

# Design of a highly sensitive photonic crystal waveguide platform for refractive index based biosensing

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**Abstract** In this paper, a photonic crystal waveguide platform on silicon-on-insulator substrate is proposed in order to realize a highly sensitive refractive index based biosensor. Following the design, the analysis of the sensor structure are made by using the three dimensional Finite Difference Time Domain method. The principle of sensing is based on the change in refractive index, which in turn changes the output spectrum of the waveguide. Results show that the sensitivity of the sensor depends mainly on the geometrical properties of the defect region of the photonic crystal structure. The phenomenon is verified for various samples having refractive index ranging from 1 (air) to 1.57 (Bovine serum albumin). Further, the structure is compared with few other conventional photonic crystal waveguide designs to analyze the sensing performance. The estimated value of sensitivity of the sensor is found to be 260 nm/RIU with a detection limit of 0.001 RIU. This high sensitivity can enhance the performance of low-concentration analytes detection.

**Keywords** Photonic crystal waveguide · FDTD · Biosensor · Refractive index sensing

## 1 Introduction

Photonic crystals are periodic dielectric material with periodicity in either two dimensions (2D) or three dimensions (3D). The two dimensional periodicity can be formed by etching holes in a dielectric material that provides the photonic band gap, a range of frequency over

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