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Design of synthetic receptors for monitoring of ATS-based stimulants

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Motivation

• The thread of **synthetic drugs** is one of the **most significant current drug problems** worldwide. **Amphetamine-Type Stimulants (ATS**) are globally second most widely used drugs after cannabis.

• ATS production **contributes to environment pollution**, so there is a **demand to develop robust and sensitive sensors** that can detect ATS and in environmental water samples.

• **Molecular imprinted polymers (MIPs)** have been implemented as sensing layer. MIPs are characterized with a **high mechanical and thermal stability**, show chemical resistance in a **broad pH.** These properties make them the preferred type of receptors for this application.

Principle of the method

• MIPs are polymers that has been processed using the **molecular imprinting technique** which leaves cavities in polymer matrix with **affinity to a chosen "template"** molecule.

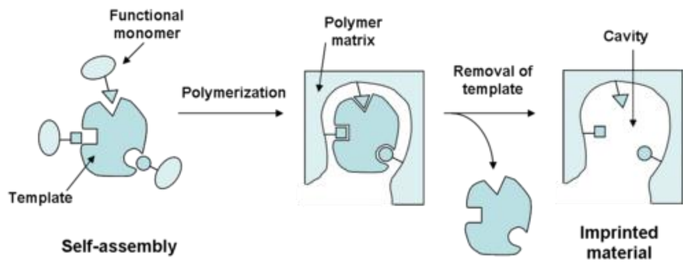

Fig. 1 Molecular imprinted polymers

• Capacitive sensor utilized in this research is based on **capacitance measurement** on the electrode/solution interface.

• When electrode is immersed in the aqueous solution, **electrode surface becomes charged** due to differences in electron (or ion) affinities between the solid surface and the solution or the ionization of surface groups.

• This results in a **strong interaction** between solution molecules and electrode sensing layer. **Electrical double layer (EDL)** is formed at the surface interface.

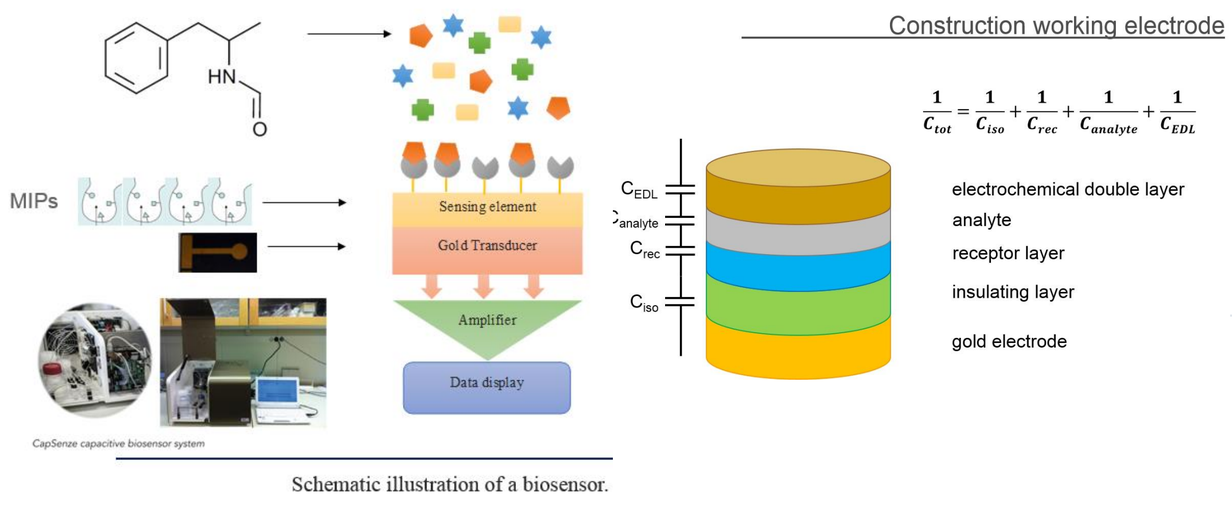

Fig. 2 Capacitance sensor pronciple(left) based on electrical double layer theory(right)

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Results

• **MIPs specific for ATS were synthesized** using two different techniques, thermo and UV-initiated polymerization.

•Subsequently, **comparision with commercialy available MIPs** for amphetamine was performed in point of specificity and cross reactivity

• **Different linkers** and immobilization techniques were examined to choose optimal method.

• Obtained results gave conclusion about **MIPs based sensor** applicability.

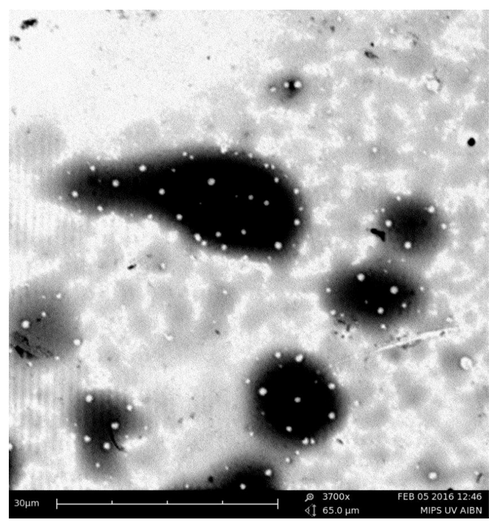

Fig. 3 SEM picture ot the electrode surface after functionalization with imprinted polymers synthesized via UV polymerization

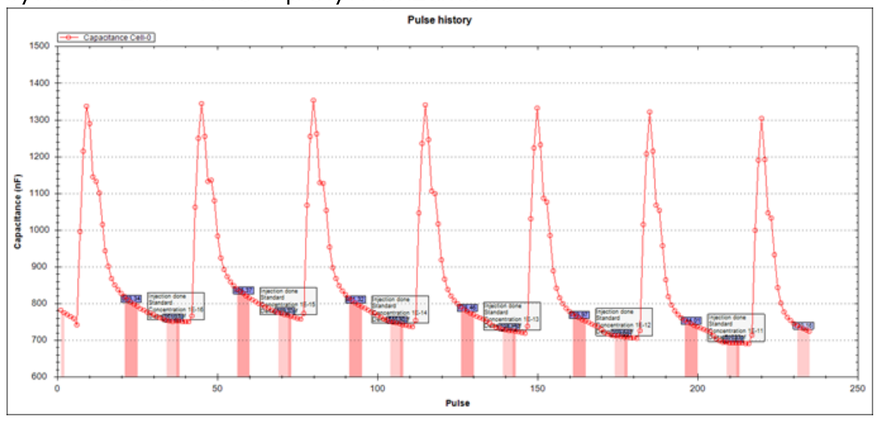

Fig. 4 Picture of capacitive sensor output. Presented pulse history was obtained with thermo initiaded MIPs immobilized on gold electrode; concentrations of injected standards were 0, 25, 50, 100, 150, 200 µM of N-formyoamphetamine (N-FA)

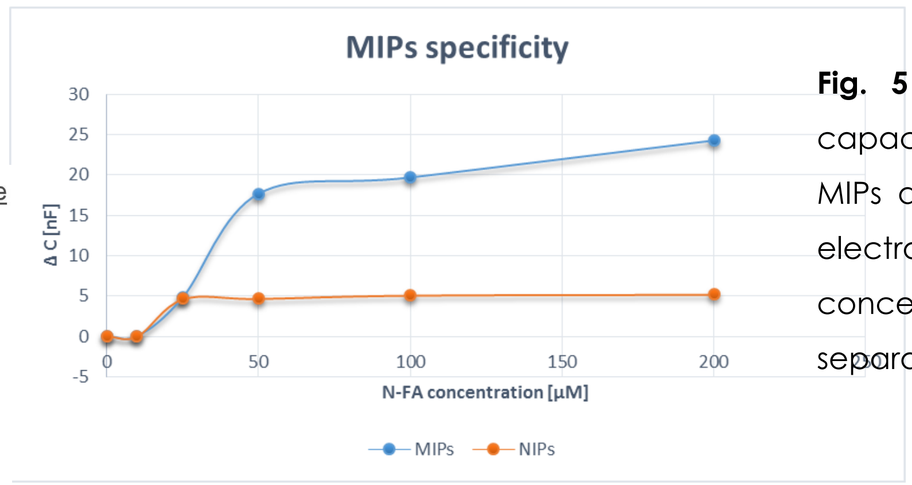

Fig. 5 Differences between capacitance changes (nF) of MIPs and NIPs functionalized electrode in function of concentration (µM) for separate injections

Conclusions

• Two different approaches for ATS specific **MIPs and NIPs synthesis**, thermo and UV initiated polymerization, were elaborated and investigated.

• **Commercial MIPs** were attached to electrode by electro-polymerization and tested the same way as synthesized particles.

• Test performed with **extreme pH** resulted in capacitance disturbances, method needs further optimization.

• Even though UV based method resulted in betterr insulation of electrodes, experiments performed with capacitance measurement show **higher specificity for thermo-initiated MIPs**.