BISMUTH DOPED LASER-INDUCED (Bi-LIG) GRAPHENE ELECTROCHEMICAL SENSOR FOR THE DETECTION OF HEAVY METALS

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Heavy metals (HM) are among the main environmental pollutants affecting human health [1]. They bioaccumulate in the body, inducing cell membrane and DNA damage and disrupting protein function and enzymatic activity; leading to illnesses such as cancer, immune system deficiencies, mental growth retardation, and malnutrition [2].

Produce consumption is one major route of exposure to HMs for humans. Therefore, HM monitoring in the agricultural context is critical to prevent and mitigate the risk of poisoning in the food chain. Electrochemical sensors are suitable for HM monitoring since they are accurate, portable, and robust sensing devices. However, the intricate fabrication process of sensing materials hinders their scalability and reproducibility thus preventing their adoption as the staple for routine HM monitoring.

In this work, we investigate bismuth-doped laser-induced graphene (Bi-LIG) as a candidate electrode material for the simultaneous detection of Zn, Pb, and Cd at trace level using square wave anodic stripping voltammetry (SWASV). Bi-LIG electrodes result from an easily scalable single-step fabrication process and promise enhanced electroanalytical performance due to the synergy between the properties of LIG; flexibility, chemical resistance and porosity, and the electrocatalytic properties of the bismuth nanoparticle [3].

Bi-LIG is synthesized from polyimide film coated with a bismuth and chitosan ink before the lased induction process. The obtained Bi-LIG will be studied using Raman spectroscopy to determine the quality of the graphene, and XRD will be applied to study the composition of the bismuth nanoparticles synthesized by laser induction. Additionally, the electrochemical properties of synthesized sensing material will be investigated utilizing cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). Finally, the sensing material will be applied for the simultaneous detection of Zn, Pb, and Cd using SWASV, and its analytical performance will be compared to that of bismuth film on the glassy carbon electrode.

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