

Área: FIS

Low-Cost Electrochemical Sensors Based on Exfoliated Graphite for Pharmaceutical Detection

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Keywords: Exfoliated graphite; Electrochemical sensors; Analytical method development; Drug detection.

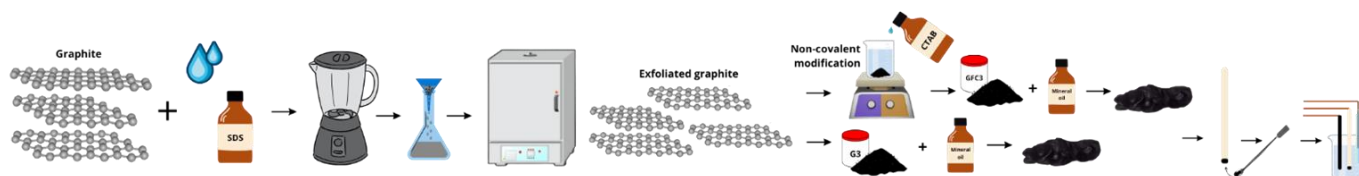
Highlights

Efficient graphite exfoliation using a low-cost Blender method. G3 material showed optimal performance for sensor development. Promising results for pharmaceutical detection in electrochemical sensors.

Abstract

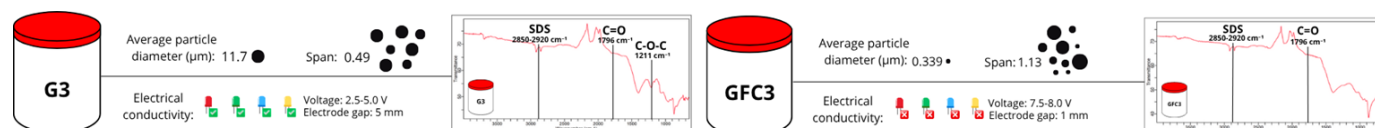
The detection of pharmaceuticals in water, effluents, and biological fluids requires analytical methods that are both sensitive and accessible. Conventional techniques such as chromatography and spectrometry, although highly accurate, are limited by high operational costs, low portability, and long analysis times (Wang et al., 2025). Electrochemical sensors based on two-dimensional materials with flexible structures and tunable surface properties, have emerged as promising low-cost and portable alternatives (Sutanto et al., 2024). In this study, a low-cost carbon paste electrode was obtained via liquid-phase graphite exfoliation, for pharmaceutical detection in environmental and biological samples. Figure 1 illustrates the schematic procedure for material preparation and electrode assembly.

Figure 1. Schematic representation of the material preparation and carbon paste electrode assembly



Characterization included particle size analysis by laser diffraction (SALD), FTIR, and conductivity tests with LEDs (Figure 2).

Figure 2. Comparative characterization of G3 and GFC3 materials based on particle size distribution, electrical conductivity, and FTIR analysis



Cyclic voltammetry using the G3 in a standard $K_4 [Fe(CN)_6]^{3-}/4-$ solution (1 mmol L^{-1} in 0.1 M KCl) revealed current peaks of $\pm 250 \mu\text{A}$ (-0.2 to $+0.6 \text{ V}$ at $0.4 \text{ V}\cdot\text{s}^{-1}$), gradually increasing over cycles due to surface activation and electrochemical conditioning (Nascimento et al., 2021). Future work will evaluate the supporting electrolyte, pH, scan rate, and method validation for pharmaceutical quantification in different matrices. Considering the limited characterization facilities available, additional analyses such as surface group identification and determination of the point of zero charge (pH_{pzc}) will be explored to complement the results.

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