3D printing pen: an alternative tool to fabricate electrochemical sensors applied to Pb^{2+} quantification in remote localization by SWASV.

Renato S.O. Lins (PG)[1], William B. Veloso (PG)[1], Débora N. Medeiros (PG)[1], Lauro A. Pradela-Filho (PQ)[1], Thiago R. L. C Paixão (PQ)[1], Mauro Bertotti (PQ)[1]*

renatolins@usp.br; rsolins@ufam.edu.br

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Highlights

3D printing pen affords the fabrication of low-cost 3D-printed sensors. A promising approach is reported for Pb^{2+} determination in remote localization. The studies were performed in the presence and absence of Bi^{2+}, a chemical modifier.

Resumo/Abstract

Disposable electrochemical systems for heavy metals detection are important for attending remote localizations affected by anthropogenic factors involving mining activities [1]. Herein, electrochemical sensors were developed with a 3D printing pen and poly(methyl methacrylate) mold. The electrodes were printed with Carbon Black/Polylactic Acid (CB/PLA) filaments. The resulting devices, tested as working electrodes (Figure 1A), were applied to Pb^{2+} detection. For electrochemical measurements, a Pt wire was used as an auxiliary electrode (AE) and Ag/AgCl (KCl sat.) as a reference electrode. The square-wave anodic stripping voltammetry (SWASV) was performed in the absence and presence of 1 μmol L^{-1} Bi^{2+}. The results (Figure 1B) showed a lower background current in the presence of Bi^{2+}. Additionally, a remarkable increase (3.7-fold) in the analytical signal was observed in the presence of Bi^{2+}, demonstrating the possibility of using the proposed sensor for Pb^{2+} detection at low concentrations. Therefore, a 3D printing pen affords the fabrication of miniaturized sensors for point-of-need applications. The proposed device will be used to quantify Pb^{2+} in remote locations of the Amazon state. As a result, this project involves the collaboration of the Federal University of Amazon and the University of São Paulo, in agreement with the main purpose of the annual conference of the Brazilian Chemical Society.

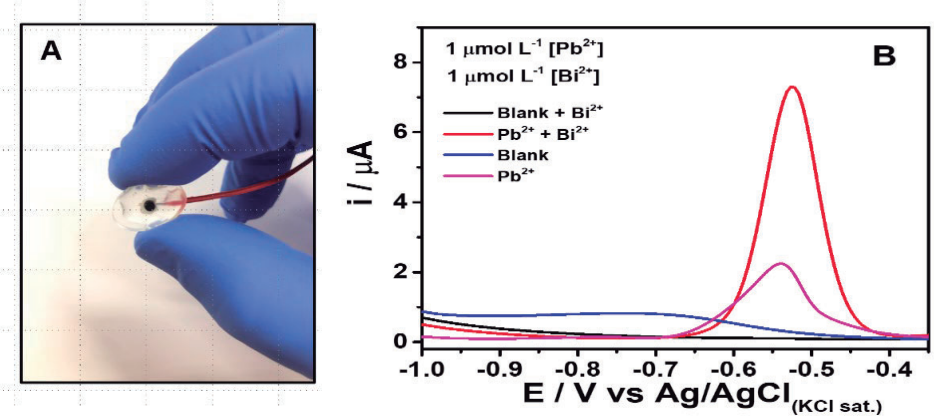

Figure 1. (A) Image of the electrodes. (B) SWASVs recorded in 1 μmol L^{-1} Pb^{2+} solution in the absence and presence of 1 μmol L^{-1} Bi^{2+}. Supporting electrolyte: 0.1 mol L^{-1} acetate buffer (pH 4.5). $E_{deposition}$ -1.2 V; $t_{deposition}$: 80 s $E_{cleaning}$ 0.7 V; $t_{cleaning}$ 15 s; Amplitude: 60 mV; Frequency: 60 Hz; Increment of potential: 5 mV.

[1] Bernalte E, Arévalo S, Pérez-Taborda J, Wenk J, Estrela P, Avila A, Di Lorenzo M, Sensors and Actuators B: Chemical, 307, 2020,127620.

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