

Thiol-functionalized multiwall carbon nanotubes for electrochemical sensing of thallium

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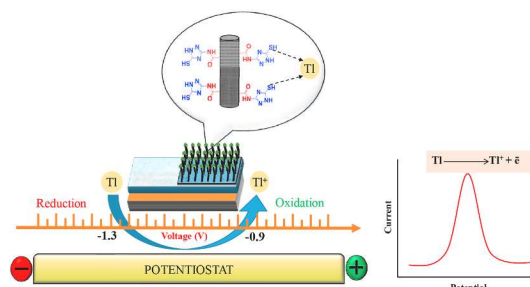
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HIGHLIGHTS

- Highly sensitive modified ITO glass based electrode is developed for thallium detection in this article.
- Thiol groups introduced through chemical modification provided high selectivity and towards thallium.
- The developed sensor showed detection limit ($1.29 \mu\text{g L}^{-1}$) much below than the permissible limit of Tl(I) set by EPA.
- The sensor possesses wide linearity range ($10\text{--}100 \mu\text{g L}^{-1}$) and shows high resistance towards interfering ions.

GRAPHICAL ABSTRACT



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ABSTRACT

An electrochemical sensor is fabricated using indium tin oxide (ITO) electrode loaded with 3-Amino-1,2,4-triazole-5-thiol functionalized multiwall carbon nanotubes (T-MWCNTs) for detection of thallium. The modified MWCNTs were characterized by FTIR spectroscopy, SEM and HRTEM studies. SEM images demonstrated that the width of tubular structure of T-MWCNTs increase considerably after functionalization. The electrochemical response of the prepared sensor is analysed by performing differential pulse anodic stripping voltammetry (DPASV). T-MWCNTs based sensor was found to exhibit good sensitivity and a broad linear range of $10\text{--}100 \mu\text{g L}^{-1}$ along with a limit of detection (LOD) of $1.29 \mu\text{g L}^{-1}$ for Tl(I). The sensor showed good repeatability (RSD of 1.16% and 2.09% for 20 and $50 \mu\text{g L}^{-1}$ concentrations of Tl(I) respectively) and retained $\sim 95\%$ of its response even after 15 days, indicating high stability of T-MWCNTs/ITO/glass electrode towards the detection of thallium. The applicability of the prepared sensor was analysed in real industrial water samples with the help of spiking study that was performed using certified Tl(I) solution traceable to National Institute of Standards and Technology (NIST) and demonstrated a recovery $> 96\%$.

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