Silver/Bismuth/Nafion Modified Pencil Graphite Electrode for Trace Heavy Metal Determination

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A low-cost modified pencil graphite electrode (PGE) was developed for the determination of trace heavy metals in wastewater. Graphite rods (2HB) of 3 mm diameter from a commercial brand of pencils were modified by varying amounts of silver nanoparticles (AgNP) and bismuth (Bi) mixed in a solution of 1% Nafion[®] and isopropanol via the drop coating technique. The PGE modified by 3 mg AgNP and 2 mg Bismuth was deemed the best electrode as it yielded the highest anodic peaks as determined by anodic stripping voltammetry (ASV). By optimizing the ASV parameters, it was determined that the optimum accumulation time and deposition time are 120s and 15s, respectively. The calibration curve was used to determine the limits of detection which were 0.19 parts per billion (ppb) for Cd²⁺ and 0.30 ppb for Pb²⁺ while the limits of quantitation were 568 ppb for Cd²⁺ and 894 ppb for Pb²⁺. The Pearson coefficients of the calibration plots of Cd²⁺ and Pb²⁺ are 0.9822 and 0.9569, respectively. Wastewater samples were collected and analyzed for trace heavy metals using the optimized electrode.

Keywords: anodic stripping voltammetry, pencil graphite electrode, bismuth, silver nanoparticles, Nafion[®]

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