Characterization by Different Techniques of Multiwall Carbon Nanotubes Functionalized with Metal Nanoparticles

Garibay - Febles, V.[1], Cruz-Castro, L.[1] and Diaz-Barriga, L.[2]

[1] Mexican Petroleum Institute, Mexico, [2] Instituto Politecnico Nacional, Mexico

In recent years, it has been proved that the addition of metallic Nanoparticles (NPs) to multiwall carbon nanotubes (MWCNT) have superior characteristics compared to the isolated MWCNT or NPs. Different groups around the world have found new and better electronic, magnetic, mechanical and optical properties by functionalizing NTCMP with NPs of different metals [1, 2, 3, 4, 5, 6]. In the present investigation, the properties of (NTCMP) functionalized with mono and bimetallic nickel and silver nanoparticles (NPs) in different relative concentrations (Ni: Ag, 1: 1, 9: 1, 1: 3, 3: 1), contributing to the knowledge of the surface characteristics of this type of material. The oxidation of the NTCMP was through an acid treatment with nitric acid (HNO_3) with a purity of 70%. The functionalization is obtained from chemical impregnation and the reduction of metal salts; this method was preferred because the NPs achieve a uniform rearrangement over the MWCNT. The structural and optical characterization of the samples was carried out using the techniques of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X-ray diffraction (XRD) and Raman spectroscopy. The vibrational properties of the oxidized MWCNT modified the ID / IG ratio from 1259 to 1267. The change of the ratio ID / IG in the oxidized material is due to the introduction of new defects, as well as changes in the geometry of MWCNT caused by the union of new functional groups. The X-ray diffractograms allow us to identify the reflections corresponding to the Ni, Ag nanoparticles and the Ni-Ag alloy present in the different materials analyzed. The EDS values ""obtained by SEM confirmed the presence of the metals, as well as the compositions in % weight and atomic percent for the different relationships, preserving the initially proposed proportions. From the results obtained by TEM, it was discovered that the 3: 1 ratio is the one with the highest population of Ni-Ag NPs on MWCNT, while the monometallic sample of Ni has the lowest population of NPs. For the 1: 3 ratio there are different sizes of NPs, some forming agglomerates of NPs reaching 20 nm on average.

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