PÔSTER - RESUMO - SENSORES E BIOSSENSORES

NANOSTRUCTURED THIOPHENE-FLUORENE CONJUGATED POLYMER INTERFACES FOR ELECTROCHEMICAL DETECTION OF CD^{2+} AND CU^{2+}

Giovana Artuzo Parolin (giovana.parolin@ufscar.br)

Laura Péres (laura.peres@unifesp.br)

Marystela Ferreira (marystela@ufscar.br)

Conjugated polymer nanoparticles (CPN) have emerged as versatile materials in organic electronics owing to their remarkable optical and physicochemical properties, as well as their tunable electronic structure [1]. These characteristics make them highly attractive for sensing applications. In this context, the development of selective and sensitive electrochemical sensors for the detection of heavy metals, such as Cd2+ and Cu2+, which pose significant risks to the environment and human health [2], is of great importance. The incorporation of nanostructured materials represents a promising strategy to enhance electrochemical response and operational stability. In this work, nanoparticles of a thiophene-fluorene-based copolymer derivative were employed as active material in an electrochemical sensor, providing a high surface area and a large density of reactive groups and active sites, and, consequently, promoting improved adsorption of metal ions, facilitating electron transfer, and enhancing electrochemical reactions, potentially leading to superior sensor performance. The CPNs were prepared by the nanoprecipitation method [3] and subsequently deposited onto a graphite electrode (gPBAT) using the layer-by-layer (LbL) assembly technique. Six bilayers were constructed by alternating the deposition of the CPNs with the

polyelectrolyte poly(ethyleneimine) (PEI), enabling controlled film growth and improved surface organization. The modified electrodes were characterized by square wave voltammetry (SWV) in buffer solution (PBS) to construct analytical calibration curves for Cd2+ and Cu2+ detection. In addition, recovery tests were performed to evaluate the applicability of the proposed sensing platform. The modified electrodes exhibited well-defined oxidation peaks for Cd2+ at approximately -0.55 V, and +0.15V for Cu2+, and concentration-dependent SWV responses for both metals. A linear analytical response was observed in the investigated range, with sensitivities of 1.66 and 1.11 mA cm-2 mM-1 for Cd2+ and Cu2+, respectively. The higher sensitivity toward Cd2+ is likely associated with stronger coordination interactions between the metal ions and sulfur-containing sites of the conjugated polymer backbone. Recovery tests demonstrated reliable analytical performance, particularly for Cu2+ at lower concentrations. These results highlight the effectiveness of thiophene–fluorene-based conjugated polymer nanoparticles as active platforms for heavy metal electrochemical sensing.

Acknowledgements:

INEO, Capes (Finance Code 001), FAPESP (2025/27044-5, 2014/50869-6), and CNPq (408449/2024-1, 311562/2023-0).

References:

[1] H. Zhang, et al., Nanoscale, 17, 2386-2407 (2025);

[2] T. Hu, et al., Sensors, 23, 4125-4141 (2023);

[3] G. A. Parolin, et al., ACS Appl. Nano Mater., 8 (35), 17329-17338 (2025).

Palavras-chave: conjugated polymer nanoparticles; electrochemical sensor; metal detection; square wave voltammetry; electrochemical sensing; layer-by-layer films.