Multifunctional nanocomposites based on different types of graphene and tungsten oxide

Sergio H. Domingues[1] (PQ)*, Caroline B. de Aquino[1] (IC) e Joana C. Pieretti[1] (IC)

[1] Graphene and Nano-materials Research Center – Mackgraphe, Mackenzie Presbyterian University, São Paulo, Brazil

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Introduction

Films of different types of graphene (*e.g.* reduced graphene oxide - rGO and graphene oxide - GO) and tungsten oxide (WO_3) has received increasing attention because of their wide range of potential applications (gas or liquid sensors, supercapacitors, electrochromic or photocatalytical devices).[1-2] The individual precursors (GO, rGO and WO_3) present the advantages of synthesis and deposition on several substrates, with different amounts. However, when considering electrochromic, capacitive or sensor properties, the stability, limit detection and sensibility of them may become a problem. In this sense, the main go of this work is the electrosynthesis and characterization of nanocomposites of different kinds of graphene and tungsten oxide as thin films. We believe that the electrosynsthesis of these materials, together as a nanocomposite, , may present better adherence, avoiding the leaching of components in the reaction medium when applied as sensor, presenting higher sensibility and stability properties based on the synergic effect when compared to the neat ones.

Results and Discussion

GO was synthesized by the modified Hummers method:[3] pristine graphite was oxidized by a chemical reaction (obtaining graphite oxide - Gr-O) and, in the following, the product was exfoliated by sonication in water, giving rise to GO. The nanocomposites (on FTO substrates) were synthesized through cyclic voltammogram, the aqueous electrolyte was prepared by adding tungsten powder into H_2O_2 (30%) under stirring until the complete metal dissolution and the resulting solution was diluted with the GO dispersion [0,5mg.mL^{-1}]. All samples, including the neat materials, were characterized by thermogravimetric (DTA), electron scanning microscopy (SEM), UV-Vis and Raman spectroscopy, X-ray diffraction (XRD) and electrochemical techniques as cyclic voltammogram, with $LiClO_4$ on acetonitrile (0,1mol.L^{-1}). Besides, the nanocomposites were applied as sensors. Raman spectra (Figure 1) of neat tungsten oxide and rGO/WO_3 nanocomposite revealed bands at 678 cm^{-1} and 963 cm^{-1}, ascribed to O-W^{6+}-O bridging and νW=O double bond, respectively, confirming the metal oxide presence.

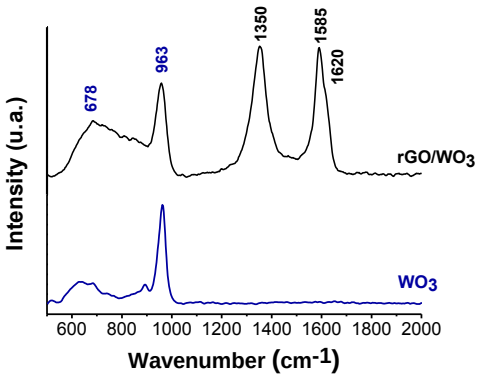

Figure 1. Raman spectra of WO_3 and graphene/WO_3 nanocomposite.

Besides, graphene/WO_3 spectrum presented three other bands at D (1350 cm^{-1}), G (1585 cm^{-1}) and D' (1620 cm^{-1}), commonly related to be the graphene finger prints.[3] Overall, the presence of all these bands confirm the synthesis of the nanocomposites. Results of cyclic voltammogram in Li^+ electrolyte corroborates with Raman spectra, where the graphene/WO_3 exhibits higher current density than the neat metal oxide. Moreover, the nanocomposites have been tested as hydrazine sensor using electrochemical methods, and up to now have shown better sensibility than the neat materials.

Conclusion

Results confirmed the electrosynthesis of graphene/WO_3 nanocomoposite as homogeneous thin films, which presents potential to be employed as hydrazine sensor.

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