Poster 29

Molecularly Imprinted polypyrrole polymers: A strategy for the determination of glyphosate in real samples.

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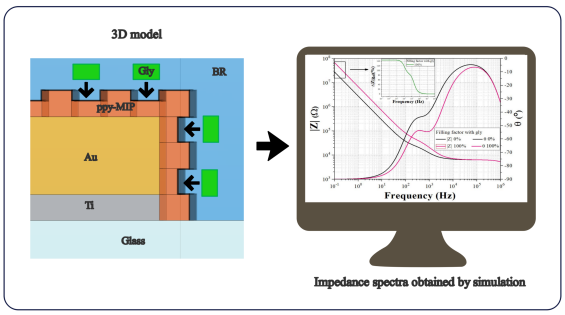
Molecularly imprinted polymers (MIPs) coupled with electrochemical transducers enable selective, low-cost, and portable detection of glyphosate in environmental and food samples. MIPs create recognition sites complementary to glyphosate's structure, ensuring high selectivity even in complex matrices. When integrated onto screen-printed or metal electrodes, they produce measurable electrochemical signals, i.e., current, potential, or impedance, upon glyphosate binding. Recent advances, including electroactive MIP films [1], surface-imprinted polypyrrole nanotubes [2], and nanomaterial-enhanced composites [3], have achieved low detection limits (ng·L^{-1} - nM), good reproducibility (RSD < 5–7%), and successful application to real water and food samples with minimal pretreatment. These systems complement chromatographic methods by providing faster, cheaper, and simpler on-site monitoring. Key challenges remain, including matrix interferences, fouling, stability, and validation against reference methods, but ongoing improvements in imprinting chemistry and device integration are driving progress toward reliable field-deployable sensors.

This study employs a polypyrrole-based molecularly imprinted polymer (MIP) as a recognition layer for glyphosate detection in real samples. The MIP was synthesized via electropolymerization followed by overoxidation and characterized using Electrochemical Impedance Spectroscopy (EIS) across different frequencies. Real sample concentrations (0, 0.41, and 0.51 ng/mL) were analyzed sequentially on the same sensor. The impedance magnitude changes with increasing glyphosate concentration, reflecting changes in the MIP's electrical properties, and confirming that the imprinted sites promote glyphosate incorporation within the polymer matrix and achieving detection of concentrations as low as 0.1 pg/mL. Graphical abstract illustrating glyphosate detection via a polypyrrole-based molecularly imprinted polymer using electrochemical impedance spectroscopy [4].



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