The Design of a New Photonic Crystal Splitter

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Abstract. This paper designs a new kind of photonic crystal splitter. This kind of beam splitter is designed on the basis of the radiant photonic crystals. For improvement points beam splitter transmissivity and joined the tetragonal autocollimation photonic crystal structure. By increasing the autocollimation photonic crystal defect, the total transmittance got a lot of ascension. And the radiant photonic crystal splitter ratio can be easily adjusted. The beam splitter has great potential for application in optical integration.

Radiant structure and the optical transmission properties of photonic crystals

Figure 1 (a) gives the radiant structure of photonic crystal splitter. Beam splitter is about x axisymmetric two identical radiant photonic crystals. Radiant photonic crystals is only a quarter of the arc, and the radius of the location has changed direction of medium. Figure 1 (b) medium the location of the column in the radius direction is given. The abscissa of the radius of each point represents the direction of a dielectric column, 0 for medium radius direction in the middle of the column, plus or minus column position direction, said media ordinate said every medium column distance center medium column. Alumina almost perfect band gap structure makes it a very attractive material, therefore, choose here alumina as a medium of radiant photonic crystal column, the dielectric constant of 9.8. At the same time, the choice of air (s = 1) as substrate. The center of the radiant photonic crystal radius of 50 a. Here only consider the TM mode (column) electric field direction parallel to the media. When calculating the photonic crystal band and frequency lines such as the plane wave expansion method is used, when calculating the field distribution of the light field with the finite difference time domain method is used.

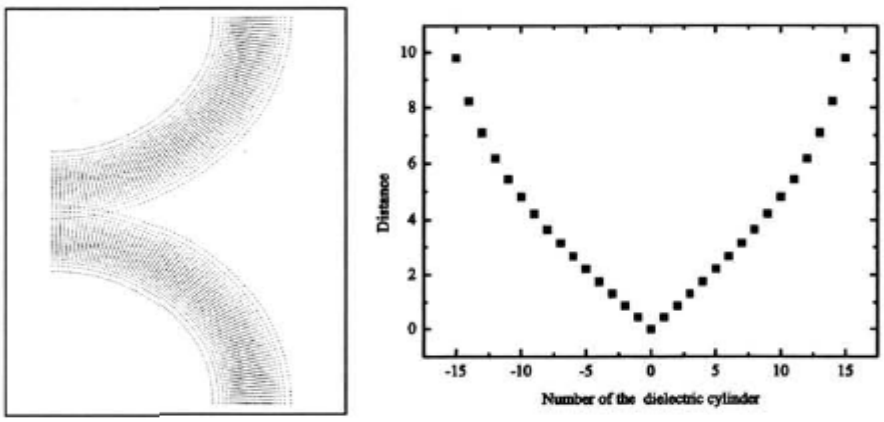

Fig.1. (a) Radiant photonic crystal splitter structure; (b) the location of the various radiation photon crystal layer medium column

Here defined exit surface at the top of the beam splitter for emergent l, exit surface of the bottom of the exit surface 2. Figure 2 (a) gives the radiant photonic crystal splitter every exit the transmission spectrum. The light source is placed in the left side of the beam splitter, 69 a from the plane of incidence, the width of the light source is 18 a. Can be seen from the diagram, the exit surface 1 and out shoot 2 basic is consistent with the transmission spectrum. Angelica sinensis, a frequency in the 0.12 to 0.2 (a/a) (a/a), between the transmission rate is relatively high. But the highest transmittance is only 33%. Gives the radiant figure 2 (b) the total transmission spectrum of

photonic crystal splitter, namely the sum of two emergent surface transmittance. Can be seen from the diagram, the maximum transmission rate was 65%, its corresponding normalized frequency of 0.133 (a/a).

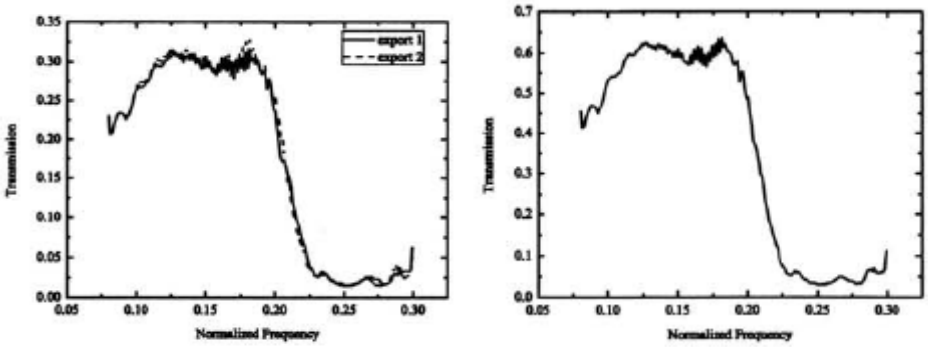

Fig.2. Radiant photonic crystal splitter (a) on the surface of the two transmission of transmission spectrum (b) the total transmission spectrum

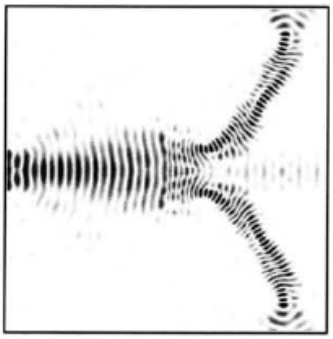

Fig.3. Incident light into the radiant field distribution map of photonic crystal splitter transmission

Figure 3 shows the frequency of 0.133 (fir) optical transmission through radiant field distribution of photonic crystal splitter. Can be seen from the diagram, although most of the light incident into the beam splitter, and exit from two exit, but one part by air and light beam splitter interface reflection without incident into the beam splitter, incident into the light there is also a part of the beam splitter will be on the border of two radiant photonic crystal scattering.

Radiant photonic crystal splitter design

In order to improve the radiant photonic crystal splitter transmittance of the system, and introduces the conventional photonic crystal structure of tetragonal structure. Square photonic crystal lattice constant is 7 a / 3, medium column radius of 14 a / 15. Crystalline silicon content of abundant natural and almost perfect band structure makes it a very attractive material, therefore, choose crystalline silicon as medium column material here. Crystalline silicon dielectric constant is 1 1.56 (n = 3.4).

At the same time, the basal material selection air (s = 1). Figure 4 (a) gives the photonic crystal frequency line, etc. Can be seen from the diagram, when the frequency range of 0.13 to 0.145 (a/a) (a/q), the photonic crystals such as frequency line is square. That is to say, in the light of the frequency range in square photonic crystal, autocollimation phenomenon happens. In introducing two round square photonic crystal defects, and the radiant photonic crystal splitter placed in the defect. The inner diameter of the defect of 40 a, width of 20 a. Figure 4 (b) is given to join square photonic crystal structure of the beam splitter system.

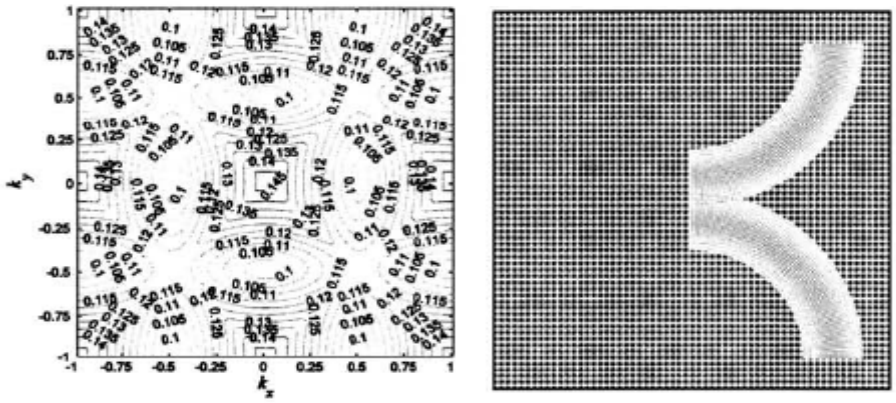

Fig.4. (a) such as frequency of autocollimation photonic crystals line; (b) to join autocollimation photonic crystal structure of the radiant photonic crystal splitter system

Figure 5 (a) is given to join each square photonic crystal structure of the beam splitter system exit the transmission spectrum. Light source is still placed in the left side of the beam splitter, 6% from the plane of incidence, the width of the light source is 18 a. Can be seen from the diagram, the exit surface 1 and out shoot 2 basic is consistent with the transmission spectrum. Angelica sinensis, a frequency (a/q) in 0.11 to 0.15 (a/a), the transmission rate is relatively high. The transmission rate of 40%. Gives the radiant figure 5 (b) the total transmission spectrum of photonic crystal splitter. Can be seen from the diagram, the maximum transmission rate was 80%.

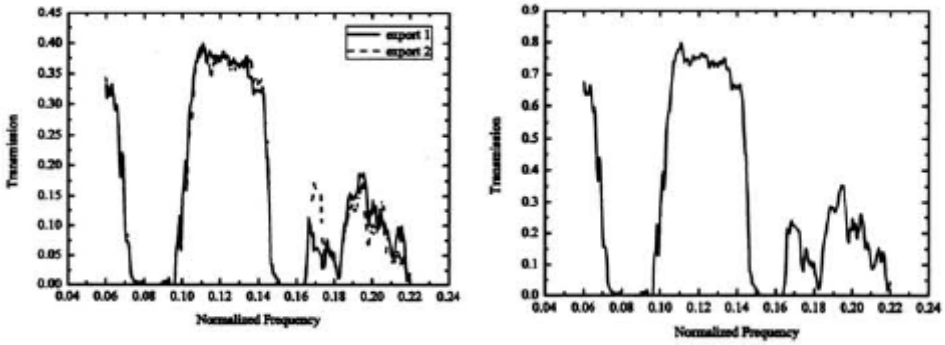

Fig.5. Radiant points Cambodia systems (a) photonic crystal on the surface of the two transmission transmission spectrum (b) the total transmission spectrum

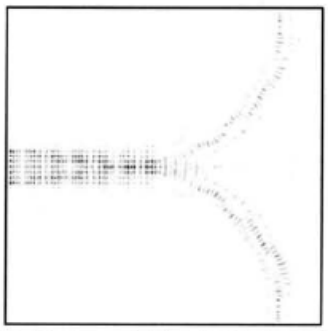

Fig.6.autocollimation photonic crystal defect radius for a 60 days in radiant photonic crystal splitter field distribution of the system

Figure 6 shows the frequency of 0.133 (a/a) optical transmission through joining square photonic crystal structure of the beam splitter system of field distribution. Can be seen from the diagram, in the process of transmission, almost all of the incident light will be along the autocollimation photonic crystals into radiant photonic crystal splitter, and along the radiant transmission photonic crystal splitter. However, there are still part of the incident in the light of the beam splitter will on the border of two radiant photonic crystal scattering.

In order to avoid the light leakage, which lies at the intersection of two radiant photonic crystal need to autocollimation expand photonic crystal defect. Can be seen from the field distribution and the inner diameter of the defect air and light autocollimation photonic crystals on the border of two radiant photonic crystal leakage there is no direct relationship. Here, therefore, only changed the autocollimation photonic crystal defect of air outside diameter.

Figure 7 shows the autocollimation photonic crystal defect of air outside diameter for 62 a, beam splitter system each exit the transmission spectrum. Light source is still placed in the left side of the beam splitter, 69 a, from the plane of incidence, the width of the light source is 18 a. Can be seen from the diagram, the exit surface shot the transmission spectrum of surface 2 l and the basic is the same. Angelica sinensis, a frequency (a/q) in 0.11 to 0.15 (a/a), the transmission rate is relatively high. Almost 45% and the highest transmittance. Gives the radiant figure 7 (b) the total transmission spectrum of photonic crystal splitter. Can be seen from the diagram, the maximum transmission rate was 87.5%.

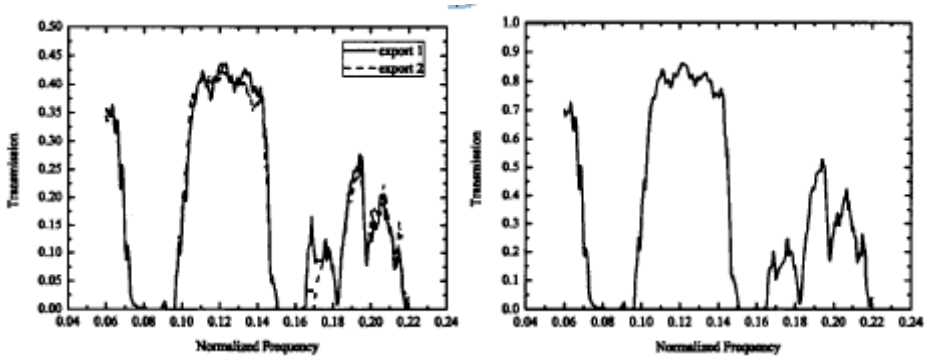

Fig.7. Autocollimation photonic crystal defect radius for 62 a radiant photonic crystal splitter system (a) on the surface of the two transmission transmission spectrum (b) the total transmission spectrum

Radiant splitting ratio of the photonic crystal splitter

To represent radiant photonic crystal splitter system splitting ability, defines the splitting than T = T1 / T2. Among them, the T1 and T2 respectively represent emergent surface 1 and the firing surface 2 measured transmittance. By changing the position of the light source can easily change the beam splitter splitting ratio of the system. Figure 8 shows the splitting ratio along with the light source position center distance from the axis of symmetry of the beam splitter system change curve. Among them, the abscissa represents the light source position center axis of symmetry of the distance from the beam splitter system, the unit is a, ordinate said splitting ratio. Can be seen from the diagram, when the light source position center distance from the axis of symmetry of the beam splitter system between 2 a and 9 a, splitting ratio change is bigger, and when the distance is less than or greater than 9 a, 2 a splitting ratio changed little.

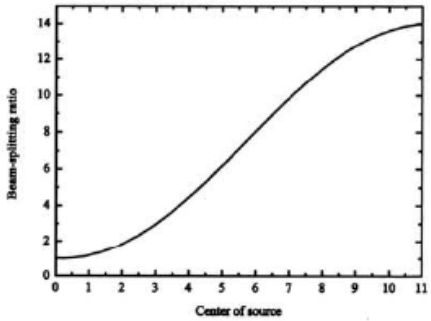

Fig.8.changes of the splitting ratio at different positions of the light source

Conclusion

This paper proposes a new beam splitter system. This kind of beam splitter system consists of two radiant photonic crystals and tetragonal autocollimation of photonic crystals. About the optimization of system parameters, points the Cambodian system overall transmittance was 87.5%. Beam splitter than can also be convenient to adjust. Optical splitter research is conducive to the further development of optical integration.

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