POLYANILINE/MULTI-WALL CARBON NANOTUBE COMPOSITES

Raquel Sainz[1], A.M. Benito[1], M.T. Martínez[1], B. Corraze[2], O. Chauvet[2], A. Dalton[3], R. Baughman[3], W.K. Maser[1]
[1]Instituto de Carboquímica (C.S.I.C.), C/Miguel Luesma Castán 4, E- 50011 Zaragoza, Spain
[2]LPC, IMN, Univ. Nantes, rue de la Houssinière, F-44322 Nantes, France
[3]University of Texas at Dallas, NanoTech Institute, Richardson, TX 75083-0688, USA
E-mail: wmaser@carbon.icb.csic.es
http://www.icb.csic.es/nanotubos/first.html

With a highly promising application potential carbon nanotubes (CNTs) [1] are attractive building blocks for the development of a future nanotechnology resulting in novel materials and devices of great practical interest [2]. One strategy to achieve this goal is the fabrication of CNT/polymer composites with enhanced functionality [3-5]. Beside enhanced operational functionality in CNT/polymer composites, a major point towards device applications is their processability. Favorable interactions between CNTs and the polymer matrix as well as the solubility of the whole composite are the two key factors. In this sense, the electroactive conducting polymer Polyaniline (PANI) is of particular interest: The ease of synthesis, the high degree of processability, the low synthetic costs, the environmental stability, the low synthetic costs, the large number of intrinsic redox states give PANI a considerable technological importance [6,7]. Therefore, the use of PANI as matrix material for CNT based composites deserves further scrutiny.

PANI/CNT composites have been prepared by using an in-situ approach, i.e. polymerization of aniline in the presence of CNTs. The CNTs were well graphitized straight multi-wall carbon nantoubes (MWNTs) from arc-discharge experiments [8]. A soluble CNT/PANI composite powder was obtained which can be processed into blue-colored tranparent films of use in further applications.

The composite was characterized by electron microscopy, infrared and Raman spectroscopy, thermogravimetric analysis, conductivity, and fluorescence. Enhanced π-π^* interaction between the pi-bonded surface of the CNTs with PANI has been observed by IR and Raman spectroscopy. This leads to enhanced thermal stability of PANI. The conductivity of the composite is largely determined by the CNTs thus rendering the non-conducting PANI into a thermally stable, conducting soluble composite material. Although showing a drastically increased conductivity, fluorescence of the composite is preserved. This is of great importance for the development of improved optoelectronic devices.

References:

[1] M.S. Dresselhaus, G. Dresselhaus, Ph. Avouris, Eds., Carbon Nanotubes: Synthesis, Structure, Properties and Applications, vol 80 (Springer, Berlin, 2001)
[2] R.H. Baughman, A.A. Zakhidov, W.A. de Heer, Science, **297** (2002) 787.
[3] S. A. Curran et al., Adv. Mater, **10** (1998) 1091.
[4] J.N. Coleman et al., Phys. Rev. B **58** (1998) 7492.
[5] H.S. Woo et al., Synth. Met. **116** (2001) 369.
[6] A.G. Macdiarmid, Synth. Met. **125** (2002) 11.
[7] T.A. Skotheim, R.L. Elsenbaumer, J.R. Reynolds, Eds., Handbook of conducting polymers, 2nd ed. pp. 823-961 (Dekker, New York, 1998)

Figures:

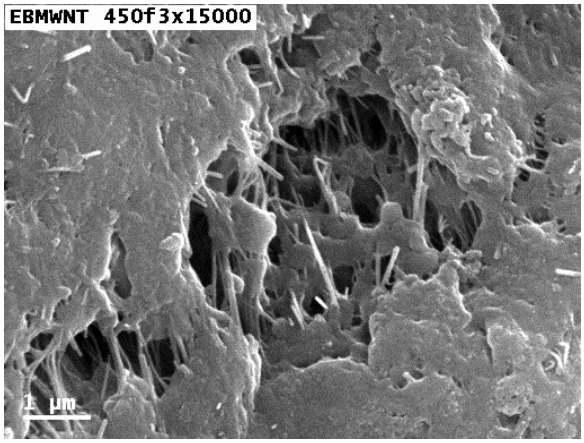

Figure 1: Scanning electron micrograph of CNT/PANI composite