Thermal based detection of Bisphenol A by incorporating molecularly imprinted polymers

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The Heat-Transfer Method (HTM) is a promising transducing technique capable of performing a broad range of bioanalytical tasks. To demonstrate the capabilities of the sensor, experiments on the detection of Bisphenol A (BPA) in a buffer solution have been executed. Hereby bulk polymerized Molecularly Imprinted Polymers (MIPs) have been used as the biomimetic receptor.

The sensor consists out of a planar heater. During measurements, the heater is maintained at constant temperature (T1) by applying a controlled power (P). Directly on the heating structure sits an aluminum substrate, functionalized with a MIP layer. On top of the substrate, a 90 µL PMMA flow cell is placed through which the analyte can be flushed. A mechanically secured thermocouple continuously monitors the temperature (T2) in the fluid at a fixed height above the heater. A relative value for the thermal resistance (Rth) between T1 an T2 can be calculated as: $R_{th} = (T1-T2) / P$

Depending on the concentration of target molecules in the matrix, more molecules will bind with the MIP. According to the pore blocking principle, an increase in concentration of target molecules increases the Rth. In order to inspect the influence of nonspecific bindings or the matrix, the measurement was repeated with a substrate coated with Non Imprinted Polymers (NIP) In this case there should not be a correlation between Rth and the concentration of target molecules.

For both the MIP and NIP measurements, buffer solutions spiked with up to 50 ppm BPA have been flushed trough the flow cell. For the MIP measurements, a clear response of Rth to increasing concentrations of BPA were observed. Hereby the detection limit was in the lower ppm range. The NIP measurements showed no response to increasing BPA concentrations.

By using a thermal readout method in combination with MIPs, it was possible to detect BPA in a buffer solution down to a lower ppm level. Similar measurements performed with a NIP coated substrate verified that the increase of Rth was caused by specific binding rather than nonspecific binding, or differences in Rth of the matrix.