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Communication

A voltammetric sensor for simultaneous determination of lead, cadmium and zinc on an activated carbon fiber rod

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Graphical Abstract

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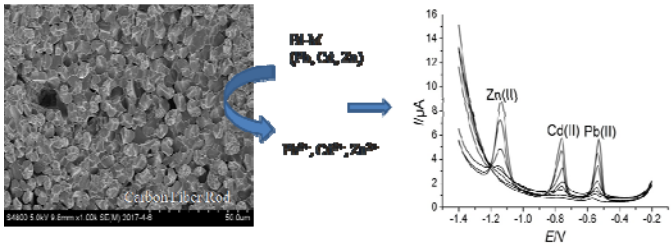

A simple, low cost and sensitive voltammetric sensor was developed for the simultaneous detection of Pb^{2+}, Cd^{2+}, and Zn^{2+} based on a disposable carbon fiber rod (CFR). The important factors to enhance the sensing property were creation of a clean surface by dealing with CFR at a high potential and electrochemical deposition of Bi film to improve the accumulation of heavy metal ions.

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ABSTRACT

In this work, a simple, low cost and sensitive voltammetric sensor was developed for the simultaneous detection of lead (Pb^{2+}), cadmium (Cd^{2+}), and zinc (Zn^{2+}) ions based on a disposable carbon fiber rod (CFR). The important factors to enhance the sensing property were creation of a clean surface by dealing with CFR at a high potential and electrochemical deposition of bismuth (Bi) film to improve the accumulation of heavy metal ions. The morphology and conductivity of such activated CFR was characterized by scanning electron microscopy and electrochemical impedance spectroscopy, respectively. In terms of application, differential pulse anodic stripping voltammetry (DPASV) was employed for the simultaneous detection of Pb^{2+}, Cd^{2+}, and Zn^{2+} on Bi film-coated activated CFR. Experimental parameters, such as the pH value of buffer solution, stirring speed and enrichment factors were optimized. Under optimal conditions, the DPASV peak currents showed good linear relationships with Pb^{2+}, Cd^{2+} and Zn^{2+} concentrations in the range of 0.5-2.25 μg/L, 0.5-4.0 μg/L and 1.0-4.0 μg/L with detection limits of 0.1, 0.3 and 1.0 μg/L (S/N=3), respectively. Finally, the proposed analysis system was successfully utilized for the simultaneous detection of Pb^{2+}, Cd^{2+}, and Zn^{2+} contents in rice samples. This study indicated that Bi film-coated activated CFR based DPASV sensor can be a promising and reliable tool for rapid analysis of emergency pollution affairs of heavy metal ions in food.

Heavy metals, such as lead (Pb), cadmium (Cd), and zinc (Zn), have been long recognized as the most important environmental pollutants for their non-biodegradability and toxicity above certain thresholds [1-3]. Pb and Cd are proved to be a carcinogenic agent and can cause serious damages to body organs (*e.g.* kidney, liver, central nervous system, bone) [4, 5]. Though Zn is classified as one of the essential elements, it can also produce toxic effects when taken at high levels [6]. Rice is one of the main foods in our daily life.