Electrochemical determination of lead & copper ions using thiolated calix[4]arene-modified screen-printed carbon electrode

ABSTRACT

This study used a thiolated calix[4]arene derivative modified on gold nanoparticles and a screen-printed carbon electrode (TC4/AuNPs/SPCE) for Pb2+ and Cu2+ determination. The surface of the modified electrode was characterised via Fourier-transform infrared spectroscopy (FTIR), field emission scanning electron microscopy (FESEM), cyclic voltammetry (CV), and electrochemical impedance spectroscopy (EIS). Differential pulse voltammetry (DPV) was used for the detection of Pb2+ and Cu2+ under optimum conditions. The limit of detection (LOD) for detecting Pb2+ and Cu2+ was 0.7982 × 10−2 ppm and 1.3358 × 10−2 ppm, respectively. Except for Zn2+ and Hg2+, the presence of competitive ions caused little effect on the current response when detecting Pb2+. However, all competitive ions caused a significant drop in the current response when detecting Cu2+, except Ca2+ and Mg2+, suggesting the sensing platform is more selective toward Pb2+ ions rather than copper (Cu2+) ions. The electrochemical sensor demonstrated good reproducibility and excellent stability with a low relative standard deviation (RSD) value in detecting lead and copper ions. Most importantly, the result obtained in the analysis of Pb2+ and Cu2+ had good recovery in river water, demonstrating the applicability of the developed sensor for real samples.

Keyword: Calixarene; Screen printed-carbon electrode (SPCE); Differential pulse voltammetry (DPV); Heavy metal; Lead (Pb2+); Copper (Cu2+)