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Designing a Refractive Index Gas Biosensor Exploiting Defects in Photonic Crystal Core-Shell Rods

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Abstract : This article introduces a compact sensor based on high-transmission, high-sensitivity two-dimensional photonic crystals. The photonic crystal consists of a square network of silicon rods in the air. The sensor is composed of two waveguide couplers and a microcavity designed for monitoring the percentage of hydrogen in the air and identifying gas types. Through the Finite-Difference Time-Domain (FDTD) method, we demonstrate that the sensor's resonance wavelength is contingent upon changes in the gas refractive index. We analyze transmission spectra, quality factors, and sensor sensitivity. The sensor exhibits a notable quality factor and a sensitivity value of 1374 nm/RIU. Notably, the sensor's compact structure occupies an area of 74.5 μm2, rendering it suitable for integrated optical circuits.

Keywords : 2-D photonic crystal, sensitivity, F.D.T.D method, label-free biosensing
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