Synthesis and Characterization of a Novel Nanostructured Porous Hybrid Material Based on Salts of the Vanadonickelocuprate (II) POM with Multiwall Carbon Nanotubes

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The unique chemical, physical, electronic and high thermal properties of carbon nanotubes (CNTs) made them interesting materials for widespread applications in different fields [1, 2]. One of the CNT's drawbacks which leads to some limitations in their applications is the low chemical reactivity of them. So, in for the most of applications, nanotubes require modification, such as changing some of the graphite properties, supporting or attaching different groups, especially inorganic particles for future utilization of modified nanotubes.

To date, several approaches have been reported for modification of CNTs [3, 4]. However, a few methods have been developed for modifying CNTs with inorganic metal oxide clusters. In this regard, Polyoxometalates (POMs) represent a diverse range of inorganic metal oxide clusters which have been introduced for modification of CNTs. Their versatile nature in terms of structure, size redox chemistry, photochemistry, redox behavior, charge distribution and other unique physicochemical properties means that POM chemistry is one of the important areas in inorganic chemistry. So, modification of CNTs with POMs will make CNTs more attractive in various fields. Moreover, the electrochemical properties of HPAs may be fully maintained when they are introduced to CNTs.

In the present work, we designed a novel nanostructured porous hybrid material based on salts of the Vanadonickelocuprate (II) POM with multiwall carbon nanotubes. The functionalization of multiwall carbon nanotubes was confirmed by Fourier-Transform Infrared spectroscopy (FTIR), X-ray diffraction (XRD), Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). The TEM images showed the highest dispersion of POM particles in the multiwall carbon nanotubes and also, filling them. Because POM segregation occurred for nanotubes functionalized with a mild oxidizer such as nitric acid, suggesting the importance of covalent bonding through the surface acid groups.

This method can be used to exploit the properties of this POM-CNT nanostructure and their application in nanoelectronic devices, catalysis, electrocatalysis, electronic, pharmacology, and magnetic materials.

References

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