課題番号　　:F-14-UT-0144
利用形態　　:機器利用
利用課題名(日本語)　　:非交差導波路を用いた光スイッチに関する研究
Program Title (English)　:A New Optical Switch: Non-crossing Waveguide with Ring
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1. 概要(Summary)

Optical switch is an important device in Si photonics for wavelength division multiplexing (WDM) communication networks. Waveguide crossing and light directional switch are fundamental devices, and the switch function has been realized using Si ring resonator with thermal controller. However, crossing of two waveguides leads to a large scattering loss and cross talk due to high optical confinement in Si waveguides, which delays in WDM application of Si photonics.

The lowest crossing loss reported is 0.045 dB/crossing [1], using multimode interference (MMI) structure as in Fig. 1. However, the MMI crossing cannot function as a switch and thus use as an optical switch. The present report proposed a novel structure of optical switch; non-crossing waveguide with a ring; two taper-out waveguides for crossing as in Fig. 3. Two-dimensional (2D) finite domain time difference (FDTD) simulation reveals that the taper-out crossing reduced its crossing loss to 0.02 dB/crossing at 1550 nm.

2. 実験(Experimental)

We fabricated the optical switch circuits using electron beam lithography at Takeda CR. The sidewall roughness has been a main source for the scattering loss inside the waveguide [2]. We will use a recipe of a mixture gas of SF_6, CHF_3 and O_2 for a smooth side wall and high anisotropic etching of the Si waveguide [3].The flow rate of the mixture gas, bias power and the gas pressure as parameter will be optimized for silicon etching. SiN_x will be sputtered and etch to form the cladding waveguide, and finally SiO_2 will be deposited by sputtering.

3. 結果と考察(Results and Discussion)

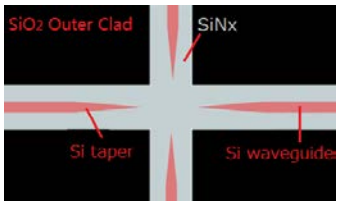

Fig. 1　Non-crossing intersection

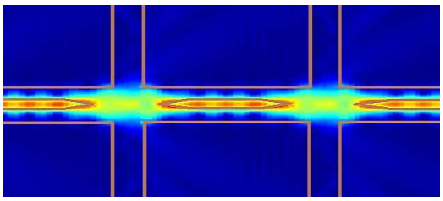

Fig. 2　New taper-out crossing

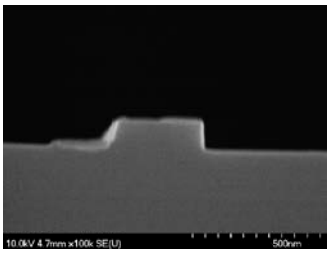

Fig. 3　The SEM picture of the cross section of fabricated waveguide

The crossing loss is measured by Transmission measuring system. 0.048 dB/cross is observed at 1550 nm, while the cause of the mismatch between experiment and simulation is still unknown and need further experiment.

4. その他・特記事項(Others)

参考文献

[1] M.A.Popovic, et al., Opt. Lett. **39**-2, 335, 2014.

[2] C. Manolatou, "Passive Components for Dense Optical Integration Based on High Index-Contrast", June 2001, Ph.D. Thesis, MIT.

[3] R. Legtenberg, et al. J. Electrochem. Soc., **142**- 6, 2020, 1995.

5. 論文・学会発表(Publication/Presentation)

なし

6. 関連特許(Patent)

なし