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Electrode-modified with nanoparticles composed of 4,4'-bipyridine-silver coordination polymer for sensitive determination of Hg(II), Cu(II) and Pb(II)

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A glassy carbon electrode modified with nanoparticles of 4,4-bipyridine-silver coordination polymer was used for highly sensitive analysis of heavy metals (Hg(II), Cu(II) and Pb(II)) by differential pulse voltammetry. The coordination polymers were immobilized on the glassy carbon electrode surface via an organic layer that contains phenylmethyl-4,4'-bipyridinium and coordinated silver ions. The modification method is rapid (an electrode is produced in less than 30 min); electrodes are stable and can be used for the analysis of at least 70 real samples. A glassy carbon electrode (GCE) modified with nanoparticles composed of a 4,4'-bipyridine silver coordination polymer (CP) were applied to the sensitive differential pulse voltammetric analysis of the ions Hg(II), Cu(II) and Pb(II). The coordination polymer was prepared by mixing a solution of silver nitrate and 4,4'-bipyridine at room temperature. The surface of the GCE was modified with an organic layer of synthesized 1-[(4-nitrophenyl)methyl]-4,4'-bipyridinium and silver ions, which caused the binding of the added Ag-bipy-CP. Anodic (oxidative) peaks of the electrode were at +300 mV for Hg(II), -70 mV for Cu(II), and at -540 mV for Pb(II) [versus Ag/AgCl]. The detection limits were 0.09 mg/L Hg(II), 0.71 mg/L Cu(II) and 2.3 mg/L Pb(II). Relative standard deviation was 3.2% at a level of 4 mg L of Hg(II) for n=10. Importantly, the sensitivity and stability of the developed modified electrodes allowed their used for determination of Hg(II) in spiked fish samples and Cu(II), Pb(II), and Hg(II) in spiked plant samples with good recovery 90 to 108%. This study demonstrates the utility of coordination polymers for the development of electrochemical sensors and opens a new area of applications for these versatile materials.

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