Loss reduction at slab-array interface in Si waveguide AWG using local rib waveguide structure with minimum terrace area

Hideaki Okayama[1,2], **Yosuke Onawa**[1,2], **Daisuke Shimura**[1,2], **Hiroki Yaegashi**[1,2] **and Hironori Sasaki**[1,2]

[1] Oki Electric Industry Co., Ltd., R&D Center, [2] PETRA
E-mail: okayama575@oki.com

1. Introduction

We reported on design considerations for arrayed waveguide grating (AWG) using Si wire waveguide [1] to realize 100GHz-class channel spacing with improved loss characteristics. The rib waveguide structure with terrace is often used to reduce the excess loss generated at slab to arrayed waveguide junctions [2, 3]. In a previous report, we proposed a very simple structure for this purpose using minimum terrace area [2]. In this report we demonstrate the experimental results.

2. AWG device structure

The structure of AWG is shown in Fig.1.We use slab waveguides with parallel arrangement and stray light reduction structure similar to previous reports [1, 2]. The arm length is designed to attain 100 GHz wavelength channel spacing and 200% wider free spectral range (FSR) for the TE mode. A 1 μm wide and 200 nm thick wire waveguide is used at the arrayed waveguide.

Loss reduction structure at the slab to arrayed waveguide interface was examined by 3D-FDTD simulation. The MMI-rib waveguide aperture showed the lowest insertion loss and highest uniformity. The terrace area of the rib waveguide can be placed only near the end of the slab to collect the light radiated into the gap. We used 3 μm wide apertures (500 nm gap) at the slab to arrayed waveguide interface. For this wide aperture, a parabola like width taper [4] was required to connect MMI and arrayed waveguide for low loss. The terrace thickness of 130 nm was used which is a standard in the foundry. A 0.6 dB total excess loss from input to output is attained by the simulation.

3. Experimental results

The device was fabricated using SOI wafer, the immersion ArF lithography and dry etching. Measured wavelength response is shown in Fig. 2. The device was designed for 8ch output. The insertion losses of 1.2 dB at minimum and extinction ratio of 16 dB were attained. The output uniformity was 0.5 dB. A device with simple width taper wire waveguide and 5μm apertures was also fabricated. The insertion loss was 4 dB for this device. We attained 2.8dB improvement by using the terrace structure which is near the expectation obtained by theory. The waveguide width deviations were 3 times larger than in previous report [1] which explains higher crosstalk and increased loss (+0.5dB) compared to the theory.

4. Conclusions

The Si wire arrayed-waveguide 8ch AWG with 100 GHz channel spacing showing 1.2 dB insertion loss has been reported. A loss improvement of 2.8 dB was attained using minimum terrace area.

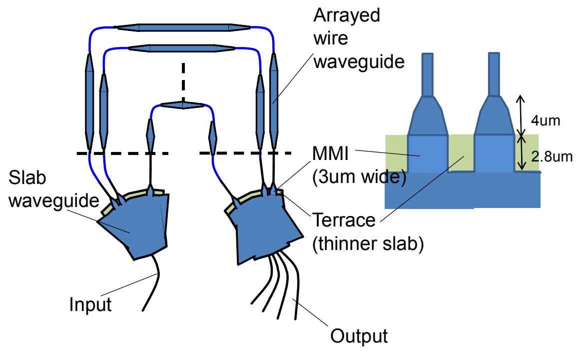

Fig. 1 AWG device structure

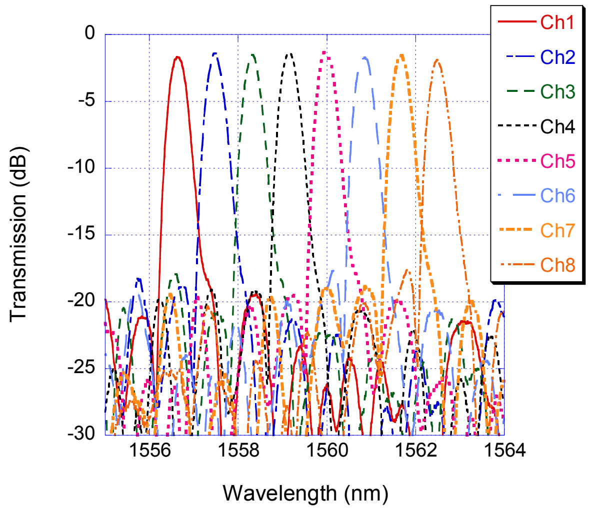

Fig. 2 Measured wavelength response

Acknowledgements

This research is partly supported by New Energy and Industrial Technology Development Organization (NEDO).

References

[1] H. Okayama et al., Tech. Digest JSAP-OSA Joint Symposia 2015, paper 14a-PB3-6. [2] H. Okayama et al., JSAP 2016 Spring Convention, paper 21p-P16-1. [3] J. Park et al., Appl. Opt. vol. 4, pp. 5597-5602, 2015. [4] T. Ye et al., Opt. Express. Vol. 22, pp. 31899-31906, 2014.