Carbon Nanotubes doped with different noble metal nanoparticles by near – percolation amperometric sensors

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Abstract

Composite materials based on different forms of carbon as conductive phase, dispersed in polymeric matrix, have led to important advances in the analytical electrochemistry field, particularly in (bio)sensor devices **[1]**. Nowadays, the increasing interest is focused on conductive composite materials based on carbon nanotubes (CNTs), due to their high accessible surface area and good electrical, thermal and mechanical properties.

The main drawback in CNTs composite materials resides in the lack of homogeneity of the different commercial CNTs lots due to different amounts of impurities in the nanotubes, as well as dispersion in their diameter/length and state of aggregation. Nevertheless, the aspect ratio of the nanotubes is one of the main parameters that determine their percolation behaviour and the conductivity of the composites **[2]**.

Accordingly, the low reproducibility in electrochemical response of (bio)sensors which contain CNTs is due to the low homogeneity of raw nanotubes. For this reason, it is important to study how the different physical properties of these raw CNTs affect in electrochemical response of final (bio)sensor developed **[3]**. Concurrently, the best composite composition in terms of CNTs content was optimized by Percolation Theory [**4]**.

Previous studies demonstrated that CNTs-doped with metal impurities (89% in carbon purity) had the best electrochemical and amperometric response compared with the same CNTs but purified. These results opened the way to selective doping of CNTs with different metal nanoparticles.Consequently, different Metal Nanoparticles (MNPs) with electrochemical activity; such as Au-, Pd-, Ag-, Cu, Pt-MNPs, and were synthesized by the InterMatrix Synthesis methodology (IMS) on the CNTs surface **[5]**, **[6]**. IMS technique leads to a more favorable distribution of the MNPs on the CNTs, where non evident agglomerates were observed by High Resolution Transmission Electron Microscopy (HRTEM).

The electrochemical response was evaluated by Electrical Impedance Spectroscopy (EIS) and Cyclic Voltammetry (CV). The feasibility of this approach in terms of electroanalytical response was demonstrated by means of the amperometric detection of ascorbic acid in HNO_3/KNO_3 solution 0.05 M **[7]**.

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