Supplementary Material (ESI) for Journal of Materials Chemistry

Supporting Information

Materials and Methods

Materials. All reagents were used without further purification. Resorcinol (99%) and formaldehyde (37% in water) were purchased from Aldrich Chemical Co. Sodium carbonate (anhydrous) was purchased from J.T. Baker Chemical Co. Highly purified SWNTs were purchased from Carbon Solutions, Inc.

SWNT-CA preparation. The SWNT-CAs were prepared using traditional organic sol-gel chemistry [*1*]. In a typical reaction, purified SWNTs (Carbon Solutions, Inc.) were suspended in deionized water and thoroughly dispersed using a VWR Scientific Model 75T Aquasonic (sonic power ~ 90 W, frequency ~ 40 kHz). The concentration of SWNTs in the reaction mixture was 1.3 wt%. Once the SWNTs were dispersed, resorcinol (1.235 g, 11.2 mmol), formaldehyde (1.791 g, 22.1 mmol) and sodium carbonate catalyst (5.95 mg, 0.056 mmol) were added to the reaction solution. The resorcinol-to-catalyst ratio (R/C) employed was 200. The amount of resorcinol and formaldehyde (RF solids) used was 4 wt%. The sol-gel mixture was then transferred to glass molds, sealed and cured in an oven at 85°C for 72 h. The resulting gels were then removed from the molds and washed with acetone for 72 h to remove all the water from the pores of the gel network. The wet gels were subsequently dried with supercritical CO_2 and pyrolyzed at 1050^{o}C under a N_2 atmosphere for 3 h. The SWNT-CAs materials were isolated as black cylindrical monoliths. Foams with a SWNT loading of 55 wt% (1 vol%) were prepared by this method.

Characterization. Scanning electron microscopy (SEM) characterization was performed on a JEOL 7401-F at 5-10 keV (20mA) in secondary electron imaging mode with a working distance of 2-8 mm. Electrical conductivity was measured using the four-probe method with metal electrodes attached to the ends of cylindrical samples. The amount of current transmitted through the sample during measurement was 100 mA, and the voltage drop along the sample was measured over distances of 3 to 6 mm. Seven or more measurements were taken on each sample, and results were averaged. Mechanical properties were studied by indentation in an MTS XP Nanoindenter with a Berkovich diamond tip. A series of both continuous and partial load-unload indents (with 5 cycles and an unloading percentage of 100% for each cycle) was carried out in laboratory air at room temperature. The loading rate was continuously adjusted to keep a constant representative strain rate of 10^{-3} s^{-1}, defined as $(dP/dt)\cot\theta/4P$, where P is load, t is time, and $\theta = 72.1^{o}$ is the equivalent cone angle of the Berkovich tip used. For every cycle, the unloading rate was kept constant and equal to the maximum loading rate of the cycle. The Oliver-Pharr method [*2*] was used to analyze partial load-unload data in order to calculate the indentation elastic modulus as a function of the indenter penetration.

1. R. W. Pekala, *Journal of Materials Science* **24**, 3221 (1989).
2. W. C. Oliver, G. M. Pharr, *Journal of Materials Research* **7**, 1564 (1992).