XXV SIMPÓSIO BRASILEIRO DE ELETROQUÍMICA E ELETROANALÍTICA

20 a 23 de outubro de 2025
Majestic Hotel - Águas de Lindóia - SP - Brasil

Modified 3D Pen-Printed Electrodes Integrated into a Low-Cost Automated Device for Electrochemical Glutathione Detection

Carlos E. C. Lopes[1], Luiz R. G. Silva[1*], Irlan S. Lima[2], Josué M. Gonçalves[3], Lúcio Angnes[2], Jéssica S. Stefano[1], Luiza M. F. Dantas[1], Iranaldo S. da Silva[1]

[1] *Federal University of Maranhão,*[2]University of São Paulo, [3]Mackenzie Presbyterian Institute

**e-mail: luiz.guterres@ufma.br*

Glutathione is a key antioxidant found in animal, plant, and microbial tissues, with altered levels being associated with several diseases [1]. Therefore, the development of accessible and low-cost detection methods is essential [2]. In this work, we propose a simple and economical electrochemical approach for glutathione determination using electrodes fabricated from a carbon black-based conductive filament. The electrodes were manually produced using a 3D printing pen and reused Falcon tube caps, offering a rapid and flexible alternative to conventional 3D-printed electrode fabrication. The complete electrochemical device was constructed via fused deposition modeling and allows the integration of a repurposed DC motor from an inkjet printer, featuring front inlets for the reference and counter electrodes, as well as for an electronic pipette, and a bottom support for the working electrode (Fig. 1). The sensing surface was modified with a dispersion of carbon black and cobalt phthalocyanine in 20% aqueous ethanol. The modified electrodes were characterized by SEM-EDS, XRD, Raman, and FTIR. Amperometric detection was performed at 0.00 V under constant stirring. The method exhibited a sensitivity of 0.0149 A L mol^{-1}, a linear range from 5.0 to 180.0 µmol L^{-1}, and detection and quantification limits of 1.30 and 4.50 µmol L^{-1}, respectively. The method was successfully applied to fortified protein supplement sample, with recoveries ranging from 90.0% to 98.0%. Owing to its portable design, low cost, and ease of operation, the proposed device is also suitable for on-site glutathione monitoring.

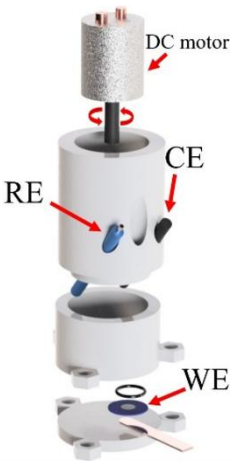

Fig. 1. 3D printed electrochemical device

Acknowledgments:
UFMA, FAPEMA, CAPES, CNPQ.

References:

[1] Hanko, M., et. al., Analytica Chimica Acta, 1062, 1-27, 2019.
[2] Ukirade, N., et. al., Hybrid Advances, 3, e100042, 2023.