Synthesis and Application of Nanocomposite of ZnS, Ni₂P and Reduced Graphene Oxide as Electrochemical Sensor for Determination of Chlorpyrifos in Farmland Water

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This study was performed on the synthesis of ZnS, Ni₂P and reduced graphene oxide (ZnS@Ni₂P/rGO) nanocomposite as an electrochemical sensor of chlorpyrifos (CPS) in farmland recirculated waters. The electrodeposition method was used to modify a glassy carbon electrode (GCE) surface with rGO, ZnS and Ni₂P nanoparticles. Morphological and structural analyses using SEM and XRD showed that defects in rippled nanosheets of rGO on GCE provided the substrate for high porous and high crystalline electrodeposition of ZnS@Ni₂P nanoparticles which led to a higher effective surface area and could effectively promote the electron transfer of the electrode. Results of electrochemical studies using DPV and amperometry indicated sensitive, selective and stable responses of ZnS@Ni₂P/rGO/GCE to the presence of CPS. Results indicated a wide linear response range from 25 to 375 µM with a high sensitivity of 0.89799 µA/µM and a limit of detection of 0.004 µM. Comparison of the obtained sensing properties with the previously reported sensors illustrated the comparable electrochemical performance of ZnS@Ni₂P/rGO/GCE, which was correlated to the high electron transfer rate contributed by the edge-rich architecture of the rGO and catalysis sites of ZnS and Ni₂P nanoparticles. The modified CPS sensor demonstrated good accuracy in prepared real samples of agricultural recirculated water, with appropriate recovery (≥ 92.50%) and RSD (≤ 3.31%) values. Therefore, ZnS@Ni₂P/rGO/GCE can be reliable for the determination of CPS in farmland recirculated water and agricultural wastewater samples.

Keywords: Chlorpyrifos; Nanocomposite; ZnS; Ni₂P; Reduced graphene oxide; Farmland waters; Amperometry

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