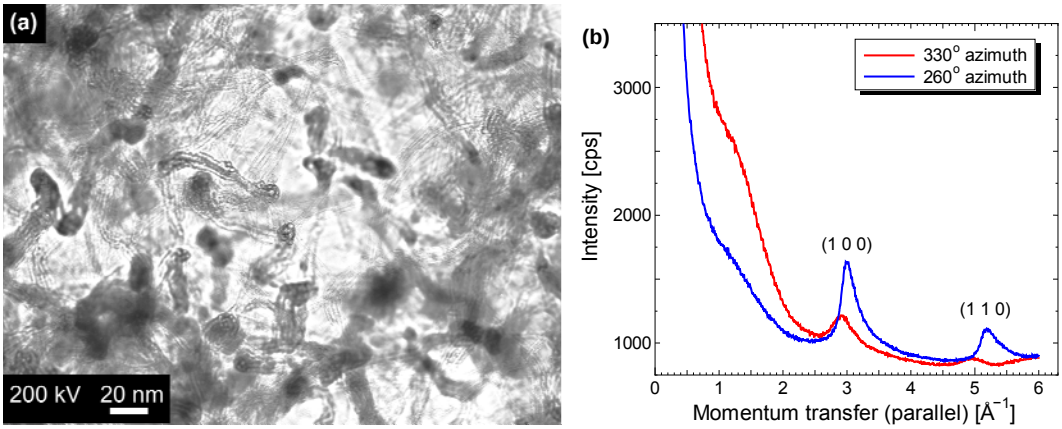

Figure 1. TEM image of the vertically aligned SWNTs showing very small bundles, and (b) X-ray scattering spectra showing SWNT peaks, but no bundle peaks for low momentum transfer (below 2 Å^{-1}).

[1] Y. Murakami, S. Chiashi, Y. Miyauchi, M. Hu, M. Ogura, T. Okubo, S. Maruyama, Chem. Phys. Lett., 385 (2004) 298.
[2] S. Maruyama, E. Einarsson, Y. Murakami and T. Edamura, Chem. Phys. Lett., 403

(2005) 320.

*Email address: maruyama@photon.t.u-tokyo.ac.jp