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Bismuth nanoparticles decorated graphenated carbon nanotubes modified screen-printed electrode for mercury detection

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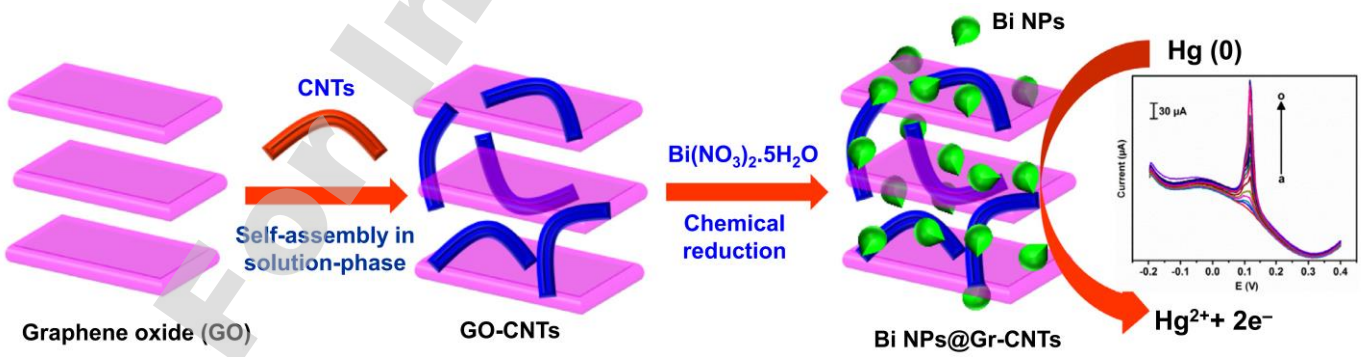
ABSTRACT

A three-dimensional hierarchical network of bismuth nanoparticles decorated graphene-carbon nanotubes nanocomposite (Bi NPs@Gr-CNTs) was synthesized and employed for electrocatalytic detection of mercury (Hg (II)). The electrocatalyst was characterized via scanning electron microscopy, transmission electron microscopy, Energy-dispersive X-ray spectroscopy, X-ray diffraction, FT-IR, electrochemical impedance spectroscopy, and cyclic voltammetry. The electrocatalytic activity of Bi NPs@Gr-CNTs modified screen-printed carbon electrode (SPCE) toward Hg (II) was studied using cyclic voltammetry, and differential pulse voltammetry. The Bi NPs@Gr-CNTs/SPCE exhibited excellent electrocatalytic ability to Hg (II) in comparison to control electrodes. Under optimized conditions, Bi NPs@Gr-CNTs/SPCE exhibits excellent Hg (II) sensing attributes in the range of 1.0 nM–217.4 μM with 0.2 nM of detection limit. The electrode was specific for Hg (II) in presence of other metal ions ascribe excellent selectivity. Practicality of the method was demonstrated in tap water, fish oil tablet, human serum, and urine samples (spiked method), which presented acceptable recoveries.



Scheme 1. Synthesis of Bi NPs@Gr-CNTs nanocomposite for electrocatalytic mercury sensor.

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Metallic Transition Metal Dichalcogenide Nanosheets as an Effective and Biocompatible Transducer for Electrochemical Detection of Pesticide

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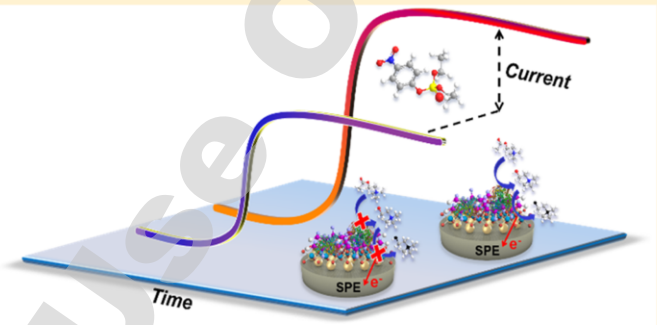
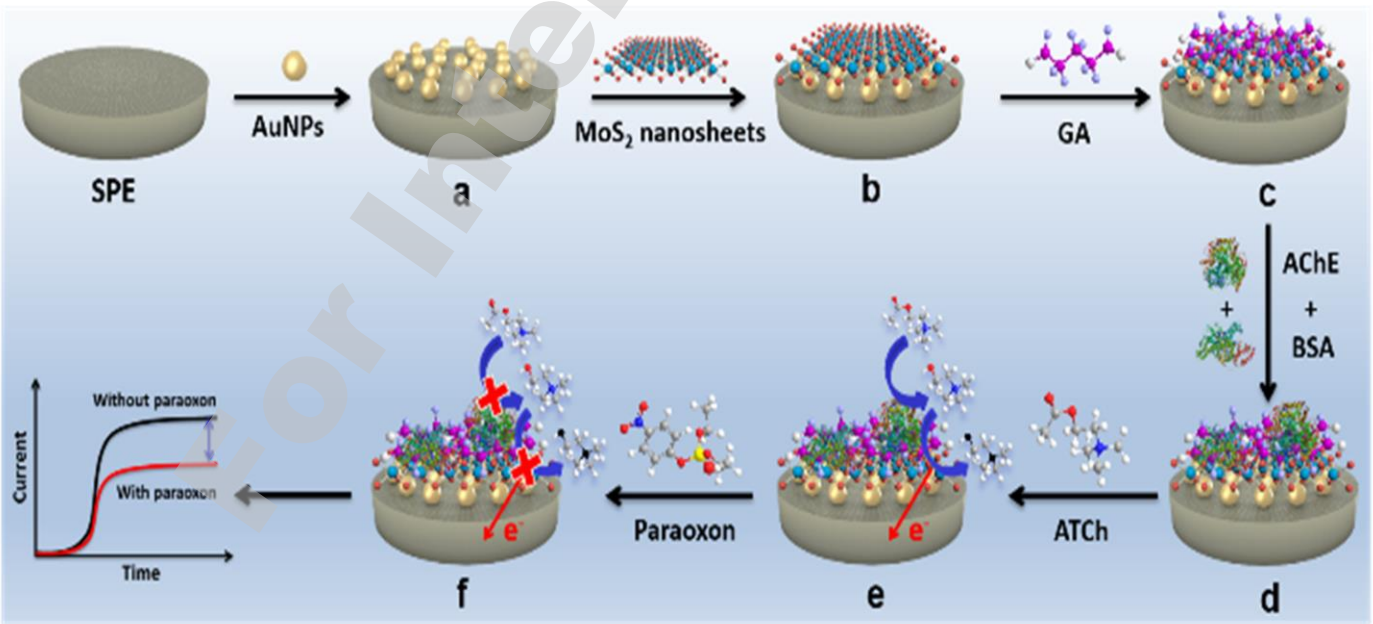
Supporting Information

ABSTRACT: Owing to their large specific surface, favorable electrical conductivity, and excellent electrocatalytic capabilities, two-dimensional transition metal dichalcogenides have received considerable attention in the field of biosensors. On the basis of these properties, we developed a portable and disposable enzyme-based biosensor for paraoxon detection using a metallic MoS_2 nanosheets modified screen-printed electrode (SPE). The exfoliated ultrathin metallic MoS_2 nanosheets can accelerate the electron transfer on electrode surface and contribute to the immobilization of acetylcholinesterase (AChE) via the cross-linking of glutaraldehyde. Electrodeposited gold nanoparticles (AuNPs) on SPE were used to immobilize MoS_2 nanosheets through the interaction between Au atoms on AuNPs and S atoms on MoS_2. Using acetylcholine as the substrate, AChE can catalyze the formation of electroactive thiocholine and further generate the redox current. In the presence of paraoxon, the activity of AChE can be inhibited, making the related electrochemical signals weaken. Under the optimized conditions, this electrochemical biosensor exhibited a favorable linear relationship with the concentration of paraoxon from 1.0 to 1000 $\mu g\ L^{-1}$, with the detection limit of 0.013 $\mu g\ L^{-1}$. Furthermore, this developed biosensor was successfully applied to detect paraoxon in pretreated apple and pakchoi samples, which can provide a reliable method for the rapid analysis of organophosphorus pesticides in agricultural products.





Scheme 1. Schematic Illustration of the Proposed Pesticide Biosensor[a]

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Flow-injection analysis coupled with electrochemical detection of poisonous inorganic arsenic(III) species using a gold nanoparticle/carbon nanofiber/chitosan chemically modified carbon screen printed electrode in neutral pH solution

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Development of simple and selective detection of poisonous arsenic species [As(III)] in drinking water is the subject of continued research in the multi-disciplinary areas of chemistry and biology. In this paper is reported, a well dispersed gold nanoparticle decorated-carbon nanofiber-chitosan modified carbon screen printed electrode (SPE/CNF-CHIT@Au_{nano}) prepared using an inexpensive and simple electrochemical method for electro-catalytic oxidation and flow injection analysis (FIA) of inorganic As(III) species in a neutral (pH 7) phosphate buffer solution. The modified electrode has about a four times higher current signal for the arsenic oxidation than that of a gold polycrystalline electrode. The SPE/CNF-CHIT@Au_{nano} system is highly stable in vigorously stirred solutions. Rotating disc electrode (RDE) studies performed using a glassy carbon electrode–rotating disc electrode (GCE–RDE) with its surface modified using the CNF-CHIT@Au_{nano} film gave a heterogeneous rate constant, $k_{cat} = 1.92 \times 10^4$ mol^{-1} dm^3 s^{-1} for the electrochemical oxidation of As(III). Furthermore, SPE/CNF-CHIT@Au_{nano} was used as an efficient electrochemical detector (ECD) for the FIA of arsenic(III) in a neutral pH solution. The present FIA-ECD shows zero interference with other common cationic and anionic species. As an analytical application, selective detection of As(III) in arsenic polluted industrial effluent and tap water samples were determined satisfactorily with good recovery values. The analysis results from FIA-ECD were comparable with those obtained using the inductively coupled plasma – optical emission spectrometry method.

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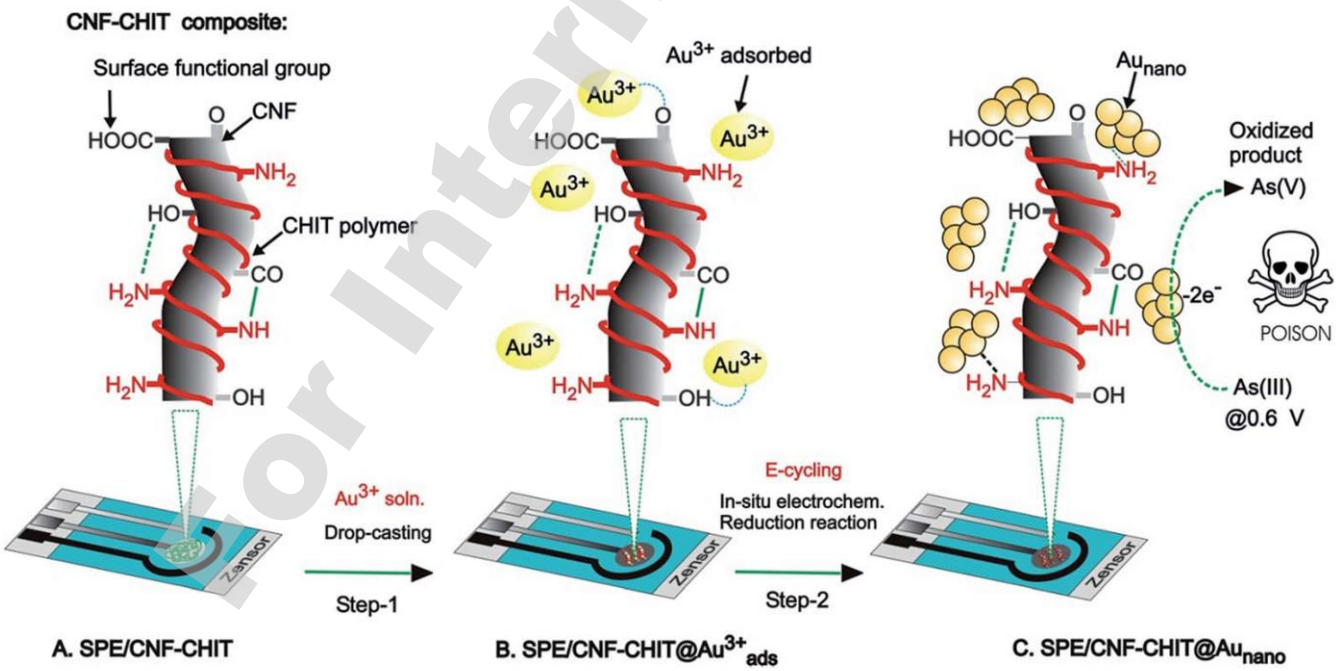

Scheme 1 Schematic representation for the SPE/CNF-CHIT@Au_{nano} modified electrode and its As(III) electrocatalysis (A–C).