Surface plasmon resonance based fiber optic nicotine sensor using gel entrapment technique

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ABSTRACT

We propose an experimental study on the surface plasmon resonance (SPR) based fiber optic nicotine detection utilizing silver and poly (Ortho-aminophenol) entrapped gel thin films. The sensor works on wavelength modulation scheme.The interaction of the hydrogen bonds of nicotine with the POAP of the entrapped gel layer gives rise to the change in volume of the gel matrix and hence changes dielectric function of the gel layer which is observed as a dip in the transmitted power spectrum. With the increase in the nicotine concentration from 0 to 150 mM, a sufficient amount of shift in the resonance wavelength is observed. The proposed sensor can be used for online monitoring of nicotine in different environment.

Keywords: Surface plasmon resonance, sensor, nicotine, optical fiber, silver, Poly(Ortho-aminophenol).

SUMMARY

In recent past, the field of plasmonics has become very prominent due to its variety of applications[1, 2]. Surface plasmon resonance (SPR) is one of the most novel and promising optical techniques for applications in different fields of technology.SPR technique has been used in the fabrication of various devices, one of these is in the field of sensing[3-7]. The design of SPR based sensors includes various considerations which have been well reported in the literature[7]. The very first sensing application of SPR technique was reported in 1983. Since then, several SPR sensing structures for chemical and biochemical sensing have been reported. In fiber based SPR technique, the probe is a segment of fiber in which the cladding is removed and a metal film is deposited on the fiber core via thermal evaporation technique. To excite surface plasmons, the metal layer, gold or silver, is coated on the core of the optical fiber[7]. Most of the metals used for the conventional fiber optic SPR sensor with single metal layer have their SPR wavelength in the visible region of the spectrum and hence cannot be used for sensing in the IR region of the spectrum, which requires attention to many of the application in biological, environmental and many security related applications.

In the present work, we have employed a successful effort in the fabrication and characterization of a fiber optic nicotine sensor utilizing the technique of surface plasmon resonance. For the fabrication of the probe coatings ofsilver and poly (Ortho-amino phenol) entrapped gel thin films over the unclad core of the fiber has been carried out. The sensor has been calibrated using different concentrations of nicotine in a fluid and wavelength interrogation method. A shift in resonance wavelength with the increase in nicotine concentration is observed. The sensor has all the advantages of a conventional fiber optic sensor such as low cost, immunity to electromagnetic interference, online monitoring and remote sensing.

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