DEVELOPMENT OF A MULTILAYERED, MOLECULARLY IMPRINTED POLYMER-BASED ELECTROCHEMICAL SENSOR FOR TETRACYCLINE DETECTION

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The widespread use of antibiotics, such as tetracycline, has resulted in persistent drug residues in the environment, which require monitoring to evaluate pollution levels. Molecularly imprinted polymer (MIP)–based sensors are considered a robust, low-cost, and easy-to-use solution for the development of analytical systems for the detection of various analytes [1,2]. The introduction of interfacial underlayers, such as self-assembled monolayers, between the electrode and the MIP layer enables the tuning of MIP properties [3].

In this work, a multilayered MIP sensor was constructed on a screen-printed carbon electrode (SPCE) platform. The SPCE was modified by drop-casting a poly(3,4-ethylenedioxythiophene):polystyrene sulfonate (PEDOT:PSS) mixture as an underlayer to tune charge-transfer characteristics. Subsequently, a molecularly imprinted polypyrrole (MIP-Ppy) layer, using tetracycline as the template, was electrochemically synthesized on the PEDOT:PSS/SPCE surface. A non-imprinted polypyrrole (NIP-Ppy) layer was prepared under identical conditions to demonstrate imprinting selectivity. The rebinding of tetracycline to the MIP/PEDOT:PSS/SPCE sensor was carried out in an acetate medium and was evaluated using electrochemical impedance spectroscopy.

The constructed sensor enabled the detection of tetracycline at micromolar concentrations. The proposed multilayered, easy-to-fabricate, MIP-based electrochemical sensor demonstrates promising potential for application in the environmental monitoring of antibiotic residues.

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