A novel photonic crystal fiber refractive index sensor based on surface plasmon resonance effect with wide detection range

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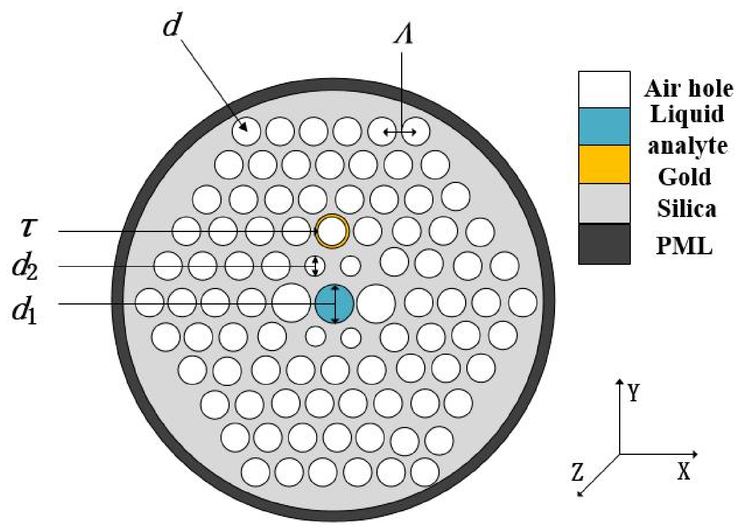
Introduction

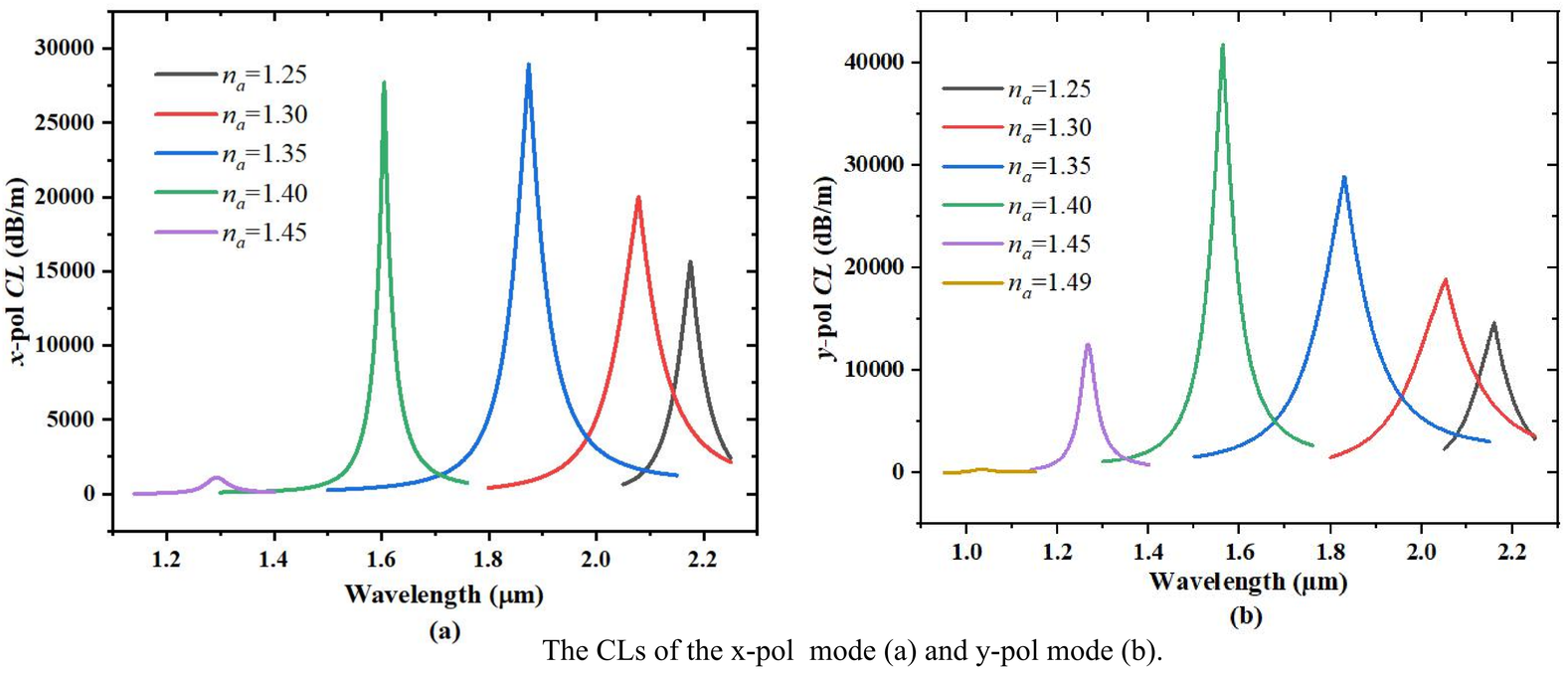
The refractive index (RI) sensor has attracted more attentions because it can easily find significant applications in the biology, chemistry, and environment monitoring. The research of photonic crystal fiber (PCF) RI sensors has made great progress in various RI sensors. Meanwhile, due to accurate perception for the microvariation of external RI, the PCF RI sensor often use surface plasmon resonance (SPR) effect to increase sensitivity .

In this paper, we design and numerically analyze a wide detection range PCF RI sensor. By studying the transmission loss of analytes under different polarization modes and different RIs, the excellent RI sensing performance can be found in the proposed PCF RI sensor. In addition, by using developed stack and draw fabrication method the PCF RI sensors can be easily fabricated.



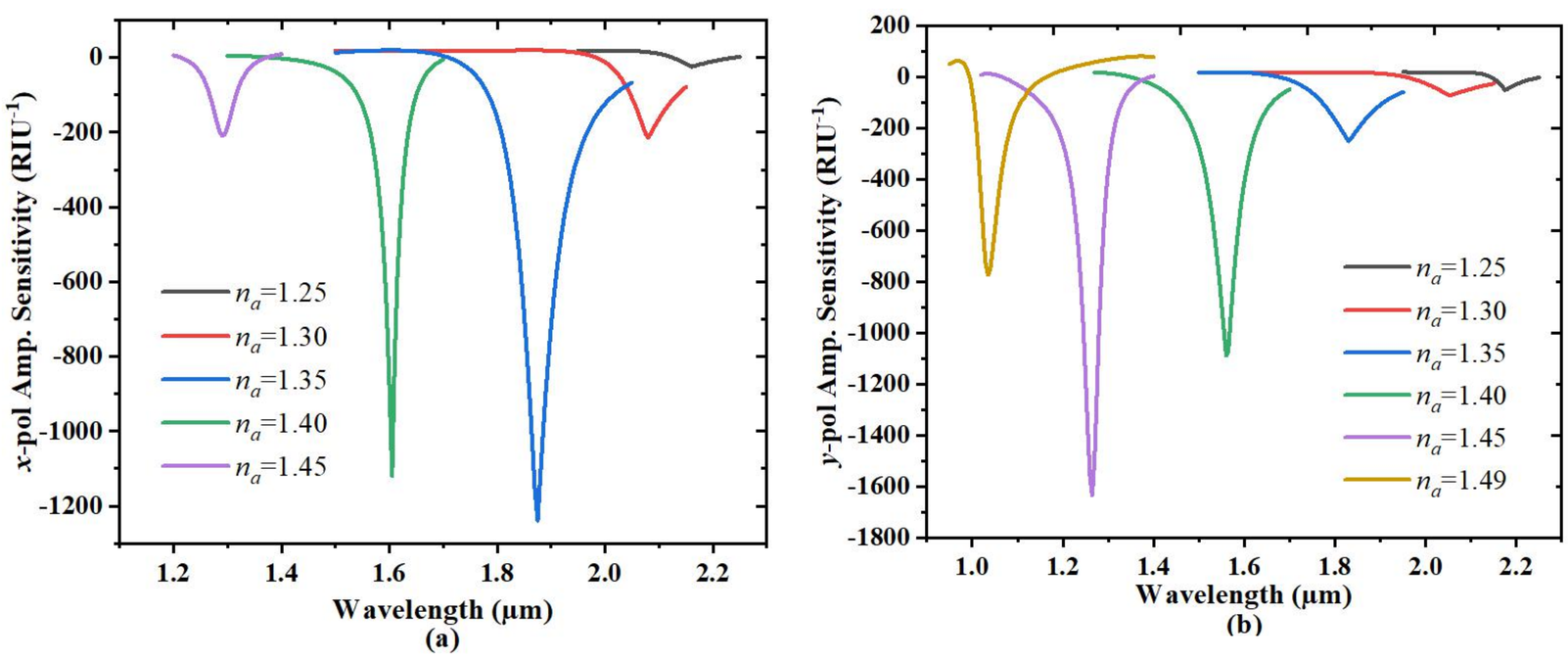
Schematic diagram of the designed PCF RI sensor

Numerical results and discussion



The CLs of the x-pol mode (a) and y-pol mode (b).

In this paper, the RI sensing characteristics were calculated using the finite element method (FEM).By calculating the confinement loss of the proposed structure, we can obtain the wavelength sensitivity (WS) and amplitude sensitivity (AS),which usually considered as two important parameters to measure sensor performance. By analyzing the WS and AS of the structure, it is known that the structure has good sensing characteristics.



The x-pol (a) and y-pol (b) AS as functions of wavelength.

Conclusion

In conclusion, a novel PCF RI sensor based on SPR effect with wide detection range is proposed and analyzed. As a result, the WSs of the x- and y-pol modes are -4476.0 nm/RIU and -4851.13 nm/RIU in the RI range from 1.25 to 1.45 and 1.25 to 1.49, respectively. Moreover, the maximum AS of the sensor can reach -1239.19 RIU-1 and -1633.54 RIU-1 for the x- and y-pol modes. With excellent sensing performance and wide detection range, the PCF RI sensor has potential applications in biological, chemical and environmental monitoring..

Acknowledgements

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