# POLARIZATION SPLITTER-ROTATORS WITH OPTIMIZED TAPER STRUCTURES

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We propose and experimentally demonstrate broadband, low-crosstalk, and low-loss polarization splitter-rotators (PSRs) with optimized taper structures at 1550-nm and 1310-nm wavelengths, respectively. The PSRs consist of particle swarm optimization (PSO) based bi-level tapers and shortcuts to adiabaticity (STA) based ridge-waveguide couplers. Ridge waveguides are introduced to increase the coupling coefficient of the STA based coupler and to reduce the crosstalk from TM0 mode. The measured polarization conversion losses (PCLs) and crosstalk (CT) are less than 0.6 dB and –20 dB, respectively, from 1500 nm to 1600 nm wavelength for the 1550-nm PSR. The measured PCLs and CT are less than 1 dB and –22 dB, respectively, from 1260 nm to 1340 nm wavelength for the 1310-nm PSR.

High-performance PSRs are preferred to realize polarization diversity for silicon photonic circuits. Various structures of PSR have been proposed, including asymmetrical directional coupler (ADC) [1,2], bi-level taper plus ADC [3], bi-level taper plus multimode interference coupler [4], bi-level taper plus adiabatic coupler [5], and bi-level taper plus asymmetric Y-junction [6]. However, none of them can have a PCL value less than 1 dB and a CT value less than –20 dB within a 80-nm-wide wavelength range.

The scanning electron microscope (SEM) pictures of the 1550-nm and 1310-nm PSRs are shown in Fig. 1 and Fig. 2, respectively. The PSR consists of a TM0-TE1 bi-level taper and a TE0-TE1 demultiplexer. The bi-level tapers are optimized based on the PSO method. The tapers, which are 20-µm long, are divided into 4 and 10 segments with equal length for the 1550-nm and 1310-nm PSR respectively. The maximum values of the average TM0–TE1 conversion efficiencies over the wavelengths from 1500 nm to 1600 nm and from 1260 nm to 1360 nm are set to the Figure of Merit for the 1550-nm and 1310-nm PSRs, respectively. The TE0-TE1 demultiplexer is optimized based on the STA method [7]. The coupling length is 70 µm. The minimum edge-gaps are 200 nm and 160 nm for the 1550-nm and 1310-nm PSRs, respectively. The total PSR lengths are about 120 µm.

Fig. 3 shows the measured results of the 1550-nm PSR. The PCLs and CT are less than 0.6 dB and –20 dB, respectively, from 1500 nm to 1600 nm wavelength. Fig. 4 shows the measured results of the 1310-nm PSR. The PCLs and CT are less than 1 dB and –22 dB, respectively, from 1260 nm to 1340 nm wavelength. The measured broadband operation is limited by the available bandwidth of grating couplers.

In conclusion, we have proposed and demonstrated practical PSRs at 1550-nm and 1310-nm wavelengths, respectively. The PSRs show lower PCL less than 1 dB and lower polarization CT less than –20 dB within a 80-nm-wide wavelength range.

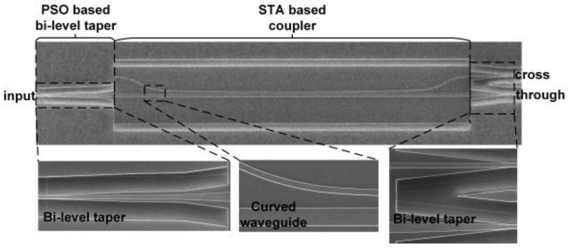


*Fig.1 SEM pictures of the 1550-nm PSR.*

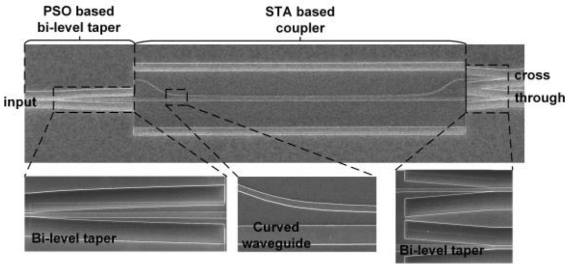


*Fig. 2 SEM pictures of the 1310-nm PSR.*

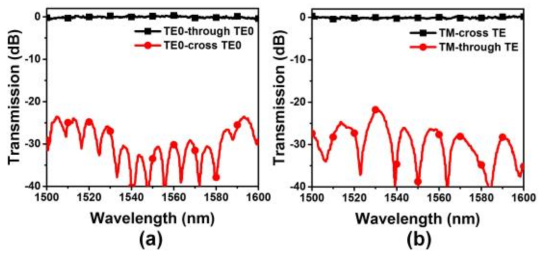


*Fig. 3 Measured results of the 1550-nm PSR. (a) TE0 polarization in. (b) TM0 polarization in.*

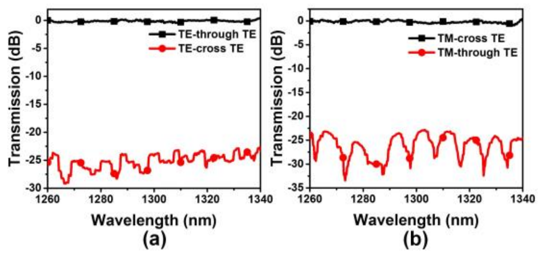


*Fig. 4 Measured results of the 1310-nm PSR. (a) TE0 polarization in. (b) TM0 polarization in.*

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