

**Capacitive sensing of amphetaminetype stimulants based on immobilized molecular imprinted polymers**

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Synthetic drugs are one of the most significant current drug problems worldwide. Amphetamine-Type Stimulants (ATS) are globally the second most widely used drugs after cannabis, exceeding the use of cocaine and heroin. ATS are potent central nervous system (CNS) stimulants, capable of inducing euphoric state similar to cocaine. ATS production contributes to environmental pollution, so there is a demand to develop robust and sensitive detection system for ATS in environmental water samples.

To perform continuous monitoring, the detecting unit must be submerged directly into the sample or furnish a constant flow-through approach. A possible application is the monitoring of drugs in wastewater which can be used to estimate drug consumption and is called sewage epidemiology.

A highly sensitive capacitive biosensor was developed to monitor trace amounts of an amphetamine derivative in aqueous samples. The sensing element is a gold electrode with molecular imprinted polymer (MIP) immobilized on its surface. A continuous-flow system with timed injections was used to simulate flowing waterways, such as sewers, springs, rivers, etc., ensuring wide applicability of the developed product. MIPs, implemented as a recognition element due to their stability under harsh environmental conditions, were synthesized using thermo- and UV-initiated polymerization techniques. The obtained particles were compared against commercially available MIP according to specificity and selectivity metrics; commercial MIPs were characterized by quite broad cross-reactivity to other structurally related amphetamine-type stimulants. After the best batch of MIPs was chosen, different strategies for immobilizing them on the gold electrode's surface were evaluated, and their stability under extreme environmental conditions was also verified. The complete, developed system was validated through analysis of spiked samples. The limit of detection (LOD) for N-formyl amphetamine was determined to be 10 μM in this capacitive biosensor system. Designed polymers demonstrated good recognition properties and stability and could be recommended for analysis of real samples. The results obtained indicate possible applications of this MIPs-based capacitive biosensor for analytical and forensic analysis.

To the best of our knowledge there are no existing MIPs-based sensors toward amphetamine-type stimulants (ATS). The development of new robust chemical receptor, for illicit drug detection reported in this paper could be beneficial for analytical and forensic sciences.

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