PÔSTER - RESUMO - SENSORES E BIOSSENSORES

ENGINEERING CARBON INTERFACES WITH SHAPE-CONTROLLED GOLD NANOPARTICLES FOR ELECTROCHEMICAL SERS DETECTION OF PESTICIDES

Theo Carracedo (theo.carracedo@usp.br)

Vitor Rithery Oliveira Cavalari (vitor.rithery@unifesp.br)

Vinícius Matheus Silva Macedo (vinicius.matheus@usp.br)

Laura Péres (laura.peres@unifesp.br)

Rodrigo M. Iost (rodrigoiost@iq.usp.br)

Theo Carracedo (1), Vitor R.O. Cavalari (1,2), Vinicius M. S. Macedo (1), Laura O. Péres (2), and Rodrigo M. Iost (1)

(1) University of São Paulo, Institute of Chemistry, Molecular Spectroscopy Laboratory, São Paulo, Brazil

(2) Federal University of São Paulo, Laboratory of Hybrid Materials, Diadema, São Paulo, Brazil

e-mail: theo.carracedo@usp.br

Abstract: The intensive use of pesticides in modern agriculture has raised serious environmental and public health concerns, demanding the development of ultrasensitive and selective analytical platforms for their detection [1]. Among emerging strategies, the integration of electrochemistry with surface-enhanced Raman spectroscopy (SERS) has attracted increasing attention due to its capability to combine molecular fingerprinting with electrochemical control. In this context, engineering carbon-based interfaces decorated with plasmonic nanostructures (gold nanoparticles)[2] represents a promising route to enhance detection performance [3]. In this study, we report the design and fabrication of engineered carbon interfaces modified with shape-controlled gold nanoparticles for electrochemical SERS investigation of pesticide molecules on the nanostructured interfaces. This integrated EC-SERS platform is designed to be a versatile analytical tool with potential applications in environmental monitoring of water sources and food safety screening for pesticide residues in agricultural products. Looking forward, the project will first validate the sensor's performance through systematic electrochemical and spectroscopic characterization, followed by testing its sensitivity and selectivity towards target pesticides like thiram and paraquat. This roadmap aims to advance the platform towards smart, on-site diagnostic systems for precision agriculture and environmental stewardship. The choice of shape-controlled gold nanoparticles (AuNPs) as the plasmonic component is strategic due to their unique and tunable properties. Gold offers exceptional chemical stability in electrochemical environments and biocompatibility, preventing interference and degradation during analysis. Most importantly, the localized surface plasmon

resonance (LSPR) of AuNPs provides the intense electromagnetic field enhancement necessary for SERS detection. By precisely controlling nanoparticle shape (e.g., spheres, rods, triangles), we can engineer their LSPR peaks to match the laser excitation wavelength, maximizing the SERS signal. Furthermore, different facets and geometries exposed by various shapes can influence adsorption kinetics and favor the binding of specific pesticide molecules, thereby enhancing both sensitivity and selectivity of the integrated EC-SERS platform. Future work will then focus on expanding the library of detectable agrochemicals by tuning nanoparticle composition and morphology,integrating the platform into microfluidic devices for field-deployable analysis, and exploring machine learning algorithms for the automated interpretation of multiplexed EC-SERS spectra.

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