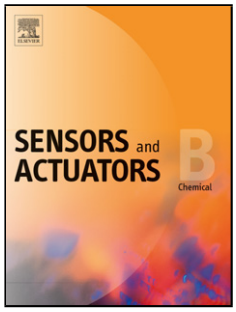

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Nano-MIP based sensor for penicillin G: Sensitive layer and analytical validation

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Highlights

- The first combination of nano-MIPs as sensitive layer and Reflectometric Interference Spectroscopy as direct optical sensing method for the quick and easy readout of PenG concentrations.
- A novel synthesis of Penicillin G imprinted polymer nanoparticles via inverse miniemulsion polymerization.
- Azide modification and covalently immobilization of molecularly imprinted poylmers on a transducer surface using click chemistry.

Abstract

We herein report the synthesis of novel Penicillin G (PenG) imprinted polymer nanoparticles (MIPs) via inverse miniemulsion polymerization. Nanoscaled co-polymer particles consisting of N-(2-aminoethyl) methacrylamide hydrochloride as functional monomer and N,N'-Ethylenebisacrylamide as crosslinker have been synthesized in the presence of PenG. These particles have been applied to form a sensitive layer for label-free direct optical sensing of Penicillin G. As reference material non-imprinted particles (NIPs) were used. The particles were characterized via scanning electron microscopy (SEM) and dynamic light scattering (DLS). Particles in the size of ≈400 nm (z-average) and a low polydispersity index (PDI < 0.05) were observed. Azide modified MIPs/NIPs were covalently immobilized on alkyne-modified glass transducers by Cu(I) catalyzed 1,3-dipolar cycloaddition. The resulting particle-modified transducers served as sensing layer in an optical sensor setup (Reflectomteric Interference Spectroscopy - RIfS). To prove its reliability and stability the transducer was tested in 78 reproducible PenG measurements over the course of 26 h. The response time of the sensor was ≈1 minute. For sensor calibration 14 randomized triplicate concentration dependency measurements for MIP and NIP transducers were conducted with different PenG concentrations ranging from 0.0015 – 0.0195 mol/L. MIP binding signals were significantly higher compared to the NIP. Determined recovery rates of three different transducers were in the range of 70-120 % which indicates a good chip to chip reproducibility. Sensor cross sensitivities between PenG and its structural buildings blocks phenylacetic acid and 6-aminopenicillanic acid were evaluated indicating a high selectivity for the presented sensor system.