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Nanocomposites Films Formed by Metallic Nanoparticles and Graphene Deposited on Silica for Optical Applications: Synthesis and Characterization

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Nanocomposites (NCs) formed by metallic nanoparticles (NPs) and carbon nanomaterials, such as graphene, may present different and new properties due to the interaction between their constituents, thus creating new materials[1]. These NCs have the advantage of a high surface/volume ratio, improved optical and mechanical properties and being considering as an alternative to overcoming the limitations of conventional materials[2]. The present work aims to the synthesis and characterization of thin films of mono/bimetallic NPs and graphene on silica substrate, prepared at the same time in a single synthesis step. As a substrate for film growth, silica coverslips previously cleaned with piranha solution were used. The precursors deposition was done by immersing the coverslips in a toluene solution containing (3-aminopropyl)trietoxysilane (APTES) together with the respective metallic salts (Au, Ag, Cu, AuCu and AgCu), and also with expanded polystyrene (EPS), remaining under heating at 60 °C for 3 hours. After this, the reduction of metallic ions was carried out through the thermal method, where the samples were taken in a muffle furnace at 350 °C for 1 hour. In the end of the synthesis steps, the films were characterized through electron spectroscopy of absorption in the ultraviolet-visible region (UV-Vis) to verify their LSPR, X-ray diffraction (XRD) to verify the nanoparticles crystalline structure, thermal analysis and Raman spectroscopy (Raman) to confirm the synthesis of graphene and transmission electron microscopy (TEM) to verify shape and size of nanoparticles and the presence of 2D carbon materials. The presence of carbon, both amorphous and crystalline, evident in the samples, but not continuously over the entire film, in addition to the formation of metallic NPs. As larger amounts of extra carbon source were added, it was observed that a greater quantity of 2D carbon structures were obtained together with the decrease in roughness of the films.

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