P-07

Dynamic Mode-Switching by Using Optical Mode Switch

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Abstract

We demonstrated optical mode switch to solve scalability issue in optical switch. We used a design that similar to Mach-Zehnder interferometer with 3μm of input and output width to provide 1st order mode propagation and get the mode switching instead of intensity modulation. We fabricated 3dB Y-junction with 13 bending angle to get mode switching with a high fabrication tolerance. As a result, mode switching for 1550nm wavelength with the injection current of 60mA (5.7V) was successfully achieved with mode crosstalk of approximately -10dB, low wavelength dependency and polarization independent characteristic. Dynamic mode switching is demonstrated by using optical mode switch. The switch utilizes phase shift based-on current injection. Less than 60 ns switching-time for the both 0th-to-1st and 1st-to-0th was confirmed for the first time.

1. Introduction

Optical switch is attractive because it decreases the power consumption of the conventional router by eliminating the optical-electrical-optical (OEO) signal exchange [1]. One of the optical switch is the optical spatial switch. However, the scalability for high integration has been one critical issue for this optical spatial switch [2]. Thus, to realize the optical switching we have proposed optical mode switch to overcome this scalability issue [3].

In this work, dynamic mode-switching is demonstrated. At least less than 64 ns switching time, for the both 0th-to-1st and 1st-to-0th, was confirmed.

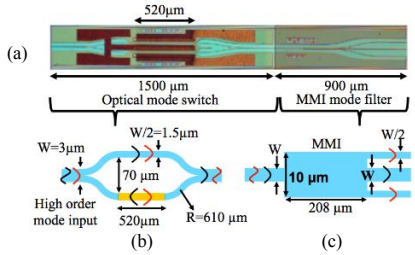

Figure 1. Device configuration. (a) Top view of implemented device, (b) configuration detail of optical mode switch and (c) MMI mode filter.

2. Concept and Design

Concept and Design

Figure 1 (b) shows the schematic view of this optical mode switch. The configuration of the optical mode switch is similar to Mach-Zehnder interferometer, however, the difference is its width in input and output waveguide to realize the optical mode switch than the interference modulation. The input and output waveguide is designed to be 3 μm while each arm to be 1.5 μm. S-bend waveguides are used in the both Y-junctions to realize the proper mode-splitter and mode-combiner with a high fabrication tolerance. We employed the trench pin junction in order to shift the phase of the light in one of the arms.

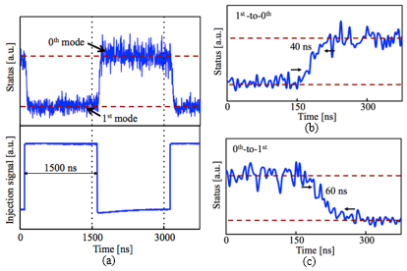

Figure 2. Dynamic mode-switching result. (a) Injection signal and device status, (b) rise time, and (c) fall time.

3. Results and Discussion

Figure 2 (a) shows device status from the injection signal of a 1500 ns with 2 V peak-to-peak square pulse. The status was evaluated by monitoring the output power at the fundamental mode port of MMI filter, as

shown in Fig. 1 (c). When the current is set to cross-state (approx.60 mA), the device status shows the lower optical power level, which corresponds to the first order mode, while the device status shows higher optical power level, which corresponds to fundamental order mode, in the case of current is set to bar-state. Figure 2 (b) shows the switching time of 40 ns for 1st-to-0th switching, while the switching time of 60 ns for 0th-to-1st switching was observed as shown in Fig. 2 (c). These switching time can be reduced by the reduction of current path resistance through the pin trench structure.

4. Conclusion

In conclusion, we demonstrated the dynamic optical mode switching for the first time by using 2x2 optical mode switch. The measured output power was -28 dB with the crosstalk of approximately -10 dB. At least less than 60 ns and 40 ns mode switching time, respectively for the both 0th-to-1st and 1st-to-0th, was confirmed for the first time. One way to improve the switching speed is by narrowing the distance between the highly doped region of p and n. However, there is a trade-off with the carrier adsorption that will lowering the output power.

Reference

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