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Performance Comparison Among Silicon-based Arrayed Waveguide Grating with Rowland and Confocal Configuration

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Abstract: With comparison, experimental results show that the AWG with Rowland configuration in combination with constant period along the tangent line to its grating pole for arrayed waveguides has the best cross talk

1. Introduction

Silicon-based N×N AWG is a key component in optical wavelength division multiplexing (WDM) networks since it can simultaneously process N2 signals at N different frequencies, significantly improving the transmission capacity [1]. Silicon AWG has a very compact device size due to the high-refractive-index contrast between silicon core and its silicon oxide (SiO2) cladding, and can be massively produced by employing CMOS technology, which can dramatically reduce the cost [2]. In this paper, we compare the performance between two widely used configurations in silicon-based AWG, i.e., Rowland and Confocal configuration. We also compare the performance under array waveguides using constant curved period in grating line and constant period in tangent line with respect to its grating pole, respectively.

2. Design

Figure 1 shows schematic of two widely used configurations of star coupler in AWG. We designed three different AWG structures as listed in Table 1. These photonic designs are fabricated on silicon-on-insulator (SOI) platform using CMOS compatible process. Center of a circle of Rowland circle and concave gratings could be located on different position, like on the circle (Confocal structure) or center of each other. Waveguide separation should be same, including same dispersion along the circle or along the tangent line of circle.

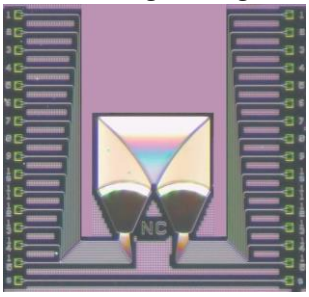

Fig. 1. Schematic of arrayed waveguide grating design

Table 1. Different AWG structure

Number	Star coupler type	Arrayed waveguide distribution
CP	Confocal configuration	Constant tangent period
RC	Rowland circle	Constant curved period
RP	Rowland circle	Constant tangent period

3. Experimental Results and Discussions

For the first design, the two circles are Confocal configuration. The input waveguides are distributed along the circle whose center is on the other circle but the separation is same on the tangent period. The schematic and

testing results are shown in Figure 2. For the second design, it is not Confocal configuration but Rowland. The input waveguides are also distributed along the circle but the center is on the center of another circle instead of this circle. For the AWG testing, we selected both center and edge waveguide as input and then monitor every output end for the AWG structure which is totally symmetric as shown in Figure 3. For the third design, array waveguides separation are gradually increasing along the circle but same along the tangent line of circle as the results are shown in Figure 4. In comparison, among the three design results, the third one's performance is best because the distinguish ratio is beyond around 20dB.

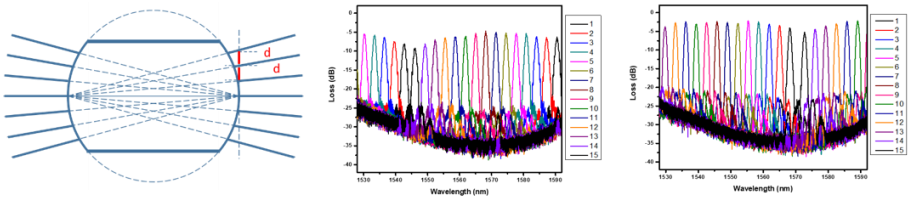

Fig. 2. Schematic illustration and testing results of CP configuration

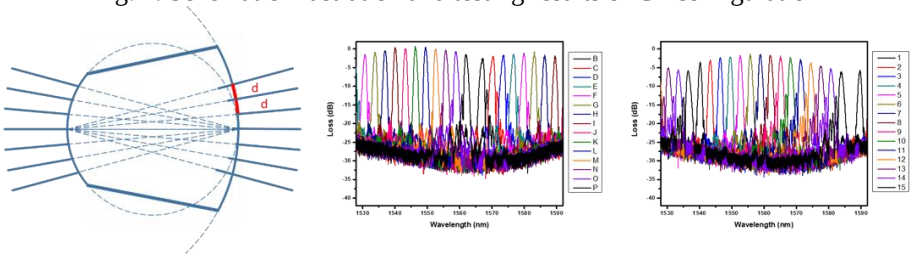

Fig. 3. Schematic illustration and testing results of RC configuration

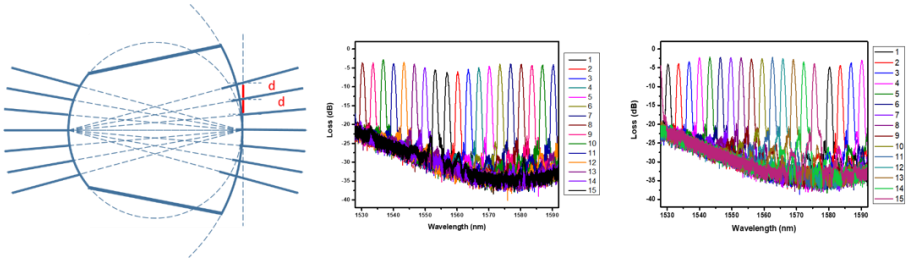

Fig. 4. Schematic illustration and testing results of RP configuration

4. Conclusions

In this manuscript, we compare silicon-based arrayed waveguide grating (AWG) with two widely used configurations, Rowland and Confocal structure. Experimental results show that the AWG with Rowland configuration in combination with constant period along the tangent line to its grating pole for arrayed waveguides has the best cross talk. This paper provides a design guideline for AWG based on high-index-contrast platform, such as silicon-on-insulator and silicon nitride platform.

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