COMPACT AND HIGH SENSITIVE SLOTTED BRAGG GRATING ON SOI PLATFORM FOR REFRACTIVE INDEX SENSOR

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Introduction

Essentials for silicon photonics are lowering size and cost without affecting effectiveness for various performances. One of the effective sensing elements with smaller footprints and few step fabrication is a micro ring resonators (MRR). Using slotted waveguides and sub-wavelength gratings (SWG) in MRRs have shown higher sensitivity [1-2]. Recently combination of the SWG and slotted waveguides exhibited even higher performances [3]. In the study, we propose a sensor with slotted SWGs on straight waveguide where Bragg grating (BG) reflection condition is fulfilled.

Structures and operation principle

In order to lower losses two different gratings in one period are also investigated, as shown in Fig. 1. For single etch-step process we adopted a high mesa waveguide of 340nm height with slots of no smaller than 30nm wide due to fabrication limit. We select waveguide parameters to obtain Bragg reflection condition:

$$2\Lambda n_{eff} = m\lambda_B,$$

where Λ is a period, m an order of Bragg diffraction, n_{eff} a waveguide effective index and λ_B a centre wavelength of the Bragg stop-band. For the lowest losses m should be one. An operation wavelength is near 1.55 μm. Refractive indices of a surrounding medium is 1.333 for water and 1.343 with alcohol.

Simulated results

With single grating type in one period we found that 3 slot case where the outer slot widths have half of middle width are best having a high sensitivity S = 605 nm/RIU, an extinction ratio ER =26 dB, a loss -5.3 dB and a sensor length as small as 6.5 μm. For two types of gratings in one period 3 to 4 slot case were the best with S = 636 nm/RIU, ER =33.3 dB, as shown in Fig. 2, and a loss -4.6 dB for a sensor length 17.6 μm.

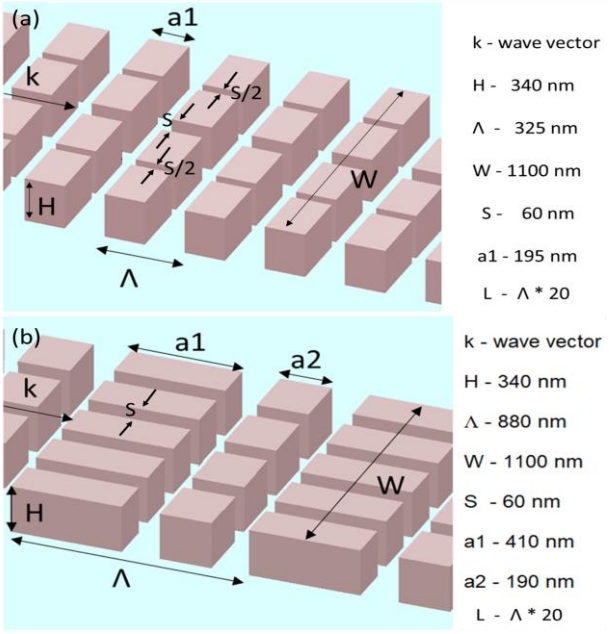

Fig. 1. (a) Single and (b) double BG structures.

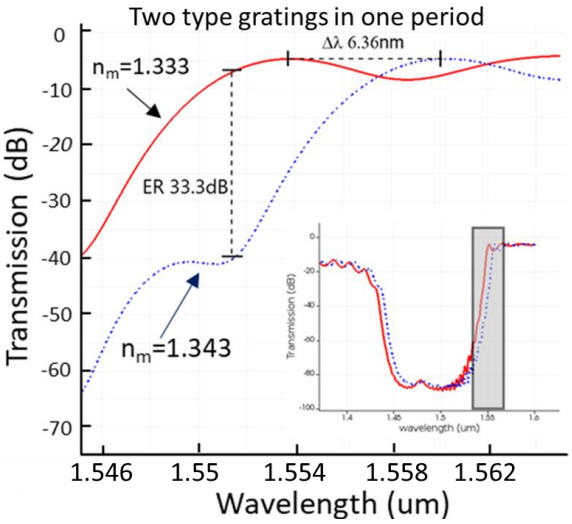

Fig. 2. Thansmission characteristics of the proposed device under the refractive index change. Inlet shows the whole stop-band.

References

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