PIEZOELECTRIC BIOSENSORS FOR POLYCHLORINATED BIPHENYLS OPERATING IN AQUEOUS AND ORGANIC PHASES

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A novel piezoelectric immunosensor for the determination of polychlorinated biphenyls (PCBs) is described. In the direct assay format adopted, we used sheep anti-PCB antibody immobilized on the surface of optically smooth gold electrodes, which were vacuum deposited on quartz crystal resonators. The sensing surface was first modified with a self-assembled monolayer of dithiobis(succinimidyl thio-propionic acid) allowing for a covalent attach-ment of Protein A. This biolayer served then for the oriented immobilization of the antibody to form a complex, further stabilized by cross-linking with dimethyl pimelimidate. In order to increase the amount of binding sites at the sensing surface, several layers of streptavidin and biotinylated antibody were alternatively deposited on the sensing surface.

The immunosensors were employed in a flow-through setup. The interaction with several PCB congeners was successfully observed in aqueous phase (phosphate buffer containing 5% of DMSO, dimethyl sulphoxide); the changes of frequency (10 min binding of 20 mg/L of PCB) were 120, 48 and 18.5 Hz for 2,4,4‘-trichlorobiphenyl (TCB), 4,4‘-dichloro-biphenyl (DCB) and 3,3‘,4,4‘-tetrachloro-biphenyl, respectively. Though spontaneous dissociation of the PCB-antibody immuno-complexes was observed, much faster regenera-tion of the sensing surface was achieved using 20% acetone in phosphate buffer.

The performance of the immunosensor was further tested in pure organic solvents including DMSO, acetone, toluene and dichloromethane. The direct assay was performed similarly as in the aqueous phase. In order to improve the measured responses, a special tracer was used – the conjugate of PCB molecule and polystyrene particles; tracer and free PCB should compete in the organic phase for the binding sites of the immobilized antibody. The polystyrene particle functioned as a heavy tag providing enhanced response in the nanobalance system. The piezoelectric biosensor appeared as a convenient transducer allowing for a real-time observation of the specific affinity interactions in organic solvents.