

陈胜钰¹, 庄冬霞², 强则焯², 陈曦曜^{1,2}

1. 闽江学院 物理学与电子信息工程系, 福建 福州 350108;
2. 福建师范大学 光电与信息工程学院, 福建 福州350007

摘要: 利用光子晶体的自准直效应进行光束的控制, 实现了基于自准直效应的二维光子晶体1×4光复用器(OMUX)。在结构中放置两个腔长不同的马赫-曾德干涉仪, 利用光束干涉原理推导出光复用器各个出口的透射谱理论公式, 然后利用时域有限差分软件对其进行数值模拟。结果显示: 模拟结果与理论分析一致, 实现了1×4光复用器的功能。当工作波长为1 550 nm时, OMUX的自由光谱区为34.1 nm, 覆盖了整个光通信C波段。由于结构大小只有40~35 μm, 并且有较高的输出功率, 该光复用器在光集成电路中有潜在的应用价值。

关键词: 光子晶体 自准直 马赫-曾德干涉仪 光复用器

1×4 optical multiplexer based on self-collimation effect in silicon photonic crystals

CHEN Sheng-yu¹, ZHUANG Dong-xia², QIANG Ze-xuan², CHEN Xi-yao^{1,2}

1. Department of Physics and Electronic Information Engineering, Minjiang University, Fuzhou 350108, China;
2. School of Physics and Optoelectronics Technology, Fujian Normal University, Fuzhou 350007, China

Abstract: An 1×4 Optical Multiplexer (OMUX) based on the self-collimation effect of a two-dimensional photonic crystal was proposed and its performance was numerically demonstrated. Two Mach-Zehnder Interferometers (MZIs) with different cavity lengths were placed in the structure. Firstly, the theoretical transmission spectra at different output ports of the cascaded MZI were analyzed with the theory of light interference, then they were investigated with the Finite-difference Time-domain (FDTD) simulation technique. The simulation results agree well with the theoretical prediction, so the cascaded Mach-Zehnder interferometer can work as a 1×4 optical multiplexer. When the wavelength is 1 550 nm, the free spectral range of the OMUX is about 34.1 nm, which almost covers the whole optical communication C-band window. The presented device shows a compact size within 40-35 μm and a high output efficiency, and has potential application values to photonic integrated circuits.

Keywords: photonic crystal self-collimation Mach-Zehnder interferometer optical multiplexer

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通讯作者: 陈胜钰

作者简介: 陈胜钰 (1973-), 女, 福建福州人, 讲师, 1996年、2005年于福建师范大学分别获得学士、硕士学位, 主要从事信息光学的研究。E-mail: chensy73@163.com
作者Email: chensy73@163.com

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