11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Synthesis Processing and Characterization of Cu-CNT Nano-composites.

Mendoza, M. E. (1)*, Solórzano, I. G. (1), Brocchi, E. A. (1), Costa, C.A. (2)

(1) DCMM, Pontifícia Universidade Católica do Rio de Janeiro, e-mail:mmendozao@aluno.puc-rio.br
(2) COPPE/ UFRJ. Universidade Federal do Rio de Janeiro

Abstract – Cu -CNT nano composites have been synthesized by chemical method: Dissociation of copper nitrate with CNTs, and reduction by H_2 atmosphere, followed by cold compactation and sintering under Ar atmosphere. The powder formed presented a good distribution and adherence of CNTs onto the copper (Fig.1). Powder copper particles were observed to be in the 50-300nm range while the bulk Cu-CNT grain size was observed to be in the 150nm -3µm range. The composite Cu-CNT presented less resistivity at low temperature ($2x10^{-6}$?.cm at 83°K) compared with copper. Hardness availed by nano indentation exhibit higher values for the composite than copper (1,7GPa vs 1,2GPa).

The increasing interest in nanostructure materials in recent years has provided incentive to develop new synthesis procedures and new kind of composites containing carbon nanotubes (CNT). Such motivation relies on the well-established superior mechanical and transport properties of CNT, their stability being an advantage when submitted to thermo-mechanical processing together with the metal powder. It is spected the resulting metal-matrix bulk nanocomposites with improved mechanical and transport properties [1,2,3].

This work reports some structural characteristics of a Copper–2%CNT synthesized by chemical method. Purified (>93%) single wall Carbon nanotubes(SWCNTs), from Nano-C (USA) were used with diameters between 5 - 10 nm and few microns of length. The nano-composites powders were produced by dissociation of a homogeneous suspension containing Cu (NO3)2. 3H2O - SWCNT with an anionic tensoactive; followed by hydrogen reduction of the obtained CuO-SWCNT product.

X ray diffraction and Transmission Electron Microscopy has been used as characterization tools. The former confirmed the presence of pure metallic copper with carbon (Fig. 1b). The later allowed the observation of a good dispersion as well as adherence between Cu particles onto CNT (Fig. 1a). The Cu powder particles were observed to be in the 50-300nm range. Bulk nano-composite pellets were obtained by a pre-compactation under uniaxial pressure of 60 MPa followed by isostatic pressure of 150MPa. Sintering of the compacted material was carry out at 650°C under Argon atmosphere by 15 min. Studies show a heterogeneous growing of copper particles with sizes between 150nm -3µm.

Low temperature electric resistivity measurement, show that the nanocomposite material has lower value (2x10-6 ?.cm) at 83°K than the copper without carbon nanotubes (6x10-6 ?.cm). Hardness and elastic modulus were determinated by nano indentation. The composite displayed higher hardness (1,7GPa) compared with copper (1,2GPa). Nevertheless elastic modulus of the copper shows a higher value than copper, because the composite presented porosity at the end of the process.

Multi Wall Carbon nanotubes (MWCNTs) were functionalized with HNO3 at 80°C by 4hours and washing with distilled water. The same chemical method procedure was used to form the composite Cu-MWCNT powder. Transmission Electron Microscopy shows a good adherence between Cu and MWCNT and heterogeneous size of copper particles. Hot sintering, variation of volume fraction and properties measurements are currently in progress.

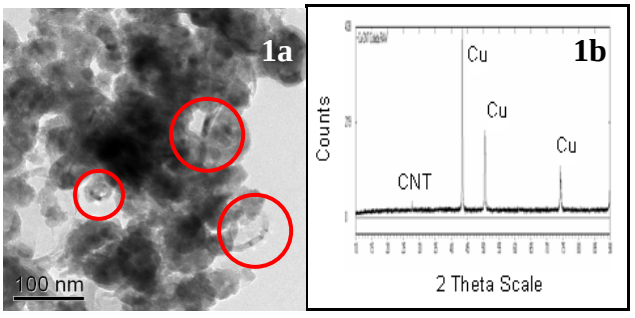

Figure 1: a) TEM bright field image of SWCNTs mixed with copper nanoparticles, and **b)** X ray diffraction pattern of Cu-SWCNT nano composite.

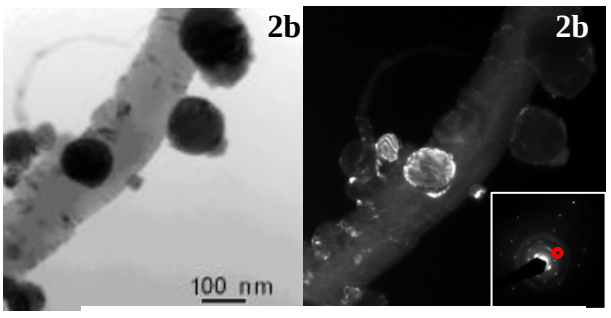

Figure 2: TEM image of a MWCNT decorated by copper nano particles, **a)** bright field image and **b)** dark field and diffraction pattern of copper nano particles.

References

[1] K. T. Kim et al., Materials Science and Engineering A 449-451 (**2007**) 46-50
[2] P. Quang, S.C. Yoon, Materials Processing Technology187-188 (**2007**) 318-320
[3] Cornelia Otto. Synthesis and Characterization of CNT Reinforced Copper Thin Films. Dissertation Stuttgart University. Bericht Nr. 194 November **2006**.