Design a Bragg Resonator

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Abstract - This proposal report describes design a Bragg resonator and simulation of the design to obtain high Q factor.

I. Introduction

The purpose of this report is to design a Bragg Resonator and simulate the design to get high value of Q factor with less 0.2nm of Free Spectral Range. The target central wavelength is 1310nm with 220nm thickness. By Using several programs such as MATLAB and Lumerical, find the needed parameters to get high value of Q factor. Then, compared each obtained result.

II. Theory

Working later

III. Modelling Waveguide

For modelling waveguide, 1310nm target central wavelength and 220nm thickness of Silicon with an oxide cladding SiO2 was used. Then used 335nm width strip waveguide instead of 350nm because of shrink issues during the fabrication.

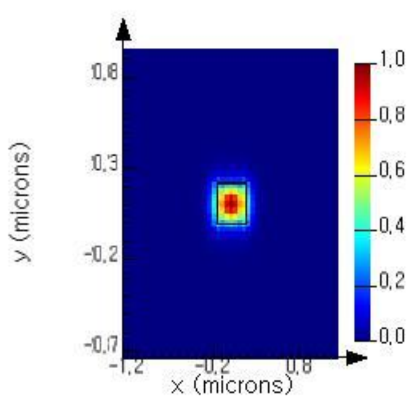

Figure 1: TE polarization of 1st mode waveguide profile with 1310nm, 350nm width and 220nm thickness

First of all, the effective index and group index was simulated by using Lumerical MODE.

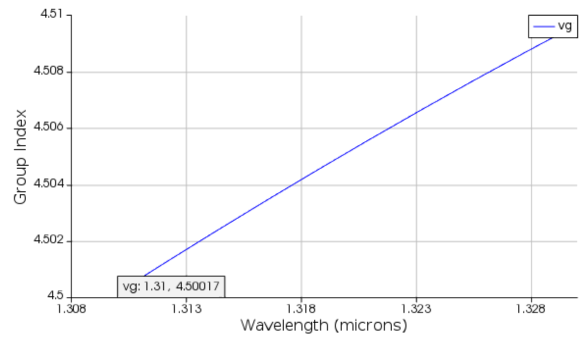

Figure 2: Group Index vs Wavelength graph

The group index was determined to be 4.5

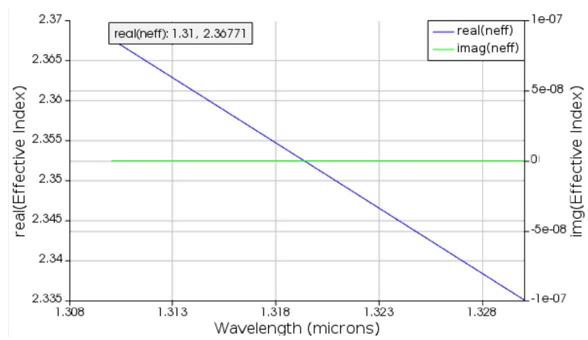

Figure 3: Effective Index vs Wavelength Graph

From this data, the effective index was fit into second order polynomial, which equation is below (unit : [μm]).

$n_{eff} = 2.36771 + 1.97686(\lambda - 1.31) + 1.45205(\lambda - 1.31)^2$

Based on this equation, effective index was 2.37. And with this value of effective index, Bragg grating period obtained from the following equation.

$$Bragg\ Grating\ Period = \frac{\lambda 0}{2 \times \text{n\_eff}} = \frac{1310nm}{2 * 2.37} = 276nm$$

IV. Simulation

A unit cell Bragg grating using Lumerical FDTD was simulated to get maximized value of kappa with 1310nm central wavelength.

For this simulation, group index(n_g)is 4.5, 335nm waveguide width(w) and 277nm bragg grating period was fixed.

And obtained value of kappa by simulating with changing dw of waveguide from 10nm to 80nm with 5nm steps. The following is the results.

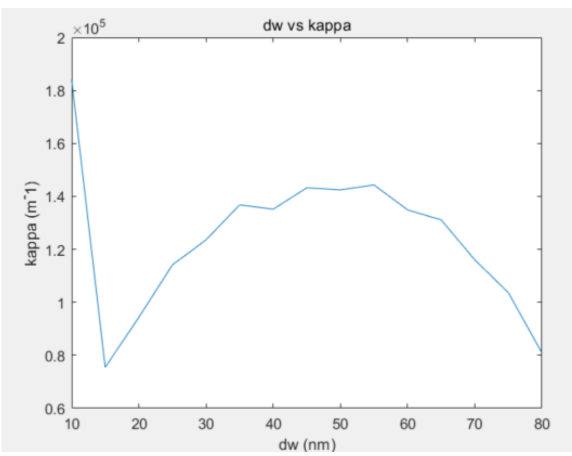

Figure 4: dw vs kappa

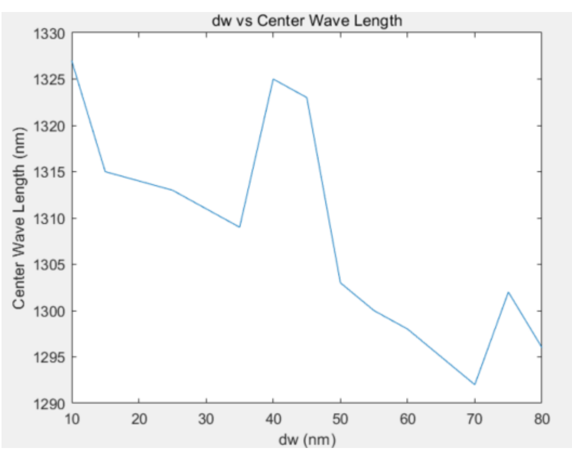

Figure 5: dw vs Central Wave Length

From the figure 4, the value of kappa is higher between 30 to 60nm of dw. However, our focus on central wave length is 1310nm. Therefore, by comparison the values, when central wave length is 1309nm, dw is 35nm. Therefore, the value of kappa is 136776 from the FDTD simulation. And obtained kappa value, delta_n was calculated which was 0.0895

V. Transfer Matrix Method

Working on it

VI. Lumerical INTERCONNECT

Working on it