Introduction to photonics

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Dispersion optimization of photonic crystal fibers using comsol simulator

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Phase 1.

Geometry:

The structure consists of 5 hexagonal rings of air-filled tubes with different dimeters as shown on the schematic in figure (1).

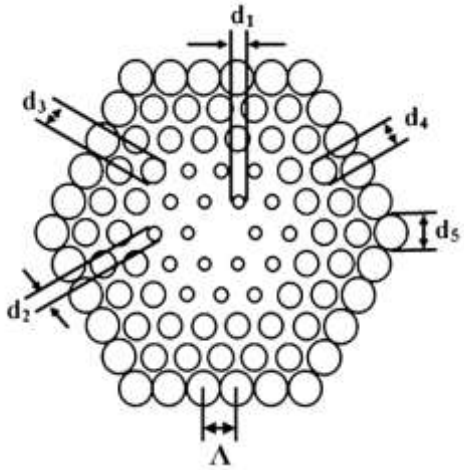

Fig (1). The desired schematic of the structure

As d1, d2, d3, d4 and d5 equals 0.5399 µm, 0.6459 µm,0.9104 µm, 0.7448 µm and 1.1967 µm respectively while hole pitch equals 1.7378 um. Figure (2) shows the implementation in COMSOL.

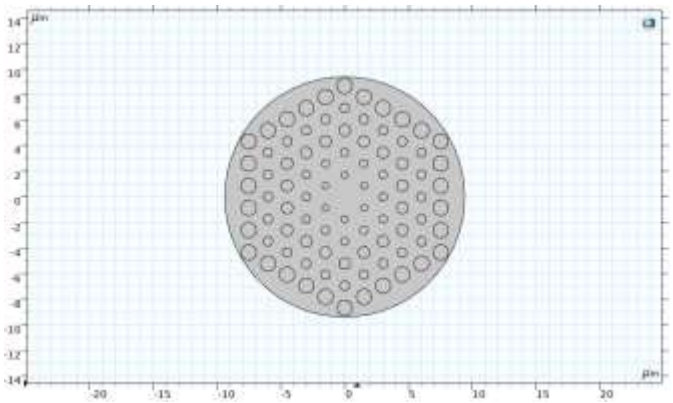

Fig (2). Implementation on COMSOL simulator.

Parameters:

All the circular holes are filled with air with n=1 and the background material is made of silica glass with n=1.444 at wavelength of 1.55 um.

The refractive index of silica is calculated form sellmeier equation (1) that represents the relation between refractive index and wavelength.

$$n^2 - 1 = \frac{0.6961663\lambda^2}{\lambda^2 - 0.0684043^2} + \frac{0.4079426\lambda^2}{\lambda^2 - 0.1162414^2} + \frac{0.8974794\lambda^2}{\lambda^2 - 9.896161^2} \quad (1)$$

Boundary conditions:

Scattering boundary condition is applied along the boundaries of the structure as shown in figure (3).

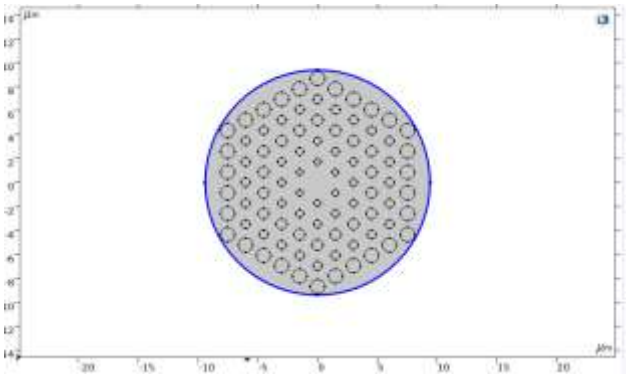

Fig (3). Scattering boundary condition

Meshing:

For the background silica domain, fine meshing is applied and for the air holes extremely fine meshing is applied as shown in figure (4).

Fig (4). meshing

Mode analysis:

At wave wavelength of 1.55 um, 10 number of modes and to search around n_silica, the results shown in figure (5) is the representation of mode analysis.

Then, the effective mode index =1.4719.

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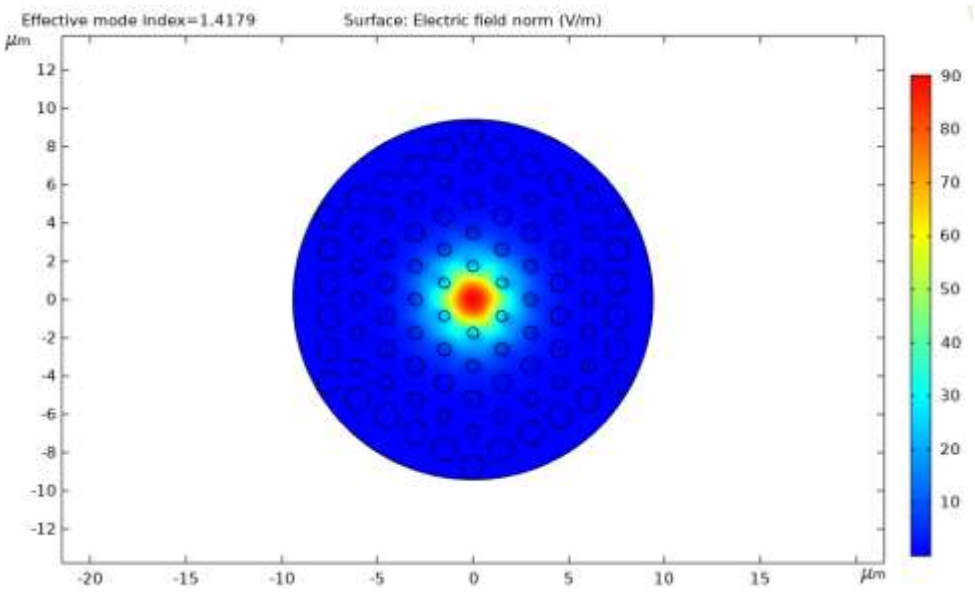

Fig (5). Electric field norm mode analysis with n_eff=1.4719

TE and TM mode:

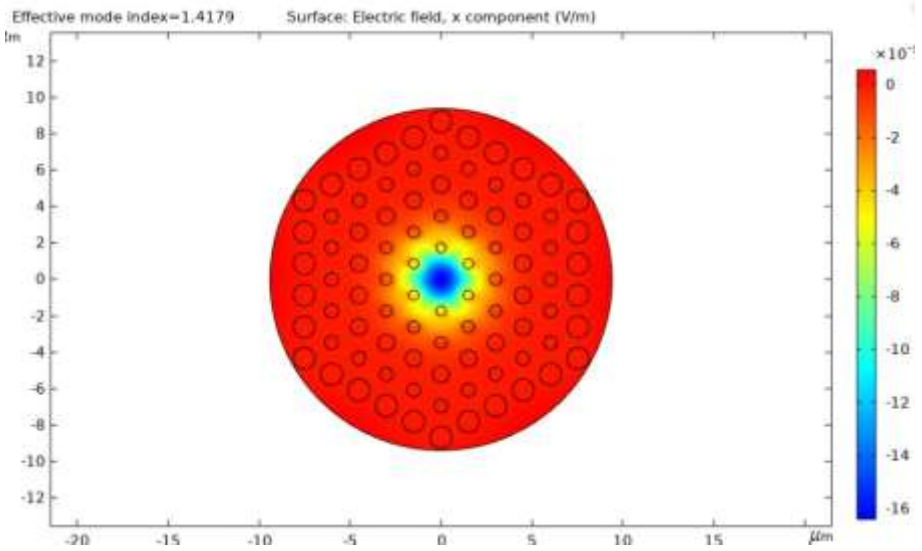

Fig (6). Electric field x component with n_eff=1.4719

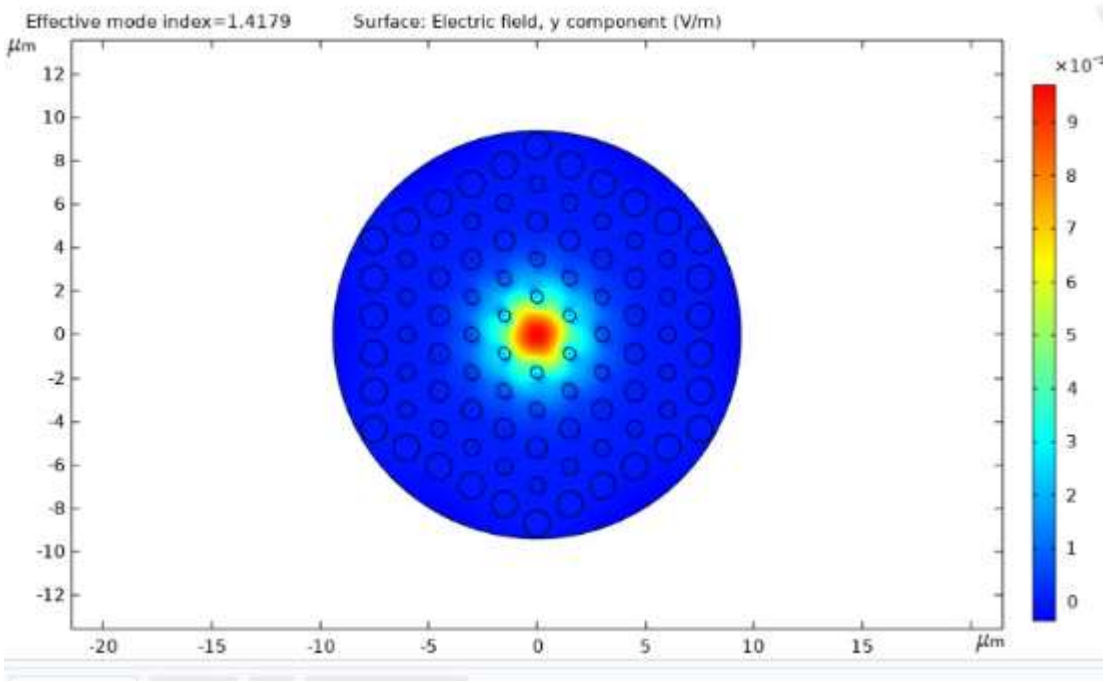

Fig (7). Electric field y component with n_eff=1.4719