

# Optical Spatial Mode Switch

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We propose optical spatial mode switch which can switch among any optical spatial modes. The conventional optical spatial switch can be replaced to optical spatial mode switch by assigning the spatial mode information to the positional information. This optical spatial mode switch has a possibility to increase the integration density, through reducing the number of optical parts connected to optical switch or downsizing by reducing curved waveguides. In this paper, we report the simulation results of the principle of switching between 0<sup>th</sup>-order mode and 1<sup>st</sup> mode.

Figure 1 shows the schematic view of the spatial mode switch which can switch between 0<sup>th</sup> mode and 1<sup>st</sup> mode. This structure has an asymmetric Y-junction waveguide and symmetric Y-junction waveguide with variable refractive index (VRI) region. In the asymmetric Y-junction waveguide, injected 0<sup>th</sup> mode and 1<sup>st</sup> mode is split into different waveguides, and this phenomenon is called mode-sorting <sup>[1]</sup>. In the symmetric Y-junction waveguide, by using VRI region to control propagation constant of the waveguide, the inverse phenomenon of mode-sorting is occurred and it can generate 0<sup>th</sup> mode or 1<sup>st</sup> mode. In this structure, the VRI region is supposed to be injected current with PIN diode <sup>[2]</sup>. When the current is injected into upper waveguide in Fig.1, the device is in NOT switched state, and current injection into lower waveguide causes switched state. In NOT switched state, the crosstalk is about -29dB. And in switched state, the crosstalk is about -26dB. Figure 2 shows the simulation results, and table 3 shows the relationship between required refractive index variation and crosstalk.

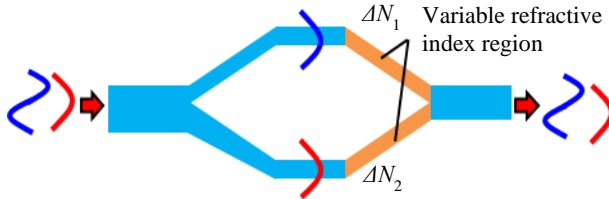


Fig.1 Schematic view of optical spatial mode switch.

表 1. Relationship between required refractive index variation and crosstalk.

Inject	Transmit	VRI	Crosstalk [dB]
0 <sup>th</sup>	0 <sup>th</sup>	-0.017	-29.2
1 <sup>st</sup>	1 <sup>st</sup>	-0.017	-29.4
0 <sup>th</sup>	1 <sup>st</sup>	-0.023	-26.2
1 <sup>st</sup>	0 <sup>th</sup>	-0.023	-26.3

## Reference

- [1] N. Riesen and J. D. Love, Appl. Opt., 51(15), 2778-2783, 2012  
 [2] J. V. Campenhout, et. al., Opt. Exp., 17(26), 24020-24029, 2009

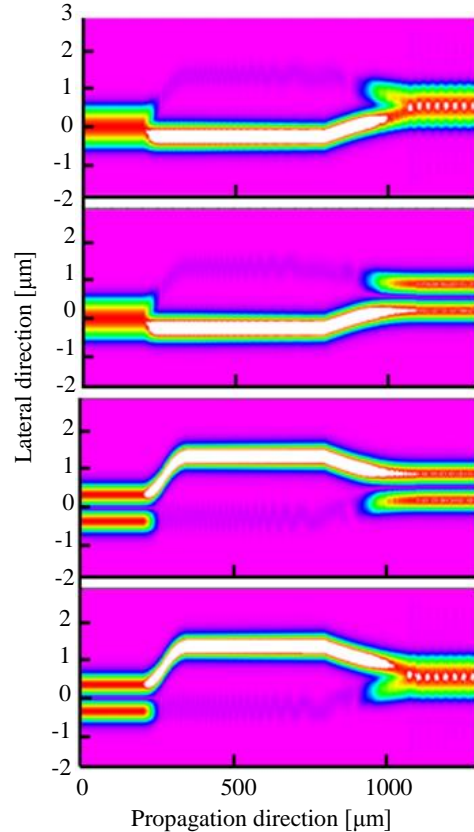


Fig.2 Simulation results of optical spatial mode switch.