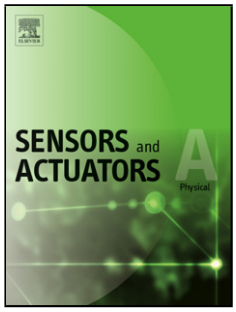

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Authors: A. Zakrzewski, S. Patela

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Investigation of the laser acetylene sensor based on two-dimensional photonic crystal

A. Zakrzewski[a,*], S. Patela[a]

[a]Wroclaw University of Technology, Faculty of Microsystem Electronics and Photonics, 27 Wybrzeże Wyspiańskiego St, Wrocław, Poland, 50-370

Corresponding author: A. Zakrzewski**,** E-mail: adrian.zakrzewski@pwr.edu.pl

Highlights

- A design of the laser acetylene sensor based on a two-dimensional photonic crystal is presented.
- The enhancement of light-gas interaction by using the slow light phenomenon is shown.
- High value of the group refractive index is experimentally confirmed.

Abstract. We have developed the laser acetylene sensor based on a two-dimensional photonic crystal. The interaction of optical wave with the analyzed gas was enhanced by the use of the slow light effect. We carried out a numerical analysis to get the optimal structure of the sensor, including the photonic crystal forming an active element of the sensor and anti-reflection sections to maximize transmission. We considered geometric features of photonic crystals such as a line defect formed by a missing row of holes, a row of holes with changed diameter and air channel. High values of group refractive index and overlap integral as well as low attenuation of the crystal are required for the sensor operation; we carried the suitable simulations to achieve the best performance of the sensor. After the simulations, photonic crystal sensor was fabricated with electron beam lithography and reactive ion etching in the silicon layer of SOI heterostructure. Finally, the laser acetylene sensor was characterized experimentally.

Keywords: laser gas sensor; acetylene; photonic crystal; numerical analysis.