PÔSTER - RESUMO - SENSORES E BIOSSENSORES

SENSING PESTICIDE RESIDUES USING EGOFETS FUNCTIONALIZED WITH MIPS

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The extensive use of pesticides in Brazil, which reached 755 tons in 2023, highlights the urgent need for monitoring technologies capable of detecting residues at trace levels (sub-ppm) to ensure food safety and public health [1]. Although methods such as High-Performance Liquid Chromatograph (HPLC) and Enzyme-Linked Immunosorbent Assay (ELISA) are highly precise, their high cost and requirement for laboratory infrastructure limit large-scale and field applications [2], favoring the development of portable sensors based on Electrolyte-Gated Field Effect Transistors (EGOFETs) [3]. This project emerges from a collaboration between the University of São Paulo (USP) and Brazilian Nanotechnology National Laboratory (LNNano) - Brazilian Center for Research in Energy and Materials (CNPEM) and proposes an innovative platform that integrates EGOFETs with Molecularly Imprinted Polymers (MIPs) for the selective detection of pesticides such as Acetamiprid, Glyphosate, Carbofuran and Carbendazim. The MIPs function as low-cost, highly stable biomimetic receptors, capable of recognizing specific analytes in complex matrices through molecular-scale cavities interactions. The research investigates the impact of

the electrical properties of the MIP matrices — comparing insulating polymers, such as polyacrylamide derivatives, and conductive polymers, such as polypyrrole — on signal transduction efficiency and biosensor sensitivity. The methodological approach encompasses the selection of priority target molecules defined by the PARA/ANVISA program, physicochemical characterization of materials, and functionalization of gate electrodes. To enhance analytical reliability in the presence of interferents on real samples of water and food extracts, the study will incorporate Machine Learning for data processing and pattern detection in large datasets. Ultimately, the project aims to demonstrate that the EGOFET/MIP architecture is a robust, miniaturized, and high-sensitivity and selective solution, contributing to the advancement of organic electronics applied to environmental monitoring, filling a technological gap in the detection of contaminants at sub-ppm levels, with the potential for integration into easy-to-operate portable electronic devices.

References:

[1] IBAMA. Relatórios de comercialização de agrotóxicos. 2024.

[2] Samsidar, A.; Siddiquee, S.; Shaarani, S. M. Trends Food Sci. Technol., v. 71, p. 188-201, 2018.

[3] Lelis, G. C. et al. ACS Appl. Mater. Interfaces, v. 17, n. 10, p. 12990-13000, 2025.

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Palavras-chave: electrolyte-gated organic field-effect transistors (egofets); molecularly imprinted polymers (mips); pesticide detection.