Área: ELE

Development of electrochemical sensor using 3D printing pen and commercial conductive filament

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Highlights

3D printing pen simplifies sensor fabrication. The electrodes dispense surface treatment for application. The proposed electrochemical devices are promising platforms for wearable and microfluidic systems.

Resumo/Abstract

3D printing has been extensively used to develop cost-effective electrochemical sensors [1]. Herein, disc electrodes were fabricated with a 3D printing pen, poly(methyl methacrylate) templates, and commercial conductive filament. The filament is based on polylactic acid and carbon black. The resulting materials were tested as working electrodes without any surface treatments. They were characterized using hexaammineruthenium (III) as an electrochemical probe. The printing processing parameters were submitted to optimization studies. They include the thickness and diameters of the electrodes. The diameter was evaluated from 1 to 4 mm. The electrode diameter was restricted by the 3D printing pen's nozzle dimension. Additionally, larger diameters generate small cracks on the electrode surface, affecting their analytical signal. Consequently, 2 mm was the best condition. Even though no signal difference was observed by varying the printing layer between 2 and 3 mm, higher thickness might increase the electrical resistance of the electrodes, compromising their electrochemical response. Considering that 2 mm of thickness allowed the renewal of the electrode surface multiple times, this condition was selected for printing. Under optimized conditions, Figures 1A and B show images of the electrochemical chips. Sharp voltammetric profiles (Figure 1C) are observed for $[Ru(NH_6)]^{2+}/[Ru(NH_6)]^{3+}$. Additionally, the fabrication process is reproducible (RSD = 4%), demonstrating the proposed electrodes are promising materials for sensing applications. Therefore, the analytical applicability of the sensors will be evaluated for caffeine and caffeic acid, thinking in food applications.

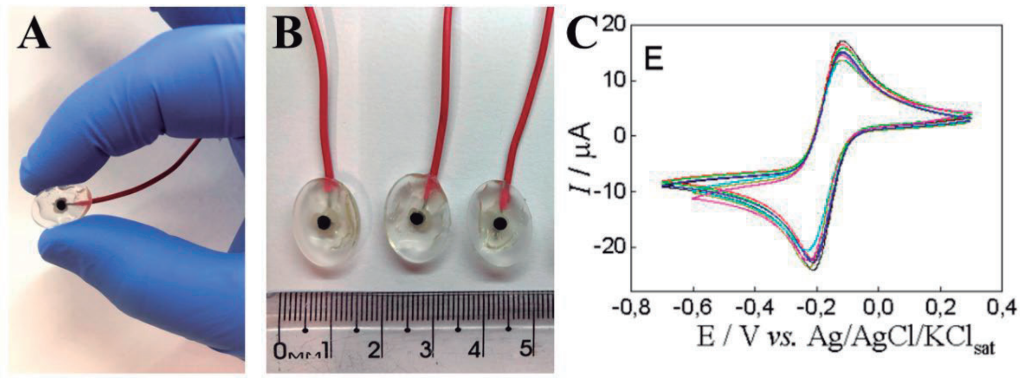

Figure 1. A and B) Electrodes' images. C) Cyclic voltammograms were recorded in 5 mmol L^{-1} $[Ru(NH_6)]^{3+}$ + 1 mol L^{-1} KCl at 50 mV s^{-1}.

[1] A. Ambrosi, M. Pumera, Chem. Soc. Rev. 2016, 45, 2740.

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