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Large Port-Count Wavelength Selective Switch Based on High-density Bragg Reflector Waveguide Array

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Abstract A wavelength selective switch based on a Bragg reflector waveguide array is proposed with large output ports over 100. Switching to arbitrary ports is demonstrated. The dense waveguide array with giant angular-dispersion enables large-scalability in small footprint.

Introduction

In large-scale optical networks, a wavelength selective switch (WSS) has been an indispensable component for reconfigurable routing with add/drop functions [1,2]. However, the conventional WSS modules are relatively bulky and have insufficient number of switching ports. In this paper, we propose and fabricate a WSS based on a monolithically integrated Bragg reflector waveguide array with ultra-large output port-count over 100. The proposed WSS can offer a record-breaking port-count in a compact size.

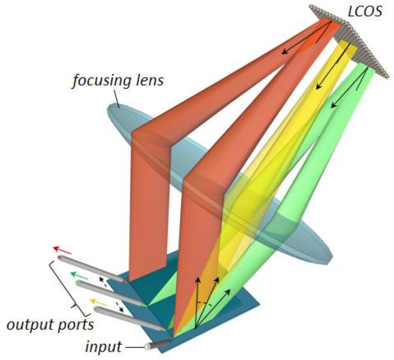

Fig. 1: A 3D schematic view of the proposed WSS.

Device Structure and Principles

The proposed WSS mainly consists of four parts as shown in Fig.1: input and output optical fibers, Bragg reflector waveguides array, a focusing lens, and a liquid-crystal on silicon (LCOS)-type spatial light modulator. An input Bragg reflector waveguide disperses the input light into different directions according to wavelength and reflects back at different positions on the LCOS screen. We can control the reflection direction by changing the periodical phase pattern on the LCOS. Thus the light is directed back to any desirable output waveguide port for different wavelength channels.

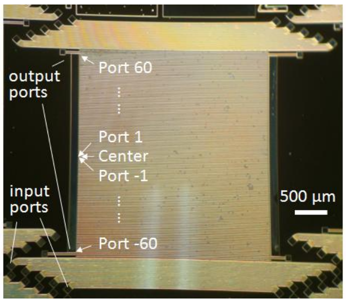

Fig. 2: A Photo of the top view of the fabricated device.

Device Characteristics and Power consumption

A fabricated device is shown in Fig. 2. The proposed prototype of WSS has a waveguide array of 120 elements with a pitch of 30 µm. A 970 nm light was inputted and switched by LCOS. First, we align the reflection light from LCOS to the waveguides array center. By changing the LCOS displaying pattern, we switch the light to all the 120 output ports. We recorded the intensities at the designated ports as well as their adjacent ports in order to know the switching performance. The results are displayed in Fig. 3 for some typical ports for clarity. We confirmed that the switching was realized in all output-ports. Next, we displayed a designed pattern on LCOS for showing an independent control of different wavelength channels. We are able to switch the incoming beams to designated (arbitrary) output channels. Here seven random ports were chosen as an example. Output spectra for those ports were shown in Fig. 4. Clear wavelength selective switching was observed for all ports and over 20dB extinction ratios were obtained for all wavelength channels.

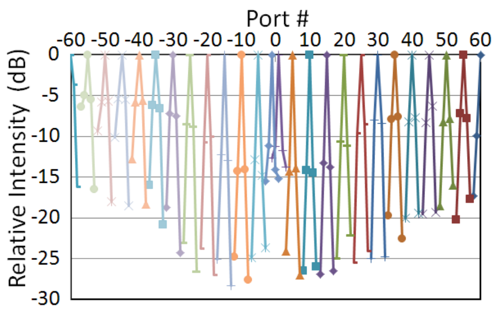

Fig. 3: Intensities of output power from 120 different ports and their adjacent ports after selective switching.

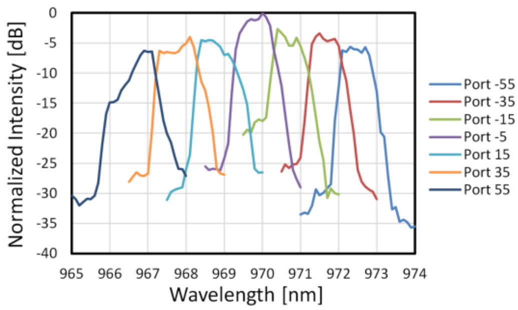

Fig. 4: Output spectra at seven output ports with seven switching channels on the LCOS spatial light modulator.

Conclusions

We demonstrated a novel compact wavelength selective switch based on a Bragg reflector waveguides array with an output port-count over 100. Switching between arbitrary ports was demonstrated.

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[2] Y. Ishii et al., Proc. ECOC 09, **PD1.9** (2009)