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FUNCTIONALIZED GRAPHENE OXIDE – BASED DETECTOR FOR HEAVY METALS

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Abstract

The objective of this study is to create a new electrochemical sensor for the sensitive and specific detection of heavy metal ions (Cu^{2+}, Ni^{2+}, Pb^{2+}, and Mn^{2+}) in water by immobilizing multi-functionalized graphene oxide (f-GO) on a TiO_2 modified fluorine doped tin oxide (FTO) glass electrode. Ammonia, thiourea, glucose, and oxalic acid were used to functionalize the graphene oxide, which was synthesized by modified Hummers process. The addition of amino, thiol, hydroxyl, and carboxyl functional groups enhanced the binding affinity for metal ions. FTIR (Fourier Transform Infrared Spectroscopy) was used to validate successful functionalization. Charge transfer resistance (R_{CT}), which is inversely related to ion concentration, was estimated using Electrochemical Impedance Spectroscopy (EIS) to evaluate the performance of the sensor. The sensor shows the lowest R_{CT} with a highest sensitivity value of $1.04491 \times 10^{-4}\ \Omega^{-1}\ ppm^{-1}\ cm^{-2}$. The estimated detection limits were 2.89 ppm (Ni^{2+}), 1.90 ppm (Pb^{2+}), 3.06 ppm (Cu^{2+}), and 1.78 ppm (Mn^{2+}). Due to its high selectivity for copper ions, the sensor offers a reliable and cost-effective method for detecting harmful heavy metal contamination in water samples.

Keywords*: Charge Transfer Resistance, Detection Limit, EIS, FTO Electrode, Sensitivity, TiO_2, Water Analysis*

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