Novel Design of Photonic Crystal Fiber TE-Pass Polarizer

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A novel design of transverse electric (TE) pass polarizer based on Si-core photonic crystal fiber (SC-PCF) is reported and studied using full vectorial finite element method. The proposed PCF has a SiO_2 cladding background and is selectively filled with gold nanorods. In addition, an elliptical Si-core is used to increase the birefringence between the two polarizing modes. Therefore, the surface plasmon modes around the gold nanorods are highly coupled with the quasi-transverse magnetic (TM) core modes while no coupling occurs with the quasi-TE core mode. Therefore, high and low confinement losses occur for the quasi TM and quasi TE core modes, respectively. Accordingly, a TE-pass polarizer is realized with an insertion loss (IL) of −0.000108 dB. Additionally, a good extinction ratio (ER) of −13.18 dB is obtained at a short device length of 29 μm.

Design and Numerical Results

Figure 1(a) shows the cross-section of the suggested device design. The device leverages on the low-loss and strong mode confinement nature of photonic crystal fiber and the lossy nature of plasmonic mode around the gold nanorods to achieve an ultra-low loss TE-pass polarizer. Figure 1 (b) illustrates the variation of IL and ER with the device length. It may be seen from this figure that the proposed TE-pass polarizer has a very low IL and a good extinction ratio. Figure 1(c) shows the propagation of the quasi-TE and quasi-TM mode through the suggested device at wavelength of 1.55 μm. It is evident from this figure that quasi-TE core mode passes through the suggested design with negligible loss, whereas quasi-TM core mode is attenuated greatly.

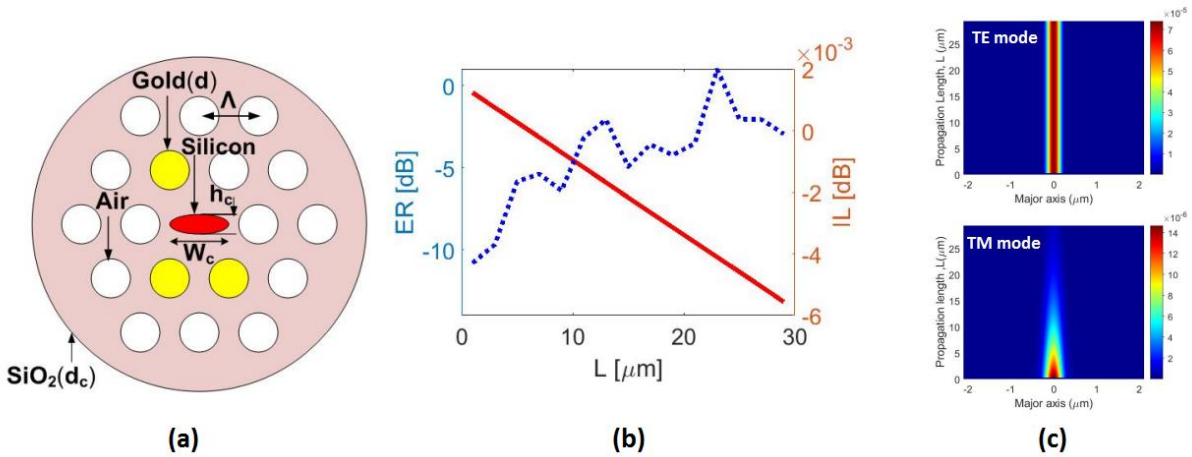

Fig.1(a) Cross-section of the proposed PCF, (b) variation of IL and CT with the device length (L) and (c) light propagation of the two polarized modes through the suggested device