Preparation and Properties of Buckypaper-Gold Nanoparticle Composites

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ELECTRONIC SUPPORTING INFORMATION

General procedures

All chemicals were purchased from Aldrich unless otherwise stated. Curly multiwalled carbon nanotubes were obtained from Nanocyl Company. HiPCO single walled carbon nanotubes were obtained from CNI. Transmission electron microscopy (TEM) measurements were carried out using a Hitachi H-7000 electron microscope. The nanotube composites were dispersed in ethanol by ultrasonication and dropped onto copper formvar grids. The TEM was operated at a beam voltage of 100kV. Fourier transform (FT-IR) measurements were performed in transmission mode using a Digilab FTS-6000 spectrometer using Perkin-Elmer microsampling attachment. Thermogravimetric analysis (TGA) measurements were carried out in air for all the samples using a Perkin Elmer Pyris 1 TGA with a temperature scan rate of 10 °C per minute. The ultra-sonic bath used was a Grant XB6 at 50-60 Hz. The tensile test measurements were carried out on a Zwick Z100 tensile tester a 100N load was used with a cross head speed of 10 mm min^{-1}.

Preparation and characterization of buckypaper-gold composites

Both SWNT and multiwalled nanotube (MWNT) based buckypaper-gold composites were prepared adding 0.035 g of each type of CNTs to 0.01 M $HAuCl_4 \cdot 3H_2O$ solution in N-methyl pyrrolidone (NMP). The suspensions were sonicated in a sonic bath for 3 hours to ensure that the CNTs were evenly dispersed through the gold-NMP solution. To achieve a flat homogeneous sheet of buckypaper the nanotubes were vacuum filtrated through a porous alumina membrane (Anodisc 47 mm in diameter) and washed with deionised water and ethanol. The free standing buckypapers were peeled from the membrane and left to dry at 40 ^{o}C. When the films were dried they were cut into strips of width ~3 mm and lengths of up to 3.5 cm. Film thickness was between 100 μm and 120 μm. Control samples without the gold salt were prepared similarly.

FTIR spectroscopy, figure 1, does not show any peaks corresponding to the gold salt solution, showing that the salt has been completely washed from the buckypaper.

TGA analysis, figure 2, shows that the weight difference between the pure SWCNT buckypaper and the SWCNT Au-composite buckypaper that remains after 900 oC was 5.67 %. There was a weight difference of 3.25 % for the MWCNT buckypaper against the MWCNT Au-composite sample. The higher quantity of metal for the SWNT Au-composite sample would suggest a higher surface energy of the SWCNT and therefore a higher redox potential.

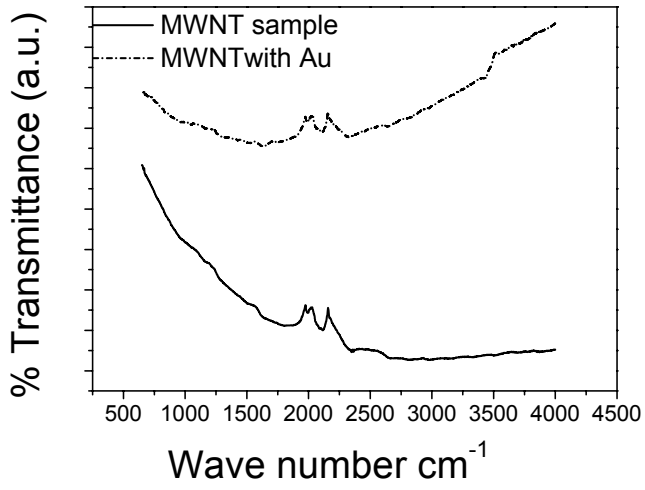

Fig. 1: IR spectra of MWNTs and MWNTs with Au.

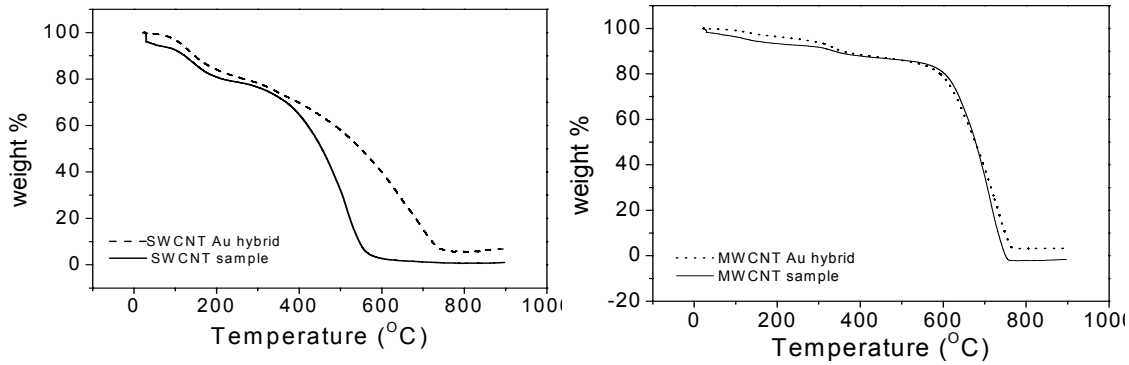

Fig. 2: TGA analysis of SWNTs and MWNTs and their gold composites.