Surface Plasmon Resonance and Molecular Imprinting Polymer based Fiber Optic Dicloran Sensor

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Dicloran (2,6-dichloro-4-nitroaniline), a chlorinated nitroaniline fungicide, is used to prevent the different crops from fungal spore germination [1]. According to studies, excess of fungicides is very dangerous for human health as well as for the environment and causes many diseases such as birth defects, neurological disorders, liver damage, cancer and hormone disruption [2, 3]. Therefore, a quick, low cost and highly sensitive sensor is required for the detection of dicloran. The aim of this work is designing of a highly selective sensor to determine the dicloran in biological and environmental samples.

We report a surface plasmon resonance (SPR) based fiber optic sensor for dicloran detection utilizing molecularly imprinted polymer (MIP) film over silver layer coated unclad core of an optical fiber. Surface plasmons are the charge density oscillations at the metal-dielectric interface and can be excited by p-polarized light. In the wavelength interrogation method with fixed angle of incidence, a maximum amount of incident light is transferred to surface plasmons at a particular wavelength called as resonance wavelength. This occurs when the wave vector of incident light matches with the wave vector of the surface plasmons which results in the excitation of surface plasmons. This phenomenon is known as surface plasmon resonance. Thus, at a resonance wavelength, a dip is observed in the transmission spectrum which is very sensitive to the refractive index of the dielectric medium in contact of metal layer [4]. Molecular imprinting is a technique which is used for the selective identification of template molecules. In this technique, artificial binding sites are formed in a polymer matrix which are complementary in shape and size to the template molecule. These binding sites are used for the recognition of template molecules [5]. When the template molecule comes in the contact of MIP layer the template starts settle down to the cavity which causes the change in the refractive index of the polymer/sensing layer.

To prepare the sensor, the sensing probe has been fabricated by coating 40 nm thick silver metal layer over a 1 cm long unclad core of the optical fiber having 17 cm length which is followed by the coating of molecular imprinted polymer. The coating of silver metal has been performed by thermal evaporation technique while the polymer has been coated using dip coating method. To calibrate the sensor, light has been launched from a polychromatic source into one end of the fiber and the transmission spectrum of the light has been recorded from the other end of the fiber by spectrometer for different diclroran concentration. A schematic of sensing probe and the experimental setup used for the characterization has been represented in figure 1. By changing the concentration of dicloran samples, a shift in resonance wavelength has been observed because of the binding of dicloran molecules with imprinted sites. The sensor operates for the dicloran concentration range from 0 to 10 μM.

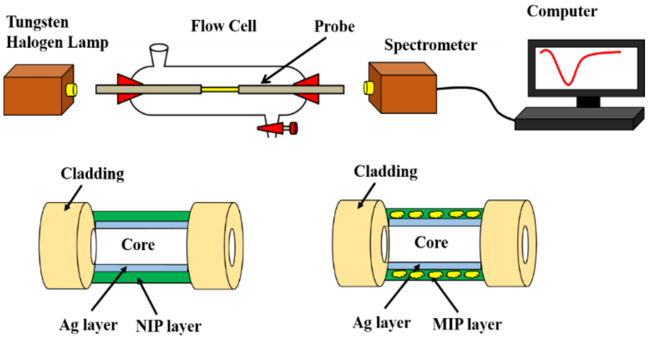

Figure 1: Schematic of the experimental setup and the fabricated probe.

The proposed sensor has high sensitivity and high selectivity and has numerous other advantages like the ease of handling, fast response, free from electrical isolation, low cost and capability of online monitoring and remote sensing.

References

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