Design of Single TM-Like Mode Holey Fibers With An Actinomorphic Elliptical-Hole Lattice Core

Zheng ZHONG [1] Yasuhide TSUJI [1] Masashi EGUCHI [2]
Muroran Institute of Technology [1]
Chitose Institute of Science and Technology [2]

1 Introduction

The single-TM-mode transmission Bragg fiber has been proposed using magnetic materials[1]. Furthermore, the technology of photonic crystals has been made great progress in the past decades. By utilizing the concept of photonic crystals, the same property of single-TM-mode transmission based on holey fibers must be realized. Therefore, since the elliptical holes are effective to break the symmetry[2], we propose a novel single TM-like mode holey fiber, which has an actinomorphic ellipitical-hole lattice core. On the basis of actinomorphic ellipitical holes alignment in the core, birefringence between the peripheral direction and the radial direction can been earned easily to achieve the single TM-like mode transmission.

2 Design and Simulation

We propose a novel holey fiber with an actinomorphic elliptical-hole lattice core to guide a single TM-like mode, which is shown in Fig. 1. It has a 4-rings core, which is characterized by elliptical holes with the radii R_L and R_S for the major and minor axis, respectively. And a large circular hole with the radius of R_a located in the center of the core makes the HE_{11}^{x} modes guided hardly. The radius of the cladding hole is represented by R_c. The refractive index of silica is calculated by Sellmeier's equation and the refractive index of air is set to be 1. We select the lattice pitch $\Lambda = 1\ \mu\mathrm{m}$, $R_a = 0.40\Lambda$, $R_S = 0.24\Lambda$, $R_L = 2R_S$ and $R_c = 0.324\Lambda$ as the structural parameters. The H-field profiles of the TM-like mode and HE_{11}^{x} mode are shown in Fig. 2 at the wavelength of $1.50\ \mu\mathrm{m}$. It is demonstrated that the HE_{11}^{x} mode is cut off by FSM. The modal effective indices of TM-like mode, HE_{11}^{x} mode and FSM as a function of wavelength are shown in Fig. 3, the single TM-like mode transmission can be achieved in the wavelength range of $1.45\ \mu\mathrm{m}$ to $1.55\ \mu\mathrm{m}$.

3 Summary

We proposed a novel single TM-like mode holey fiber with an actinomorphic elliptical-hole lattice core. The S-band of the optical communication wavelength band can be covered for the single TM-like mode transmission.

References

[1] D. Mao, Z. Ouyang, J. C. Wang, and C. P. Liu, *Opt. Exp.*, vol. 16, no. 2, pp. 628–635, Jan. 2008.

[2] M. Eguchi and Y. Tsuji, *Opt. Lett.*, vol. 32, no. 15, pp. 2112–2114, Aug. 2007.

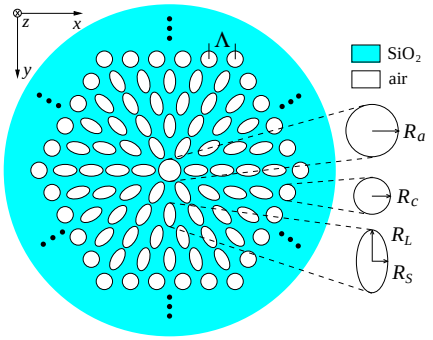
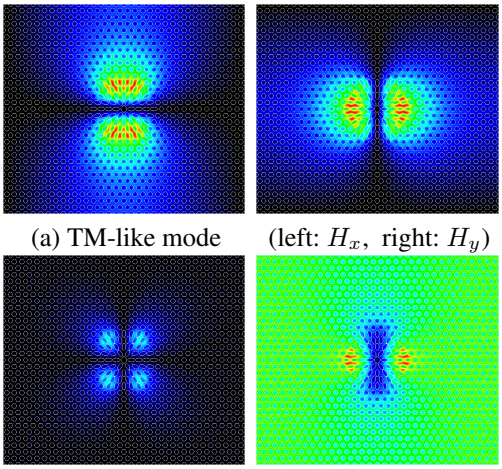


Figure 1: The cross section of the proposed single TM-like mode holey fiber.



(a) TM-like mode (left: H_x, right: H_y)

(b) HE_{11}^{x} mode (left: H_x, right: H_y)

Figure 2: The H-field profiles of the proposed holey fiber ($\lambda = 1.50\ \mu\mathrm{m}$).

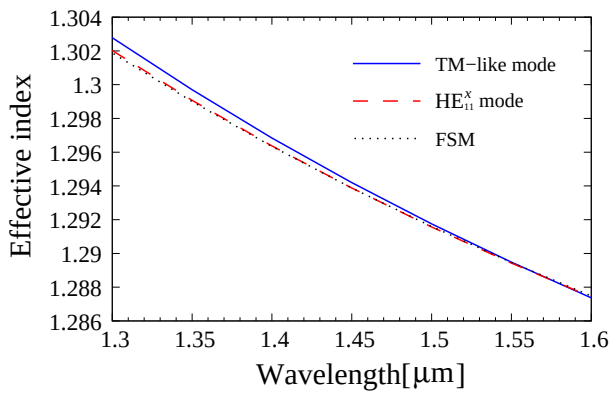


Figure 3: The modal effective indices of TM-like mode and HE_{11}^{x} mode and FSM as a function of wavelength.