

Improved detection of therapeutic drugs through electrochemically assisted surface-enhanced Raman spectroscopy (EC-SERS): towards therapeutic drug monitoring

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The performance of therapeutic drug monitoring (TDM) to a wide range of drugs in clinical settings can improve the treatment and recovery of patients [1]. However, today drug routine measurement in clinics requires long time, highly trained personnel, and costly instrumentation. Therefore, the development and implementation of fast, robust and easy to operate methods might advance the applicability of TDM for almost all the drugs. Electrochemically assisted Surface-enhanced Raman spectroscopy (EC-SERS) is a powerful technique for improving the sensitive detection of small molecules, like therapeutic drugs [2]. Although, several physicochemical aspects should be understood and controlled in EC-SERS experiments, it provides robust advantages for high sensitivity detection of TDM compounds. In this work we present a modified EC-SERS assay to improve the sensitivity and label-free detection of TDM compounds, using methotrexate (MTX) and lamotrigine (LTG) as model drugs. Our approach consisted of an electrochemical surface modification of the SERS substrate, an ordered Au nanopillar (NP) chip, that helped to bring the therapeutic drugs closer to the surface and thus boosting the vibrational bonds. This approach allowed us to acquire robust SERS mapping of the analyte, reproducible measurements and improve the sensitivity detection (Figure 1). In this method MTX was possible to be detected lower than 0.25 μM , while LTG was detected as low as 0.5 μM in electrolytic media. In conclusion, this approach shows a promising strategy for improving the sensitivity detection of therapeutic drugs under a modified EC-SERS approach that might advance the implementation of TDM point-of-care in clinical use.

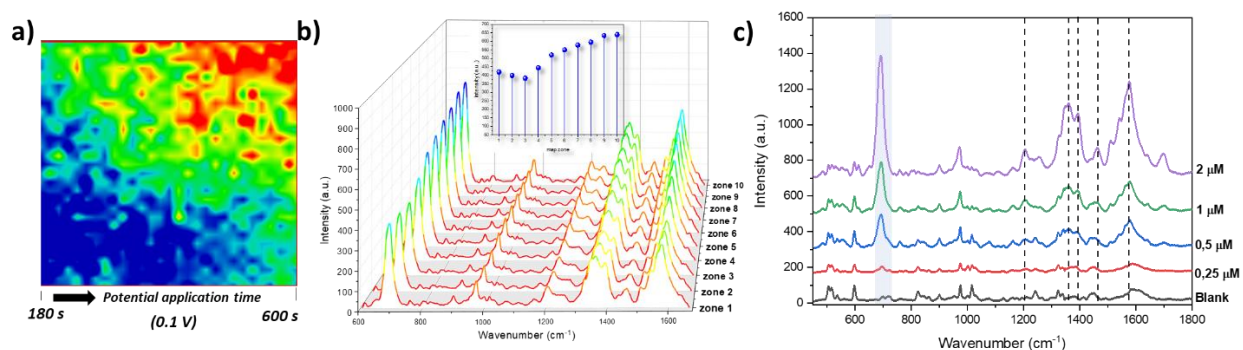


Figure 1: a) Heat map of MTX main band under EC-SERS measurement. b) Spectral distribution of MTX in the SERS map. c) SERS profile of MTX at different concentrations under the modified EC-SERS method.

References

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- [2] Brosseau CL, Colina A, Perales-Rondon JV, Wilson AJ, Joshi PB, Ren B, Wang X, Electrochemical surface-enhanced Raman spectroscopy, *Nature Reviews Methods* (2023); **3**, 79.