

Influence of Electrical Contact Resistance Compensation on Paper Based Electrodes

Nathália F. B. Azeredo, Thawan G. Oliveira, Caroline M. G. Santos, Claudimir L. Lago, Lúcio Angnes.
Institute of Chemistry. University of Sao Paulo. Brazil.
Av. Prof. Lineu Prestes 748 (Butantã), São Paulo, SP, 05508-000
e-mail address: luangnes@iq.usp.br

In a three-electrode system, uncompensated resistance (R_u) between the working and reference electrodes results in an electrostatic potential drop called iR potential drop, where i is a measured current¹. Ohmic drop is the decrease on the effective potential that a potentiostat applies and measures to the working electrode interface as a result of electric connections². Current compensation in electrochemistry is used to correct the voltage loss (i.e., iR drop) caused by the electrical contact between the working electrode and the reference electrode³. In this sense, our goal was to model the working electrode by adding a second working electrode as a resistor in order to obtain a four-electrode configuration. For this purpose, a new paper-based electrode was designed in Autodesk Fusion software and modified with Graphene-induced by CO₂ laser. The four electrodes' response was evaluated by cyclic voltammetry for three different analytes: dopamine, hexaaminruthenium and potassium ferricyanide. For all the three analytes, the compensating Ohmic current with the four-electrode configuration presented better analytical responses than the respective three-electrode configuration system (Figure 1). Based on our knowledge, this is the first work developed for this purpose on a paper-based platform. These results are correlated with those found in our previous publication using instead 3D-printed electrodes³.

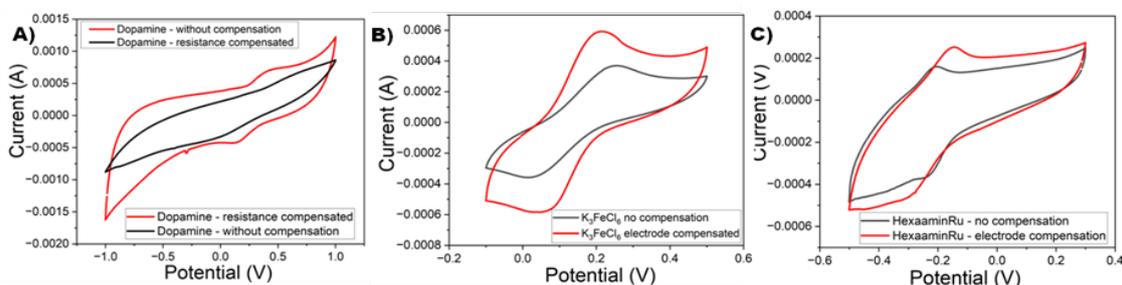


Figure 1. Cyclic Voltammetry performed for the traditional three electrodes configuration in black, and for the proposed four electrodes configuration in red. (A) Additions of dopamine 3 mM. (B) Additions of potassium ferricyanide. (A) Additions of hexaaminruthenium 5 mM.

References:

- [1] Weiran Zheng. iR Compensation for Electrocatalysis Studies: Considerations and Recommendations. *ACS Energy Lett.* 2023, 8, 4, 1952–1958.
- [2] Y. J. Son, R. A. Marquez, K. Kawashima, L. A. Smith, C. E. Chukwunke, J. Babauta, C. B. Mullins. Navigating iR Compensation: Practical Considerations for Accurate Study of Oxygen Evolution Catalytic Electrodes. *ACS Energy Lett.* 2023, 8, 10, 4323–4329
- [3] I. Verlangieri, T. G. Oliveira, F. S. Lopes, I. G. R. Gutz, L. Angnes, C. L. Lago. Handling electric connections in 3D-printed electrodes and sensors. *Microchimica Acta*, 2025, 192:265.

Acknowledgements:

