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# Comparison of a Capacitive Sensor Functionalized with Natural or Synthetic Receptors Selective towards Benzo(a)Pyrene

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**Abstract :** In recent years polycyclic aromatic hydrocarbons (PAHs), which represent a hazard to humans and entire ecosystem, have been receiving an increased interest due to their mutagenic, carcinogenic and endocrine disrupting properties. They are formed in all incomplete combustion processes of organic matter and, as a consequence, ubiquitous in the environment. Benzo(a)pyrene (BaP) is on the priority list published by the Environmental Agency (US EPA) as the first PAH to be identified as a carcinogen and has often been used as a marker for PAHs contamination in general. It can be found in different types of water samples, therefore, the European Commission set up a limit value of 10 ng L–1 (10 ppt) for BAP in water intended for human consumption. Generally, different chromatographic techniques are used for PAHs determination, but these assays require pre-concentration of analyte, create large amounts of solvent waste, and are relatively time consuming and difficult to perform on-site. An alternative robust, stand-alone, and preferably cheap solution is needed. For example, a sensing unit which can be submerged in a river to monitor and continuously sample BaP. An affinity sensor based on capacitive transduction was developed. Natural antibodies or their synthetic analogues can be used as ligands. Ideally the sensor should operate independently over a longer period of time, e.g. several weeks or months, therefore the use of molecularly imprinted polymers (MIPs) was discussed. MIPs are synthetic antibodies which are selective for a chosen target molecule. Their robustness allows application in environments for which biological recognition elements are unsuitable or denature. They can be reused multiple times, which is essential to meet the stand-alone requirement. BaP is a highly lipophilic compound and does not contain any functional groups in its structure, thus excluding non-covalent imprinting methods based on ionic interactions. Instead, the MIPs syntheses were based on non-covalent hydrophobic and π-π interactions. Different polymerization strategies were compared and the best results were demonstrated by the MIPs produced using electropolymerization. 4-vinylpyridin (VP) and divinylbenzene (DVB) were used as monomer and cross-linker in the polymerization reaction. The selectivity and recovery of the MIP were compared to a non-imprinted polymer (NIP). Electrodes were functionalized with natural receptor (monoclonal anti-BaP antibody) and with MIPs selective towards BaP. Different sets of electrodes were evaluated and their properties such as sensitivity, selectivity and linear range were determined and compared. It was found that both receptor can reach the cut-off level comparable to the established ML, and despite the fact that the antibody showed the better cross-reactivity and affinity, MIPs were more convenient receptor due to their ability to regenerate and stability in river till 7 days.

**Keywords :** antibody, benzo(a)pyrene, capacitive sensor, MIPs, river water
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