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Optical Fiber Sensors: Principles to Practice

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There are different optical techniques available for sensing applications such as Surface Plasmon Resonance (SPR), Evanescent wave, Doppler Effect, Interferometry, etc [1]. These techniques have their own advantages and disadvantages. Optical fiber based on SPR and Evanescent wave has been used for sensing applications.

Multimode fibers are mostly used for sensing applications. Such fibers are used for fabrication and characterization of a surface Plasmon resonance based fiber-optic sensor for the detection of organophosphate pesticide (chlorphyrifos) [2]. The probe is prepared by immobilizing acetyl cholinesterase (AChE) enzyme on the silver coated core of plastic-cladded silica (PCS) fiber. The detection is based on the principle of competitive binding of the pesticide (acting as inhibitor) for the substrate (acetlythiocholine iodide) to the enzyme AChE. The spectral interrogation method is used to characterize the sensor. It has been observed that the SPR wavelength decreases with the increase in the concentration of the pesticide for the fixed concentration of substrate in the fluid around the probe. The detection of pesticide can be in sub micro-molar concentration. The sensitivity, detection accuracy, reproducibility and stability of the sensor are promising. These probes are reusable and can be used for detection of different chemical and pesticides by properly choosing the corresponding enzymes.

On the other hand the optical technique like evanescent wave can be used to design ultrasensitive nano sensors for various applications including ring resonator [3]. Single mode optical fiber can be tapered down to sub wavelength region to make micro and nano fibers. These nano fiber can be embedded in low-index material (Teflon) using an inexpensive and straightforward fabrication process based on spin coating [3]. The optical properties of the silica micro/nano-fibers have been investigated when they are bare or completely or partially embedded. Optical degradation occurs in bare fibers with diameters smaller than twice the wavelength of the guided light, thus making protection through embedding necessary. Completely embedded fibers do not degrade over a long time, while partially embedded fibers can preserve the large evanescent waves without undergoing considerable degradation. Such type of nano fibers can act as ultra sensitive sensors around telecommunication window that can be used for various applications.

References

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Biography

Rajan Jha received his MSc and PhD degree from Indian Institute of Technology Delhi, India in 2001 and 2007 respectively. From early 2008 to July 2009, he was a post-doctoral researcher at ICFO-The Institute of Photonics Sciences, Barcelona, Spain. He was awarded JSPS (Japanese Society for Promotion of Science) fellowship in 2009. He is currently working as Assistant Professor of Physics in School of Basic Sciences at Indian Institute of Technology Bhubaneswar, India. He is a regular member of Optical Society of America (OSA) and is a life member of Optical Society of India (OSI) and Indian Science Congress. His areas of research are optical fiber sensors, nano- & bio-photonics, waveguide & interferometer. He has published more than 30 research articles including a review article in international journals of repute.