Si waveguide AWG using local rib waveguide MMI coupler structure at slab-array interface

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 have reported a low loss Si wire arrayed waveguide grating (AWG) using parabolic rib waveguide taper [1] to realize 100GHz-class channel spacing. We proposed recently a more simple structure using multi-mode interference coupler with minimum terrace area [2] for loss reduction. In this report we demonstrate an experimental results showing lower loss obtained by foundry dependent improved fabrication process for the latter device.

2. AWG device structure

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

Structures for loss reduction at the slab and arrayed waveguide interface were explored using 3D-FDTD simulation. A simple rectangular MMI-rib waveguide aperture showed a low insertion loss. The terrace area placed only near the end of the slab can be used to collect the light radiated into the gap. We used 1.5 μm wide apertures (500 nm gap) at the slab to arrayed waveguide interface. The 130 nm terrace thickness was used which is a standard in the foundry. By the simulation a 0.75 dB total excess loss from input to output is attained.

A simple taper waveguide with 1-1.5 μm widths shown as inset in Fig. 1 also exhibits relatively low loss. The minimum loss obtained with this structure was 1 dB for 1 μm width which is slightly larger than achievable with MMI. Wavelength ripple due to mode interference is reduced in narrower waveguides.

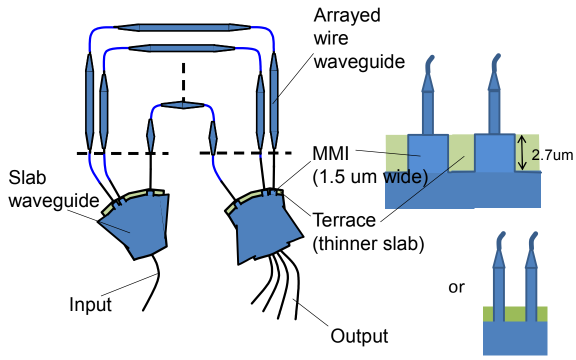

Fig. 1 AWG device structure

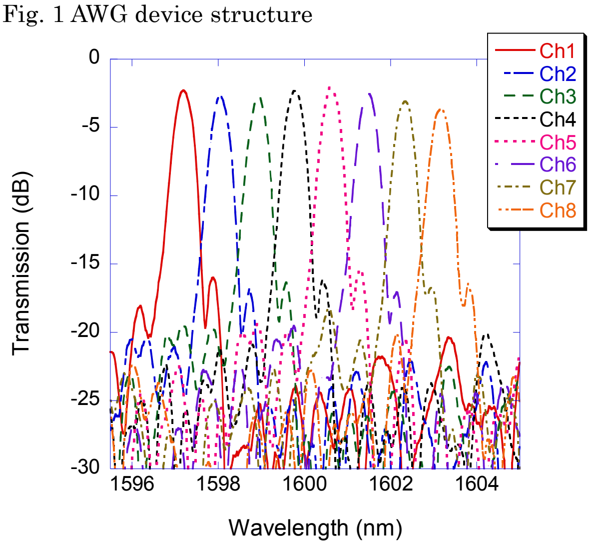

Fig. 2 Measured wavelength response

3. Experimental results

The SOI wafer, the immersion ArF lithography and dry etching were used for device fabrication. Measured wavelength response for 8ch output device is shown in Fig. 2. The insertion losses of 2 dB at minimum and extinction ratio of 14 dB were attained. A device with simple width taper wire waveguide and 5μm apertures was also fabricated obtaining an insertion loss of 3.8 dB. We attained 1.8 dB improvement by using the terrace structure. The higher crosstalk and increased loss (+1.3dB) compared to the theory is presumably due to the phase error.

4. Conclusions

The Si wire arrayed-waveguide 8ch AWG with 100 GHz channel spacing showing 2 dB insertion loss has been reported using simple rib waveguide MMI coupler at the slab-array waveguide interface. The obtained loss is among the lowest observed for 100GHz spacing Si waveguide devices including echelle grating [3].

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References

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