Materials Today: Proceedings 66 (2022) 3507–3510

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Silicon nitride based photonic biosensor for analyzing blood diseases

Ankit Agarwal [a,b,*], Nitesh Mudgal [a], Ankur Saharia [c], Ghanshyam Singh [a], S.K. Bhatnagar [b]

[a] Malviya National Institute of Technology, Jaipur 302017, India
[b] Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur 302017, India
[c] Manipal University Jaipur 302034, India

ARTICLE INFO

Article history:
Available online 2 July 2022

Keywords:
Biosensors
Photonic crystal
Blood diseases
Hemoglobin
FDTD

ABSTRACT

A Photonic sensor with a sensing ring structure for measuring the concentration or refractive index of blood components is presented in this paper. This concentration variation showcases the refractive index variation, and interpretation of refractive is detected for analyzing the blood-related disease. The finite difference time domain method is used to analyze the shifting of the resonating peak when the signal travels through the waveguide structures and interacts with the sensing ring. The sensitivity of this design structure is approximately 220 nm/RIU, and the normalized output power is 35%. The operating wavelength is 1550 nm for this design structure. The simulation is done on OPTIFDTD software.

Selection and peer-review under responsibility of the scientific committee of the 3rd International Conference on "Advancement in Nanoelectronics and Communication Technologies".

1. Introduction

Photonic crystal (PC) sensors have substantial potential applications as gas sensors, liquid sensors, environmental monitoring sensors, and biosensors. These potential applications are not only because of their compact size but also because it provides low loss communication with high speed and easily control the propagation of light [1–3]. In many ways, photonic crystal sensors are superior to other electrical and optical sensing systems. These PC sensors successfully merge the different fields as optoelectronics, microelectronics, and material science. In the current context, sensors' relevance and compactness are well-known for technological infrastructure development. To solve real-world difficulties, such as health safety concerns and fast information acquisition with even more accuracy, many researchers are working on a PC structure for compact dimensions and better sensitivity. A photonic crystal structure is a periodic structure of two refractive index profile materials [4]. This regular structure is designed to formulate the energy band. This energy band specifies either allows or forbids the flow of photons. It is also possible to influence photon propagation by altering the distribution of air holes and changing the refractive index [5–7] because the propagation of photons from input to output port is done by the Total Internal Reflection (TIR) phenomenon. This TIR phenomenon is taken an account with the help of air-holes distribution in the substrate and distribution of refractive index change [1,4]. The light is constrained in a narrow area using these structures in a photonic crystal. This region is known as a photonic bandgap region. This photonic bandgap is similar to the electronic bandgap in a semiconductor material. This photonic bandgap indicates that no photon is available having the wavelength spectrum in the region of the photonic bandgap. So, the photons having the wavelength in this region can travel freely without interaction with other photons. In this periodic structure, discontinuity is introduced to transmit optical signals of that photonic bandgap wavelength. This continuity is responsible for the confinement of the optical signal in the waveguide. This discontinuity or defect is either a line defect or point defect. Researchers have proposed various photonic crystal-based sensors with different dielectric materials for biosensors and gas sensors. Liquid sensors, resonators, interferometers, waveguides, attenuators, and optical logic gates [8–15].

Surface and homogeneous sensing are the two categories used to define the sensing mechanism [16–19]. Because the PhC structure senses changes in refractive index by moving the resonant peak of the input signal, it is based on homogeneous sensing. The biochemical's RI changed due to this shifting in resonant peak. Human blood diseases are most common in the current scenario. Sometimes this blood disorder is the cause of human death. This death identifies a blood disorder at the final stage, so proper treatment is not possible. To overcome this problem, detecting disease at an early stage is crucial. The cause of these different diseases is a

* Corresponding author.
E-mail address: ankitsagarwal@gmail.com (A. Agarwal).

https://doi.org/10.1016/j.matpr.2022.06.395
2214-7853/
Selection and peer-review under responsibility of the scientific committee of the 3rd International Conference on "Advancement in Nanoelectronics and Communication Technologies".