1. 概要（Summary）

In the field of photonics, one of the critical factors for optical resonator is the precise control of the resonant wavelength. Trimming is the solution to this problem. To pre-check the availability of neutral beam technology for waveguide trimming, in this report, we propose an estimation of silicon waveguide trimming effect by the approach based on Neutral Beam Technology.

2. 実験（Experimental）

The silicon waveguides were designed to be fabricated by Electron Beam Lithography and Reactive Ion Etching. For the NBO（Neutral Beam Oxidation） process, a vertical oxygen neutral beam can generate the NBO layer except the sidewall region of waveguide. By tilting the neutral beam, the sidewall of silicon waveguide can be oxidized, as shown in Fig. 1.
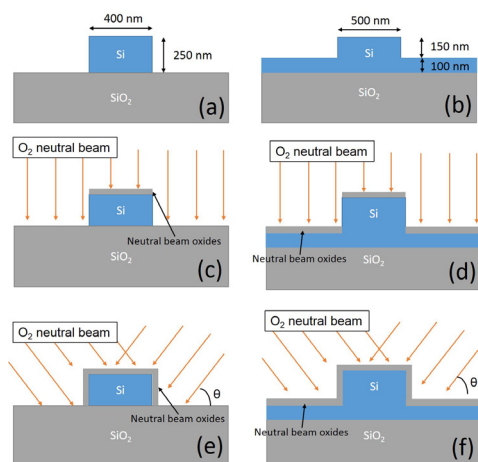

Fig. 1. The schematics of channel and rib waveguides treated by different NBO processes.

3. 結果と考察（Results and Discussion）

Generally, for an optical resonator, the resonance shift $\Delta\lambda$ due to the change of refractive index Δn_{eff} can be expressed by,

$$\frac{\Delta\lambda}{\lambda} = \frac{\Delta n_{eff}}{n_{eff}}. \qquad (1)$$

Based on Equation (1), the resonant peak shift can be estimated utilizing the data calculated above. Fig. 2 shows the estimation of resonance peak shift with the NBO layer up to 2 nm. The peak shift per nanometer NBO layer are 1.66 nm, 1.83 nm, 2.85 nm, and 4.8 nm for the vertical NBO channel WG(waveguide), the vertical NBO rib WG, the full NBO rib WG, and the full NBO channel WG, respectively. The trimming of wavelength offset by the NBO treatment is promising.
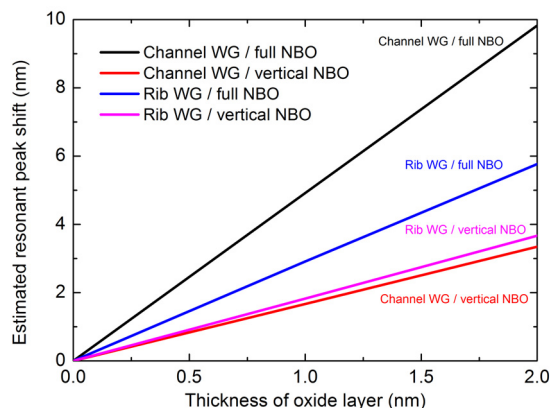

Fig. 2 Estimation of resonance peak shift with the NBO layer thickness.

4. その他・特記事項（Others）

なし。

5. 論文・学会発表（Publication/Presentation）

(1) J. Cai, T. Kubota, S. Samukawa and K. Wada, The Eighth International Symposium on Advanced Fluid Information and Transdisciplinary Fluid Integration, Nov. 2013.

6. 関連特許（Patent）

なし。