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利用形態 :機器利用
利用課題名(日本語) :
Program Title (English) :Development of mid-infrared Ge photonic integrated circuits
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リソグラフィ・露光・描画装置

1. 概要(Summary)

Mid-infrared (mid-IR) integrated photonic circuits (PICs) have numerous applications in biochemical sensing. However, traditional Si PICs suffer from strong optical absorption originating from waveguide and substrate materials in the fingerprint spectral region (8-15 μm). To overcome this limitation, we developed a novel Ge PICs. Specifically, we demonstrated a mid-IR Ge microring resonator [1] with the recorded quality (Q) factor and the first mid-IR Ge photonic crystal nanobeam [2]. Based on these results, we also delivered several oral presentations [3, 4] and invited talks [5, 6]. Our study is expected to play an important role in low-cost and portable sensing applications for molecular fingerprinting.

2. 実験(Experimental)

【利用した主な装置】高速大面積電子線描画装置, 電子顕微鏡

【実験方法】We designed and fabricated the devices based on a Ge-on-insulator (GOI) wafer in Takeda CR. We utilized electron beam lithography (F7000S) to write the devices' patterns on a resist (ZEP-520A) and used a deep reactive ion etching machine to transfer the patterns from the resist to the GOI wafer. Then, the buried oxide below the devices was removed with hydrofluoric acid such that the devices were suspended in the air. After fabrication, we checked the structure of the fabricated devices by using a scanning electron microscope (SEM) (S-4700).

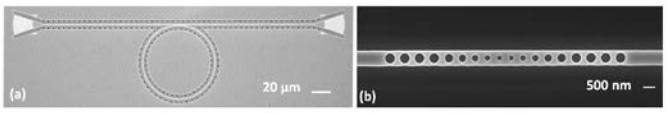

Fig.1 Scanning electron microscope (SEM) images of the fabricated Ge PICs. (a) Chip-integrated microring resonator. (b) Photonic crystal nanobeam.

3. 結果と考察(Results and Discussion)

The SEM images of the fabricated Ge devices are shown in Fig.1. At the wavelength range of 2.2-2.5 μm, we demonstrated the Ge microring resonator (Fig. 1a) with a loaded Q factor of 58,000 and the Ge photonic crystal nanobeam (Fig. 1b) with a Q factor of 18,000.

4. その他・特記事項(Others)

なし

5. 論文・学会発表(Publication/Presentation)

(1) T. -H. Xiao, Z. Zhao, W. Zhou, C. Chang, S. Set, M. Takenaka, H. K. Tsang, Z. Cheng, and K. Goda, Optics Letters, Vol. 43 (2018) pp. 2885-2888.

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(3) Z. Cheng, T. -H. Xiao, Z. Zhao, W. Zhou, C. Chang, S. Set, M. Takenaka, H. K. Tsang, and K. Goda, Photonics West, San Francisco, USA, 2019 年 02 月 06 日.

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(5) Z. Cheng, T. -H.Xiao, Z. Zhao, W. Zhou, M. Takenaka, H. K. Tsang, and K. Goda, The Conference on Lasers and Electro-Optics Pacific Rim, Hong Kong, 2018 年 07 月 30 日.

(6) T. -H. Xiao, Z. Zhao, W. Zhou, M. Takenaka, H. K. Tsang, Z. Cheng, and K. Goda, Progress in Electromagnetics Research Symposium, Toyama, Japan, 2018 年 08 月 03 日.

6. 関連特許(Patent)

なし