Bismuth Coated Screen-printed Electrode Platform for Greener Anodic Stripping Voltammetric Determination of Cadmium and Lead

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ABSTRACT

A greener electrochemical platform was developed to determine trace amounts of cadmium and lead. It is based on a disposable screen-printed carbon ink electrode modified with an in situ plated bismuth film employed as a more environmentally-friendly working electrode alternative to the widely used mercury electrode. The bismuth coated screen-printed electrode (Bi-SPE) was used for the simultaneous determination of trace Cd(II) and Pb(II) by square-wave anodic stripping voltammetry (SWASV). Operational parameters such as Bi(III) concentration, deposition potential, deposition time and rotation speed during preconcentration of the metals were optimized. The Bi-SPE presented well-defined, reproducible, and sharp stripping voltammograms. Peak current increased linearly with the metal concentration in a range of 5-40 µg L^{-1} for Cd(II) and 2-40 µg L^{-1} for Pb(II). The limits of detection were 1.7 µg L^{-1} for Cd(II) and 0.7 µg L^{-1} for Pb(II), which are better than those of the flame atomic absorption method. The proposed method was successfully applied to determine trace cadmium and lead in river water samples. Accuracy of the developed method was examined by spiking Cd(II) and Pb(II) standard solutions into river water samples, and percentage recoveries were obtained in the range of 86.4-110.6%. The SWASV with the new Bi-SPCE electrode provided advantages, including high sensitivity, low detection limits, low background current, portability, fast and cost-effective determinations, and, importantly, the use of relatively non-toxic chemicals.

Keywords: Bismuth coated screen-printed electrode, Square-wave anodic stripping voltammetry, Cd(II), Pb(II), Water samples