

Optical Mode Switch

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We compared the optical space switch and proposed the optical mode switch which can reduce the chip size^[1-3]. In order to verify the basic operation principle of the optical mode switch, cross state device is represented with a different arm length corresponding to the refractive index shift and bar state is represented by symmetrical arm length, as it is shown in Fig. 1 (b) and Fig. 1(c) respectively^[3]. Fig. 1 (a) shows the schematic diagram of an optical mode switch. By injecting the current into the phase shift region we can control the refractive index of that arm and make a π phase difference of the optical signals from the two arms. The different arm length replaced this condition, just simply to get the same result when we inject the current to optical mode switch device.

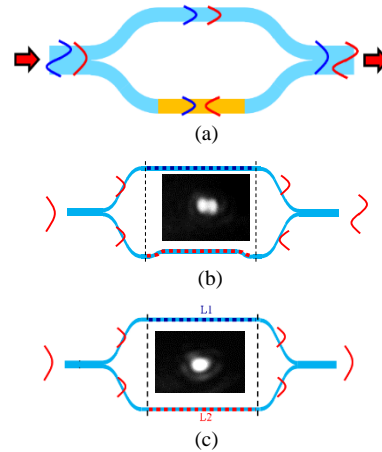


Fig. 1. Schematic concept of (a) optical mode switch, (b) different arm length device and (c) symmetrical arm length device.

In order to verify the potential mode crosstalk of the optical mode switch, we also fabricated and integrated mode filter with the optical mode switch. To filtering the fundamental mode and 1st order mode, we use the simple 1×3 symmetrical rectangular shape of MMI device that is shown in the Fig. 2.

Fig. 3 shows the simulation and experimental result that is shown as solid line and dash line respectively. For the bar-state where the ΔN is 0, the estimated crosstalk was approximately -12 dB for TE mode and -11 dB for TM mode, while the theoretical result that was shown as solid lines showed the same crosstalk between TE and TM. For the cross-state, it was realized at $\Delta N = 0.004$ as it was shown as a dashed lines in Fig. 3, this result matched well with the theoretical result. The estimated crosstalk of cross-state was approximately -10dB for both transverse electric (TE) and transverse magnetic (TM) modes at exactly same ΔN . This value is not sufficient for the practical use, however, there is a possibility that the best point may exit at slightly different ΔN of bellow 0.004.

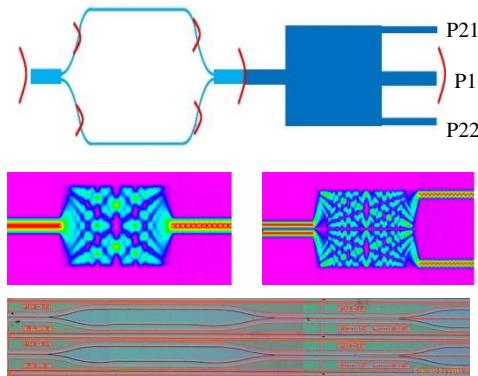


Fig. 2. Schematic of (a) MMI mode filter integrated optical mode switch, (b) BPM results of mode filter and (c) implemented device.

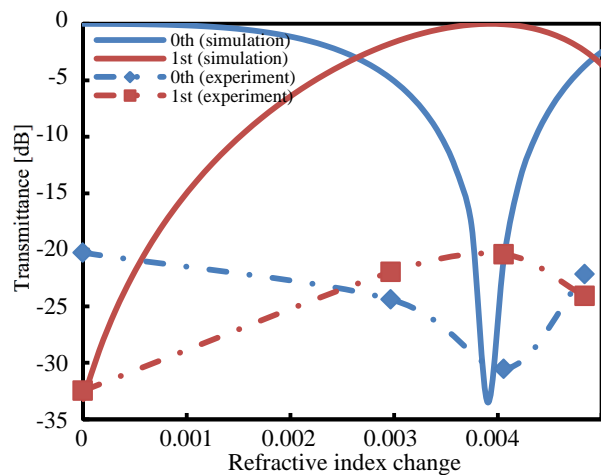


Fig. 3. The evaluated transmittance as a function of ΔN

Reference

- [1] R. Takakura et al., MOC 2013, H1 (2013).
- [2] M. Jizodo et al., OECC2013, TuPT-1 (2013).
- [3] T. Tanaka et al., OPE2014, 119 (2014).