Electrochemical characterization of supercapacitors using fluorinated singlewalled carbon nanotube electrodes

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The fluorination of singlewalled carbon nanotubes (SWCNTs) enhances excellent dispersion and wettability of individual SWCNTs in aqueous electrolytes, which may increase the specific capacitance of supercapacitor. We have fabricated an active electrode for supercapacitor using fluorinated singlewalled carbon nanotubes (SWCNTs). The fluorination of raw SWCNTs and purified SWCNTs synthesized by conventional arc-discharge has been executed by using F2 gas at 150 ~300 ^{o}C. A unit cell for the capacitor is fabricated with two SWCNT electrodes separated by a thin polymer (Celgard) in 7.5N KOH aqueous solution as an electrolyte. The specific capacitance, internal resistance, energy density, and power density are electrochemically characterized by specific surface area, cycle test, AC impedance measurement, cyclic voltammogram, and Ragon plot analysis.

Fig. 1 shows XPS valence spectra, clearly showing the decrease of the valence states near the Fermi level. This strongly suggests that the resistivity of the fluorinated nanotubes increases.

Fig. 2 shows the Raman spectra, revealing that the fluorination at a high doping rate deteriorates the nanotubes.

Fig. 3 is the specific capacitance, where the fluorinated nanotubes show a significant increase in the capacitance.

Reference.

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1. K. H. An, J. G. Heo, K. G. Jeon, D. J. Bae, C. S. Jo, C. W. Yang, C. Y. Park, and Y. H. Lee, Appl. Phys. Lett. 80(22), 4235(2002).

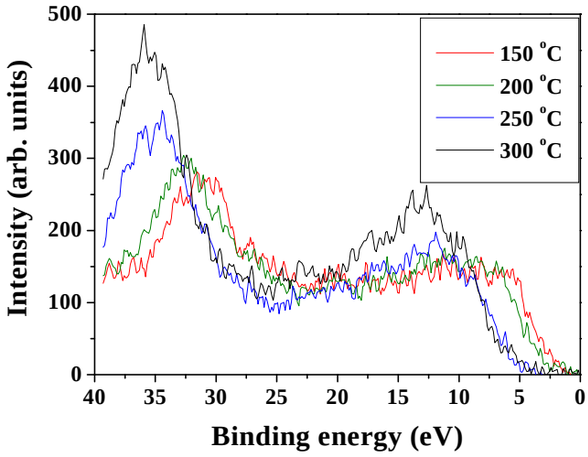

Figure 1. valance band spectra of fluorinated SWNTs

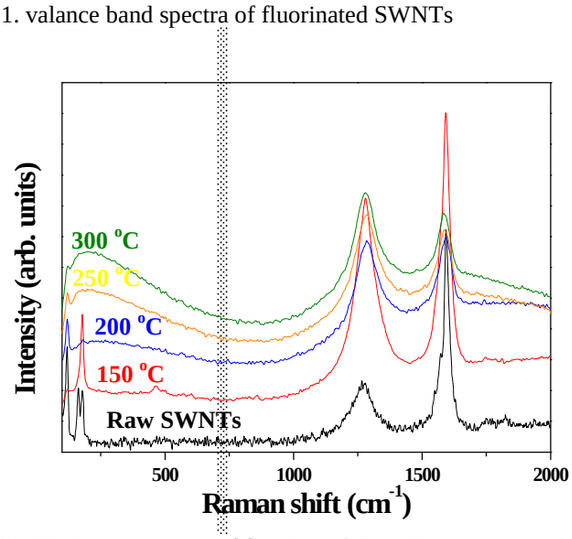

Figure 2. FT-Raman spectra of fluorinated SWNTs

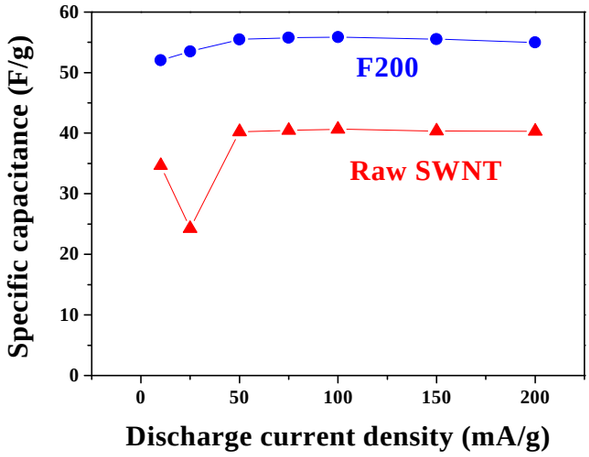

Figure 3. Specific capacitances as functions of discharging current density