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Flattened Chromatic Dispersion With Four Layer Defect Core In Photonic Crystal Fiber By Varying Design Parameter

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Abstract:
This paper presents a design for nearly zero flattened dispersion in the index guided Photonic crystalfiber (PCF). A 2-D holey index guided photonic crystal fiber having four layer defect core for three different defect core diameters are investigated. A full-vector TE, FDTD method is used to simulate and analyze the dispersion property.

Keywords: *Photonic Crystal Fibers (PCFs), Total internal reflection (TIR), Effective Refractive index (neff), Chromatic Dispersion (CD).*

1.Introduction

Photonic-crystal fiber (PCF) is a new class of fibers which offers a great deal of freedom in their design to achieve lot of peculiar properties. Photonic crystal fibers (PCFs) are made from single material such as silica, with an array of air holes running along its length. A defect can be created by removing the central air hole with glass to guide light by total internal reflection (TIR) between the solid core and the cladding region. These index-guiding PCFs also are called holey fiber, holey assisted fiber.

These fibers possess an attractive feature of great controllability in chromatic dispersion, which is very much important in order to keep the dispersion as low as possible for wide range of wavelength. The above control can be achieved by varying the air hole diameter of defect core.

A full-vector TE mode is used to perform the modal analysis which generates the effective refractive index, which is further used to calculate the chromatic dispersion.

2.Dispersion Formula

Chromatic dispersion is the main contribute to the optical

Pulse broadening. Combined effect of material and waveguide

Dispersion cause chromatic dispersion. Here sellemier formula

Is used for calculating wavelength dependent refractive index.

Where the index of air is assumed to be constant. The chromatic dispersion D is proportional to the second derivative of the n_{eff}, with respect to the wavelength (λ) obtained as.

$$D = -\frac{\lambda}{C}\frac{d^{2}Re[n_{eff}]}{d\lambda^{2}} \qquad (1)$$

Where λ is wavelength, Re [n_{eff}] is the real part of n_{eff}, , and c is the velocity of light in vacuum [5].

The chromatic dispersion is calculated as the sum of the geometrical dispersion (or waveguide dispersion) and the material dispersion obtained as:

$$D(\lambda) = Dg(\lambda) + \Gamma Dm(\lambda) \qquad (2)$$

3.Parameters Of Pcf

In this type of PCF consists of a defect core with artificially-periodic cladding consisting of micrometer-sized air-holes .The wafer chosen is silica with refractive index 1.45 and the refractive index of air holes is 1.The pitch (Λ) which is center to center spacing between two nearest air holes is kept as 2.0 µm. The air hole diameter is 1.5 µm. and defect core diameter (d') is 0um, .2.0um, .4.0um, .6.0um as shown in figure 1.

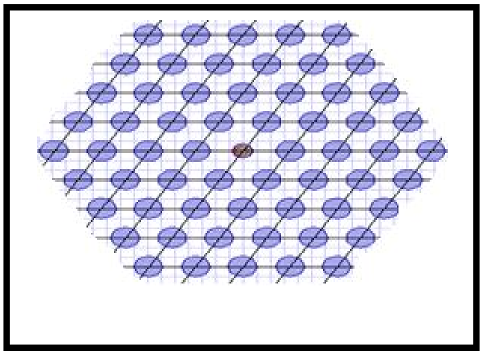

Figure1:Simulation design (Hexagonal lattice with circular air holes, Air hole spacing =2.0um, air hole diameter (d) = 1.5um, defect core (d') = 0um,.2.0um,.4.0um,.6.0um.

4.Effective Refractive Index

The Effective refractive index decreasing with defect-core increases.It is wavelength depended that decreasing with increasing wavelength.as shown in figure 2.

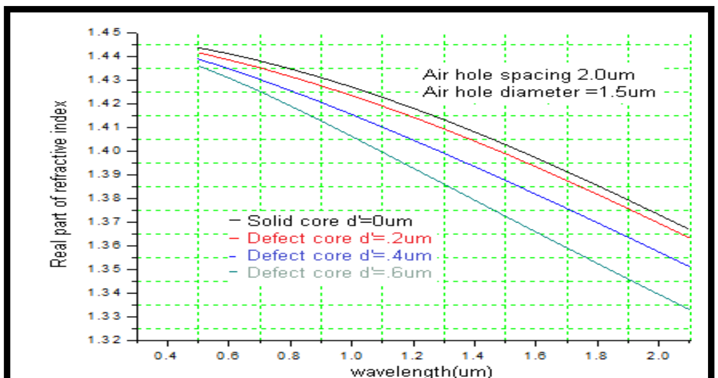

Figure 2.Real part of refractive index

5.Simulation Results

Here designed and found dispersion properties of defect core Photonic Crystal Layout with a hexagonal lattice of air holes and dielectric medium refractive index of SiO_2 is 1.45. Electric field distribution is shown in figure 2. It should be flower like arrangement with all the fields being confined in the core region.

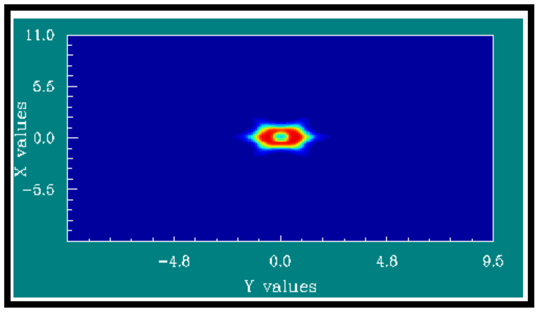

Figure 3: Electric Field Distribution At Air Hole Spacing (Λ) = 2.0 Um, Air Hole Diameter (D) = 1.50um, Defect Core Diameter (D') = .6um And Λ = 1.55 Um.

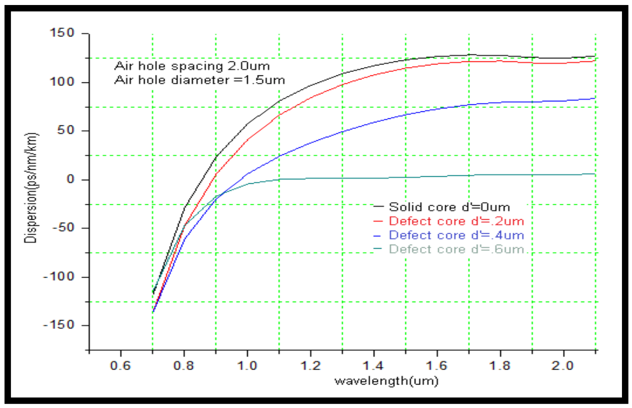

Figure 4 :Chromatic Dispersion

6.Conclusion

In conclusion, we consider four ring defect core photonic crystal fiber. Here defect core diameter is 0 um, 2.0 um, 4.0 um, 6.0 um .The chromatic dispersion decreases with increase in defect core diameter. It was shown from these results that flattened dispersion values 0.39031 ps/km/nm to 4.72915 ps/km/nm are achieved over a wavelength range 1.1 um to 1.7 um.

7.Reference

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