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Molecular imprinted polymer-coated optical fiber sensor for the identification of low molecular weight molecules

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Abstract:

A biomimetic optical probe for detecting low molecular weight molecules (maltol, 3-hydroxy-2-methyl-4H-pyran-4-one, molecular weight of 126.11 g/mol), was designed, fabricated, and characterized. The sensor couples a molecular imprinted polymer (MIP) and the Bragg grating refractometry technology into an optical fiber. The probe is fabricated first by inscribing tilted grating planes in the core of the fiber, and then by photopolymerization to immobilize a maltol imprinted MIP on the fiber cladding surface over the Bragg grating. The sensor response to the presence of maltol in different media is obtained by spectral interrogation of the fiber transmission signal. The results showed that the limit of detection of the sensor reached 1ng/mL in pure water with a sensitivity of 6.3 10^8 pm/M. The selectivity of the sensor against other compounds and its reusability were also studied experimentally. Finally, the unambiguous detection of concentrations as little as 10 nM of maltol in complex media (real food samples) by the MIP-coated tilted fiber Bragg grating sensor was demonstrated.

Keyword: Chemical probe, Maltol, Molecular imprinted polymer, Tilted fiber Bragg grating

Introduction

The rapid and sensitive detection of analytes at low concentrations has become important in many fields such as medicine, environmental monitoring and food safety. Many devices have been developed to detect binding events but the current challenge is to design simple, inexpensive, accurate, sensitive and reliable sensors [1-3]. In this context, sensing layers are crucially needed. Biological materials are often used to detect binding events, for instance enzyme-linked immunosorbent assay (ELISA) and antibodies. But over the last few decades, molecular imprinting has also been extensively developed and used for