Aim

In recent years, for solving the polarization fading problem of Fiber optical hydrophone (FOH), the polarization-maintaining fibers (PMFs) were introduced, especially the high birefringent photonic crystal fiber (Hi-Bi PCF). The PMFs seem to be more useful for the FOH miniaturization than the Faraday Rotation Mirror. In this paper, we demonstrated a novel side-hole birefringent photonic crystal fiber, with a polycarbonate-filled ellipse core for the vertical pressure sensing. Simulation results show that these characteristics strongly affect the modal birefringence $B_0$ and the polarimetric pressure sensitivity $\frac{dB}{dp}$, which has been found that could reaches as high as 5.84E-3 and 8.16E-5 MPa$^{-1}$ through the designed fiber at 1.55μm, respectively. By introducing the high birefringent structure and polycarbonate material, the proposed fiber can find important future application in the pressure sensing.

Methods

Full-vector finite element method (FV-FEM) is used to analyze the properties of PCF, which is based on the Maxwell formula, the electromagnetic equation as:

$$\nabla \times \left( \varepsilon^{-1} \nabla \times \vec{h} \right) - k_0^2 \mu \vec{h} = 0$$

Where the $\vec{h}$ is magnetic field intensity, $\vec{H}$ is the field distribution on the transverse plane, $k_0=2\pi/\lambda$ is the wave number in the vacuum, $\lambda$ is the wavelength.

For the fiber design, the structure (left) and normal electric fundamental mode along x-axis (right) are shown as below.

According to the results of the simulation above, it shows that the bigger side-holes and the approaching distance can strongly enhance the fiber pressure sensitivity.

Conclusion

Based on the FV-FEM, we design a novel birefringent PCF with polycarbonate-ellipse core. It shows that the large air holes in the cladding do have a significantly impact on the fiber core. Simulation results show that both modal birefringence and polarimetric pressure sensitivity of the proposed fiber have highly modified compared with the present PM-PCF. By introducing the polycarbonate (PC)-ellipse core and side hole, the fiber we proposed could exceedingly beneficial to the pressure sensing.