Direct synthesis of high-purity single-walled carbon nanotube mat on silicon and quartz substrates and their applications

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A new technique of synthesizing high purity single-walled carbon nanotubes (SWNTs) directly on the surface of silicon and quartz substrates was presented employing low-temperature alcohol CCVD method [1, 2] developed by our group. The proposed method does not employ conventional deposition/sputtering for catalytic mounting on the substrate, but uniquely employs an easy, costless, and versatile liquid-based method. This technique first produced SWNTs directly on a silicon substrate at the temperature of 650 deg C, with assuring sufficiently high quality where the 'G/D ratio' of Raman scattering measured by 488 nm excitation was approximately 50. This is by far the lowest temperature among the previous reports where 900 to 1000 deg C was required for the production of SWNTs on the silicon substrate.

At the optimum CVD temperature (800 deg C), a uniform mat of SWNTs was synthesized on the substrates after 1h CVD reaction to the extent that SWNTs can be macroscopically scratched off from the surfaces. The optical absorption of 'as-grown' SWNTs was first measured using thereby prepared blackened SWNT-synthesized quartz substrate. The obtained absorbance spectrum was clear and almost matched with that of the HiPco SWNTs suspended in D2O (1 % SDS), which confirmed that the product on the quartz surface was bundled SWNTs. Several applications that are possible with this technique are presented.

[1] S. Maruyama et al., Chem. Phys. Lett., 360 (2002) 229.
[2] Y. Murakami et al., Chem. Phys. Lett., in press.