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IMPROVEMENT OF WAVEGUIDE DESIGN PARAMETER TO REDUCE THE CROSSTALK BETWEEN THE WAVEGUIDE

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ABSTRACT

In this paper the coupling between linear parallel sections of a photonic crystal waveguide is investigated. We present a novel type a parallel dielectric waveguide based on photonic crystal consisting of air holes embedded in a dielectric substrate. We present a one- line defect photonic crystal waveguide with elliptical un it cell that shows 21 % transmission power improvement and with coupling power 8.5 db less than the photonic crystal waveguide with circular unit cell.

Keywords: Photonic Crystal (PC/Phc), Optical Switch, Relative Permittivity (R), Finite-Difference Time- Domain (FDTD).

I. INTRODUCTION

Photonic Crystal (PhC) has become one of the most interesting element in photonics research worldwide. In 1897, E. Yablonovitch[1] and S.Jhon [2] proposed the awareness that a periodic dielectric can provide the band gap for certain region. In the frequency spectrum, similar to an electronic band gap in semiconductor materials. Photonic crystal have wide and varied applications in the field of microwave and optical technology. The one-line defect photonic crystal waveguide (in which one row of rods is missing from the regular photonic crystal structure) is one of the device that has been widely explored [3][4]. Recently, more and more studies focusing on high efficiency of transmission rate to maintain light propagation in photonic crystal structure are being done. In this paper we are present a novel irregular one- line defect photonic waveguide with an elliptical unit cell that show 21% transmission power improvement and with coupling of power 8.5 db less than the photonic waveguide with circular unit cell.

II. DESIGN

To design the Photonic crystal waveguide we have to decide which refractive index is used. We search different refractive index-1.45, 2.94, 3.45, and 3.73

We get the output with r=0.2 and a=.43 µm

Table-1

Refractive Index	Bandgap	Difference
1.45	0	0
2.94	(1.14031,1.23982),(1.6907,1.69728)	0.099507, 0.0020738
3.45	(1.27521,1.12057),(1.46703, 1.46874)	0.00395, 0.00171014
3.73	(1.18369, 1.18752), (1.35949, 1.36103)	0.00383, 0.00153

We conclude that 2.94 has a large bandgap compare with others refractive index band gap. Large band has many applications. So we use refractive index 2.94 for remaining work.

2D photonic crystal structure with two parallel waveguide separated by single row of air holes with the circular unit cell is shown in a fig 1(a)[5]. The photonic waveguide is fabricated by etching the air holes in the substrate. Since a photonic crystal waveguide is a line defect in crystalline structure, it represent a dielectric slab of a certain width sandwiched between two semi- infinite photonic crystals. In the present design, the air holes (refractive index n=1) of the photonic structure have a radius r=0.2 and a=0.43µm, where lattice constant, and the relative permittivity of the background material is r=11.9 (corresponding to silicon material).

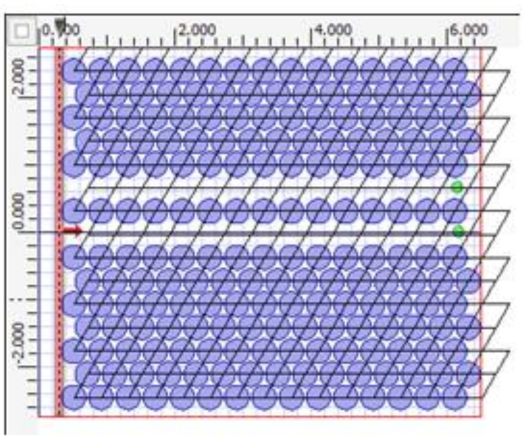

Fig: 1(a)

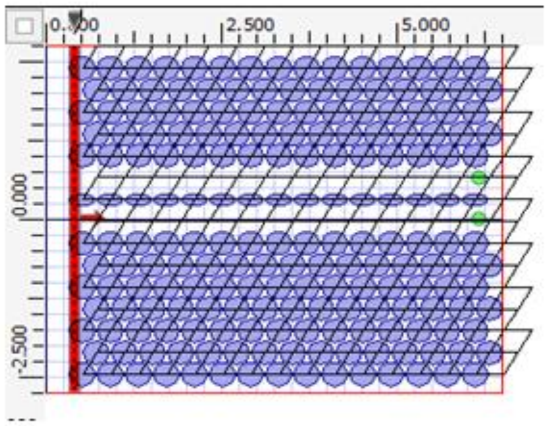

Fig 1(b)

III. RESULT

The propagation of light in photonic crystal waveguide is simulated by 2D finite difference time domain (FDTD) method using opti-FDTD.

After simulation, power is measured at both end of waveguide with structure shown in figure 1(a) and fig 1(b), and the level of coupling determine as -0.8dB and -9.3 dB respectively.

We observed that coupling to the adjacent waveguide is reduced by 8.5dB and power transmission increased by 21% with structure 1(b). This is because Bragg condition is satisfied only along the direction of propagation and

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not in the perpendicular to direction of propagation due to the fact that the periodicity of the structure is same along the direction of propagation and it varies along the perpendicular to direction of propagation. While in case of circular unit cell, Bragg condition satisfied in both directions due to same periodicity of the structure.

We can observed from fig 2(a) and 2(b) that electromagnetic wave is confined mostly in z-direction in figure 2(b) in case of elliptical holes, whereas in figure 2(a) for circular holes, we can observe that the electromagnetic wave is confined not only in z- direction but has some traces in x-direction also.

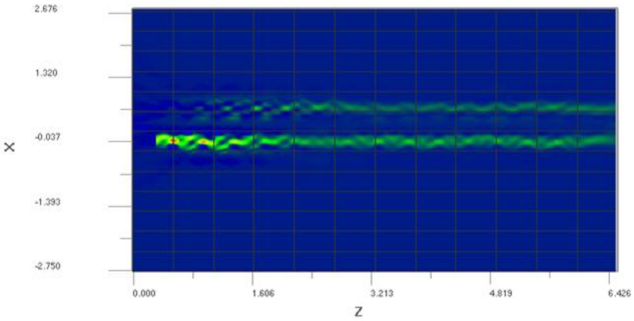

Fig 2(a)

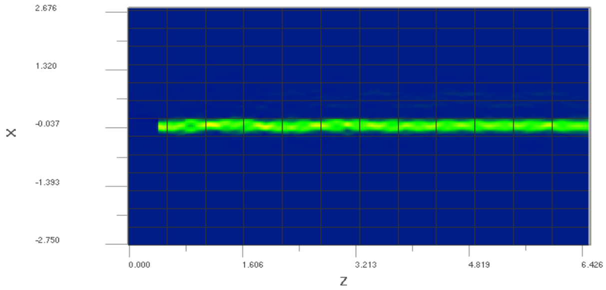

Fig 2(b)

IV. CONCLUSIONS

We have presented a novel irregular one –line defect photonic crystal waveguide with elliptical unit cell that shows a 21% transmission power improvement and with coupling power 8.5db less than the photonic waveguide with circular unit cell. It was noticed that the undesired coupling was reduce between adjacent waveguide. The possibility of a very dense packaging of high speed parallel interconnects with spacing less than approx. 0.5µm between the channel waveguide is shown. These result can be of interest in design of optical switches and devices with high level of integration.

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