Sensitive Stripping Voltammetric Determination of Pb (II) in Soil Using a Bi/single-walled Carbon Nanotubes-Nafion/ionic Liquid Nanocomposite Modified Screen-Printed Electrode

Ning Liu^{1,2}, Guo Zhao³ and Gang Liu^{1,2,*}

¹ Key Lab of Modern Precision Agriculture System Integration Research, Ministry of Education of China, China Agricultural University, Beijing, 100083, PR China

² Key Lab of Agricultural Information Acquisition Technology, Ministry of Agricultural of China, China Agricultural University, Beijing, 100083, PR China

³ College of Engineering, Nanjing Agricultural University, Nanjing, 210031, PR China

*E-mail: pac@cau.edu.cn

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In this study, Single-Walled Carbon Nanotubes (SWCNTs)-Nafion-Ionic Liquid (IL) composite modified Screen-Printed Electrode (SPE) (SWCNTs-Nafion/IL/SPE) was developed for the sensitive detection of trace Pb (II) in soil using Square Wave Anodic Stripping Voltammetry (SWASV) technique. The Bi/SWCNTs-Nafion/IL/SPE sensor was fabricated by the in-situ plating of bismuth ions on the SWCNTs-Nafion/IL/SPE surface. The morphologies and electrochemical properties of this modified SPE were characterized by Scanning Electron Microscopy (SEM), Cyclic Voltammetry (CV), Electrochemical Impedance Spectroscopy (EIS) and SWASV. The experimental parameters, such as pH value, Bi(III) concentration, deposition potential and deposition time, were optimized. The specific surface area and electron transfer capacity of the modified SPE were improved by the presence of SWCNTs, and the abilities of cation-exchange and metal ions pre-concentration were further enhanced by Nafion. Moreover, the existence of IL increased the conductivity of the composite. The detection limit of the developed sensor was 0.1 µg/L (S/N = 3) in the range of 1.0 to 100.0 µg/L for Pb (II). Finally, the Bi/SWCNTs-Nafion/IL/SPE was applied for detecting Pb (II) in real soil samples and the average recovery of 95.12% was obtained with satisfactory results.

Keywords: Single-Walled Carbon Nanotubes (SWCNTs); Nafion; Ionic Liquid; Square Wave Anodic Stripping Voltammetry (SWASV); Screen-Printed Electrode (SPE); Heavy Metals in Soil.

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