In-line Tapered Optical Fiber Mach-Zehnder Interferometer for Biosensing Applications

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ABSTRACT: Novel biosensing technologies with high degree of integration, portability, and flexibility attract significant attention for a wide range of applications in pharmaceutics and biomedical science. Photonics technologies play a significant role in developing various biosensing devices and systems with high performance. In this study, an in-line fiber Mach-Zehnder interferometric sensor is proposed and demonstrated as an effective biosensor. The sensor developed in this study bases on a microstructured optical fiber consisting of two symmetrical tapers, which has been fabricated by fusion splicing technique. Using the layer-by-layer dipping technique, multiple thin films have been deposited on the fiber structure for the detection of streptavidin, which is a common target material used to test the effectiveness of a biosensor. This effective multilayered structure for sensing relies on the electrostatic attraction between cationic and anionic materials, in which the cationic material used in this study is poly (allylamin hidrocloride) (PAH) and the anionic material adopted here is either SiO2 core/Au shell nanoparticles (SiO2:Au NPs) or poly (sodium 4-styrenesulfonate) (PSS). The sensing response of the sensors on detecting aqueous solutions of streptavidin has been observed by measuring the wavelength shift of the transmission spectrum of the tapered fiber Mach-Zehnder interferometer. Effects of depositing (PAH/SiO2:Au NPs) and (PAH/PSS) films in multilayered structures, as well as the influences of different device specifications, are investigated.

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