APRESENTAÇÃO ORAL - 3) DESIGN, SYNTHESIS, AND CHARACTERIZATION OF ELECTRONIC/OPTOELECTRONIC MATERIALS AND DEVICES

GRAPHENE-METAL NANOCOMPOSITES SYNTHESIZED VIA LASER-INDUCED GRAPHENE (LIG) PROCESS: CHARACTERIZATION AND POTENTIAL IN EMERGING APPLICATIONS

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Graphene nanostructures modified with metal have been used in biosensors, particularly in field-effect transistors (FETs) and impedance-based biosensors, showing enhanced detection capability and sub-femtomolar detection limits [1]. Additionally, the controlled morphology and properties of graphene-metal nanocomposites have been applied in catalysts, plasmonic devices, spectroscopy, fuel cells, and various types of sensors, including chemical, colorimetric, and fluorescence sensors. These materials have shown promising results in improving catalytic efficiency, energy conversion and storage, and sensitive and selective detection of analytes in complex matrices [2]. Graphene-metal nanocomposites can be formed in situ during laser-induced graphene (LIG) formation, where a laser beam is irradiated onto carbon materials coated with a metal precursor solution, resulting in the production of LIG-NPs, a three-dimensional porous material with high porosity, excellent electrical conductivity,

and good mechanical flexibility, containing metal structures dispersed uniformly throughout its volume [3]. In this study, the influence of laser writing parameters on the formation of graphene-based material and surface resistance of different LIG tracks formed on paper using a diode laser system (wavelength = 450 nm) was explored. Raman spectra were recorded for the different writing parameters, and characteristic graphene peaks (D, G, and 2D) were identified for the formed tracks. These peaks exhibited higher intensities for tracks with lower surface resistance values, 30 ohms/sq. The relationship between the intensities of characteristic peaks was calculated to evaluate the quality of the obtained material, resulting in values consistent with literature observations for high-quality graphene materials [4]. These laser writing parameters were employed in the production of electrodes used in heaters and flexible transistors fabricated on paper. The formation of LIG-NPs nanostructures was investigated as a function of the molar concentration of the precursor solution (HAuCl4) and LIG formation parameters on paper substrates. This stage of the study aimed to elucidate the optimal conditions for nanoparticle synthesis on paper, a substrate with potential applications in flexible electronics and wearable and biodegradable sensors. Through Scanning Electron Microscopy and Energy-Dispersive X-ray Spectroscopy (SEM-EDS) techniques, metallic particles with sizes between 40 and 100 nm were identified in the structure of the formed LIG. The relationship between the size and quantity of structures and the experimental parameters was investigated, demonstrating a direct correlation with the radiation exposure time during LIG-NPs synthesis, providing crucial insights for optimizing the manufacturing process and controlling the properties of this material. The results obtained will be employed in future stages in Surface-Enhanced Raman Spectroscopy (SERS) analyses. These findings not only contribute to the advancement of nanomaterial synthesis techniques but also pave the way for the development of customized materials with enhanced performance for a variety of applications in electronics, sensors, and energy conversion.

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References:

[1] doi: 10.1109/JSEN.2021.3082554

[2] doi: 10.1155/2022/1971891

[3] doi: 10.1039/D2SD00176D

[4] doi:10.1002/adsr.202300026

Palavras-chave: graphene; nanoparticles; graphene-metal nanocomposites; laser induced graphene.