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Simulation of all-optical photonic crystals of NOT logic gate according to diagonal waveguide

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Abstract

In this article, an all-optical photonic crystals of NOT logic gate according to photonic diagonal waveguide is recommended. Photonic crystal network structure is triangular made up of dielectric rods under air layer. In this plan, simulation is met in a way that logic gate acts with NOT function through applying diagonal and intersecting waveguide structures and deviator bar in a certain frequency range. Necessary consumption power is too low for gate performance. In recommended plan, bend waveguide was used to increase transferring optical power. Also, non-linear bars were used, leading to reduced consumption power of gate. Input consumption power for appropriate gate performance is 200 mw and switching time is 0.62 ps. Resolution rate of this logic gate is 9.1 dB. PWE and FDTD methods were used for calculation and numerical analysis.

Keywords: all-optical logic gate, photonic crystals, Photonic forbidden band, bend waveguide, influence.

Introduction

NOT logical gate, an essential element of all optical signal processing markers is all light and optical communication systems The logical gate to increase the capacity and speed of information processing and transmission is used. [1] gate logic-based optical fiber are difficult to scale integration chip Interferometer waveguides-based optical logical gates of a structural arrangement is complicated. These doors also improve the structure of the semiconductor light emitting instantaneous limited by noise. [2] The presence of Photonic Crystal (PC) in the design of optical logical gates, high potential high-speed switching in compact and reduce the size and lower power consumption have created. [3]

Photonic Crystal proposed new class of insulating materials that can be used in the manufacture of photonic integrated components with dimensions in the range of wavelengths used. [4]

Photonic Crystal, different wavelengths of light to be selectively reflected or transmitted. There are a range of wavelengths in the crystal because of the frequency of the crystal lattice, fully reflects the light and suffered, photonic forbidden band (PBG) said. [5]By creating a defect in the crystal lattice structure can redirect light in the banned band them. Change by removing a row of bars in the crystal lattice structure which is called a waveguide, is created. [5]

Angles between the waveguide resonator ° 45 located at some frequency is The destructive interference, leading to transmission operations can be difficult. Transmission rate at LOW, % 17 reported and the transfer of power in HIGH, % 85 would-be. [6]

In 2011 Nooshad and colleagues, all optical photonic logical gate of the NOT gate is one of them raised The gate of the photonic waveguide structure right is used to cross In the center of the logical gate with a rod linear bearing bars are used more than others. This increases the power consumption of the gate The power transmission gate logical output enabled 90% have been reported. [7] Pretty Rain

et al., in 2013, of a logical gate suggested all other optical The design of photonic crystal structure with a triangular lattice of air holes in the dielectric substrate is used. Different radius of a hole in the center of the Y waveguide is used. DB6 proposed rate is clearly gate. The gate at high bit rate Tbit / s83 / 0 works. [8]

The proposal paper, tilted waveguides structure is used as the convention without the use of nonlinear effects lead to lower power consumption and increase the resolution rate is logical gate. The proposed logical gate switching time is less than the above-mentioned articles.

Numerical analysis of methods

Photonic Crystal structure-based analysis components that can be done in two ways: (1) determine the photonic crystal lattice bar diagram, logical gate used to determine the frequency range that extends through short-wave plate (PWE)

2- determine the extent of the transmission and reflection of the light in the photonic network gate finite difference time domain method logical all the light (FDTD) occurs. [4] Photonic crystal all-optical logical gate process simulation software offers Rsoft done. BANDSOLVE crystal lattice bar diagram using the software simulation is Rsoft. PWE is listed calculation tools. Transmission and reflection optical power output curve logical gates using software FULLWAVE RSOFT be simulated. FDTD method is to calculate the above-mentioned tools.

Analysis waveguides structure tilted and bent waveguides

In this section, the analysis hard tilted and bent waveguides wave guides paid The logic gate used in the design proposed a triangular crystal lattice of dielectric rods in air substrate radius a2 / 0 and a refractive index 4/3 and networks a25 × 25 (a fixed network) Bar diagram structure Band solve software tool that simulated Rsoft banned photonic band structure (a / λ) 4518 / 0-2803 / 0 respectively. Figure 1 shows the structure of the bar diagram.

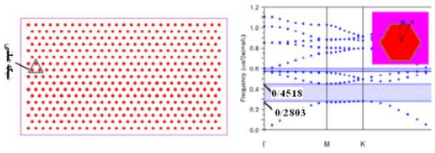


Figure 1 - Diagram of bar the triangle network

Now, a waveguide structure by removing a row rod in order to create TK (Figure 2)

. Using linear defects can we redirect light from one place to another, it would be part of the frequency band becomes an area banned the signal light spread. The light in the waveguide frequency band for the banned to be released the signal light spread. The light in the waveguide frequency band for the banned to be released into the defect is limited and leads to failure. The waveguide mode within the waveguide is reduced and more bandwidth is banned. Frequency a / λ3398 / 0 to a / λ4518 / 0 defined region of the waveguides. Intermediate frequency, calculated 3958/0

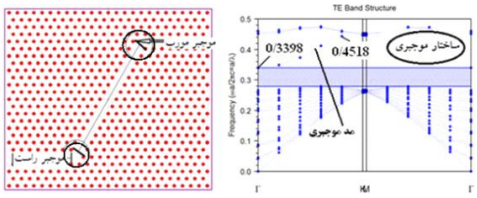


Figure 2 - Strip diagram oblique waveguide structure waveguides mode

Figure 2 shows a bar diagram waveguides structure. The structure of a waveguide diagonally to connect the two straight waveguide is made the bent waveguides with two circles shown in the output optical power transfer rate may be higher. Now, the waveguide into a signal pulse frequency and amplitude of the middle pa will apply.

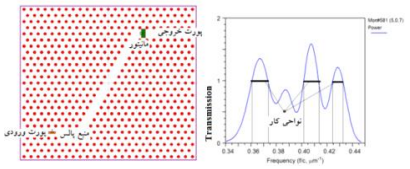


Figure 3 - diagonal and curve waveguide structure of power transmission

By doing pulses in the waveguide, the optical power transmission range and frequency range suitable for the proper functioning of the proposed gate is checked. Figure 3 the bandwidth of the three areas that show the highest rate of transmission of power in the output waveguide shows. This increases the flexibility of logical gate are proposed in different frequencies to form logical gate based connections such as waveguide cross waveguides, waveguides bend and used. . Bend over double the efficiency increases. The Bend waveguides structure and the optical power transfer curve display.

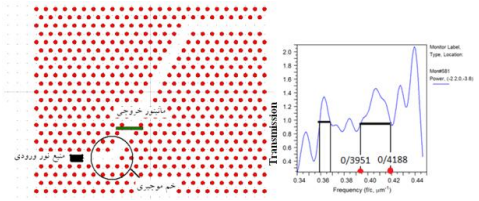
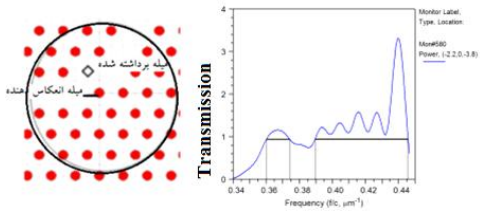


Figure 4 -

Figure 4 is a transfer rate of optical power output using a simple waveguides structure Bend over pa98 / 0 to the waveguide structure is increased right. According to Figure 4, bandwidth and transmission range in the output waveguides structure by bending increased Because of the increased in the two parameters mentioned increase coupled bending and elongation coupled waveguides is Bend. More signal coupling between the waveguide length of Bend to the input and output waveguide. The transmitted power output Bend increases. Logical gate used to increase bandwidth of another Bend shown in Figure 5 The design is suitable for the main gate. The Bend waveguides 5 a rod removed the diamond symbols are displayed result.



5. The waveguides Bend and curves of improves power transfer

By removing the rod Bend over a full coupled between the waveguide output increased and the input waveguide is established.

Reflecting a bar area on the right Bend added. The input signal is reflected by a collision with the rod to Bend, leading to a complete transfer of the signal can be output. It can be argued that the coupled rod bent increases. When an optical power injected into the waveguide. The constructive interference of light transmission at some frequency even intermediate frequency signal amplification to the output. According to Figure 5, is considered that changes in the structure of the output Bend In addition to increasing Transmission rate increases have been doing a lot of bandwidth.

1. The design and simulation of logic gates NOT light the final structure of logical gate NOT all of a waveguide optical waveguide right oblique and transverse rods Bend waveguides and a deflection in the intersection area is formed.

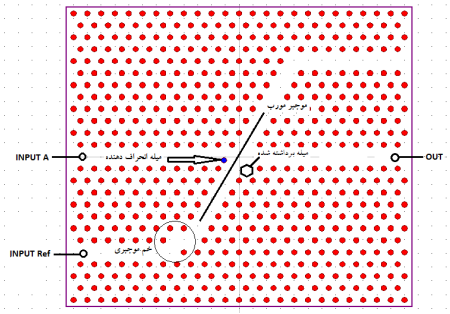
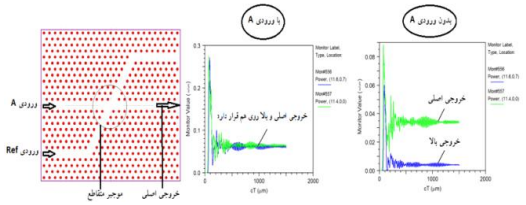


Figure 6 NOT logical gate structure

Structure Figure 6, has an entrance Ref, input A and an output F and the other is output. A input circuit is determined as main entrance Ref input as the operation works, so that their presence function is NOT possible. F output of the output circuit the second output Order to achieve NOT function with deflection rod that are used in the structure. If a second exit in the Do Not Create,. In two single-modes input range of input and main output will be increased and the active logical gate is high. As a result of a logical function NOT is not fulfilled. The deflection rod with a circle in the desired location has been determined. The rod also is linear and radial bars and other bars. The logical gate structure without deflection rod in the center the cross structure review. Cw signal to an intermediate frequency by applying both the main entrance and main entrance, we simulate the output range

. Figure 7, the logical gate NOT diversion without rod with power transfer the curve in the show.



With regard to the transfer the curve turns out to be the case without the original signal (input A), the reference signal to the input A and move a small amount of the main outlet passes (03/0).

In imposing main entrance together two signals A and reference signal Ref is reflected in the crystal lattice. Because of The destructive interference between the signals at the intersection of waveguides is reflected in both cases, the input, the

output of logical gate used in Low mode. However, by placing a bar at the intersection of waveguide structure our analysis In Figure 8, the location bars (a3 / 0- and a5 / 0-) is. (A, fixed network) radius rod bars with identical structure. . Long as the circuit does not apply to main entrance, the waveguide input signal Ref diagonal passes and collision bars are deflection to the output waveguide F is released . Gate output state is high. To move in the output waveguide, a structure in the Bend rod is removed. By removing the bars, the route will enhance Bend and lead to further transmission can be output waveguide.

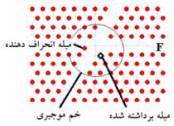


Figure 8. Remove the Bend bars is shown with the arrows

In Figure 8, waveguides Bend in the bars vacancies is marked the diamond mark. Diagonally pass from waveguide input power and hit the bars will deflection By removing the bars Bend in the Bend waveguides length and amount of the increase reflected more and more light can be transmitted to the output. Now, with the continuous signal output from the input A to check the status of pay When two signals are input to the intersection, a The destructive interference occurs at the intersection. A waveguide input waveguide length is the length of the input Ref. During inequality leads to different input waveguides when the input signal is at a crossroads. Different time, different place in the gate structure and thus lead to the phase difference between the input signals. This phase leads to the destructive interference at the arrival gate building The result is reflected in the structure of the gates is the Gate output and can be offered in Low mode. The value of like-for input signal output logical gate A, 13/0If the signal is not applied from the main entrance A, there is only one input signal, the input waveguide Ref Diagonally passes and collision bars to bend collided misleading And transmitted to the

output. The amount of power output is simulated in this case 05/1. Following figure the curve power transfer in both the main entrance and main entrance shows.

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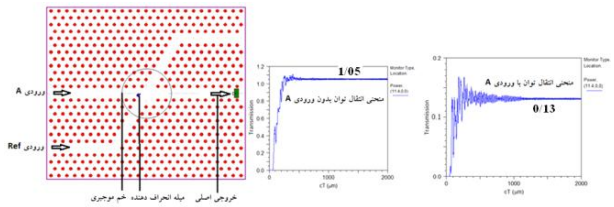

Figure 9 - NOT logical gate structure and power transfer the curve

According to the simulated values in the case of all-optical logical gate NOT is.

One of the major results of the proposed logical gate design, using the crystal lattice structure is diagonally waveguide the proposed logical gates, nonlinear rod is not used. The logical gate due to lack of linear bars (bars nonlinear refractive index in the crystal lattice structure strongly depends on the optical power [10].). The power consumption, mw 200 simulated.

Results

Photonic Crystal is one of the most important structures of logical gates are all light. The crystals are not wasted power and high power transfer capability to the semiconductor optical amplifiers are semiconductor optical Interferometer. In proposal, the bars linear and non-linear effects are even used. Line the shift bars (rod deflection of) At the junction of network structure and changes in the bend waveguides, the logical gate is realized and the ability to transfer power output increases. The power consumption is mw200 proposal Compared with the same type (China Woo et al. [1] improved In proposal Noshed [7] et al in 2011 can transfer In output waveguide 90% expressed gate Since switching to the proper functioning of the proposed gate ps62 / 0 is simulated. The proposed resolution gate logical rate dB1 / 9 are Proposal In this wavelength μm55 / 1, the fixed network μm613 / 0's. In proposal as regards the non-linear effects are used, but the well-designed mechanism, the logical gate input power for all optical switching of frequency stability is reduced.

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