Área: ELE

Development of a portable and autonomous potentiostat for field analytical applications

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Highlights

Portable, autonomous potentiostat with a microcontroller and 3D printing. The user-friendly interface allows untrained users to perform multiple electroanalytical techniques with a single button press.

Abstract

Several electrochemical methods have been developed promising application on the field, leveraging on the simple and affordable instrumentation involving electrochemistry. Despite this, most fail to prove this capability, as they still rely on expensive experimental infrastructure in research settings. Although affordable electrochemical sensor fabrication has developed greatly, the instrumentation aspect hasn't followed, particularly in the skill set needed to acquire, treat, and interpret data, which is still done by specialized users even when an affordable potentiostat is used.[1] Here we present the development of an affordable potentiostat, using simple components and an *Arduino Nano* microcontroller board, which can perform several electrochemical methods, including amperometry, cyclic voltammetry (Figure 1A), and square wave voltammetry. Further, the program running in the microcontroller, which controls the potentiostatic circuit, can acquire and store the data in its internal memory, process the signal and interpolate it against a pre-loaded calibration plot, reporting the sample concentration value in an OLED screen (Figure 1B). An internal battery powers the potentiostat, and this entire operation is autonomously performed after the press of a single button, allowing untrained users to perform complex measurements in remote locations. The potentiostat is coupled with a fully 3D printed integrated electrode system (Figure 1C), encompassing the working, pseudo reference, and counter electrode, which can be further modified for selective electrochemical sensing.[2] The combination of an affordable potentiostat with a fully 3D printed sensor allows the entire ensemble to be fabricated in a maker space or a "hobbyist garage," making this a legitimate, affordable platform for performing electrochemical methods at the cost of less than $ 72 per equipment + sensor. Together with the autonomous operation, this affordable instrumentation will help bring many of the developments in "field deployable" electrochemical sensing to fruition.

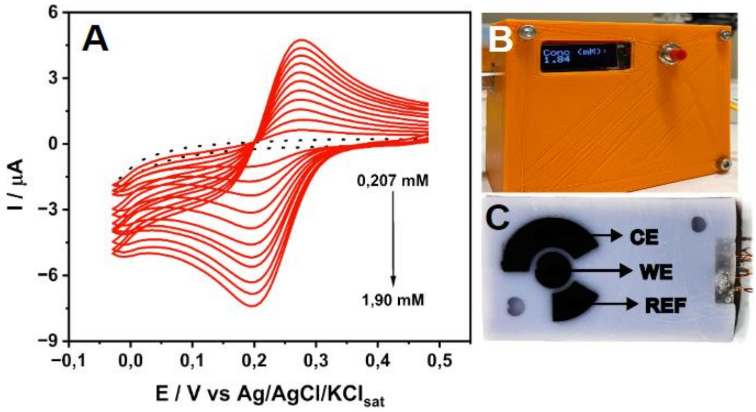

Figure 1: (A) Cyclic voltammograms recorded with the equipment for increasing concentrations of potassium ferricyanide in a 0.2 M KCl solution. The scan rate is 50 mV/s. (B) Quantification of potassium ferricyanide as a proof of concept. The reported value is 1.84 mM, with a nominal concentration of 1.90 mM. (C) 3D-printed integrated electrode system.

References: **(1)** Meloni, G. N. 3D Printed and Microcontrolled: The One Hundred Dollars Scanning Electrochemical Microscope. *Anal. Chem.* ***2017**, 89 (17), 8643–8649*. **(2)** Veloso, W. B.; Ataide, V. N.; Rocha, D. P.; Nogueira, H. P.; de Siervo, A.; Angnes, L.; Muñoz, R. A. A.; Paixão, T. R. L. C. *Microchim. Acta* **2023**, *190* (2), 63.

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