

S-Bend Silicon-On-Insulator (SOI) Large Cross-Section Rib Waveguide for Directional Coupler

Nurdiani Zamhari¹, Abang Annuar Ehsan², Mohd Syuhaimi Abd Rahman³

^{1,3}Department of Electrical, Electronic & System Engineering, Faculty of Engineering & Built Environment, Universiti Kebangsaan Malaysia

¹Department of Electrical and Electronic Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

²Institute of Microengineering and Nanoelectronics (IMEN), Universiti Kebangsaan Malaysia

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ABSTRACT

S-bend contributes the high losses in the silicon-on-insulator (SOI) large cross-section rib waveguide (LCRW). The objective of this work is to investigate S-bend SOI LCRW with two different single-mode dimensions named symmetrical and asymmetrical. The S-bend SOI LCRW has been simulating using beam propagation method in OptiBPM software. The asymmetrical waveguide with two different dimension arc given the best performance if compared to others dimension with 3 μm of waveguide spacing. It achieved 92.24% and 91.10% of normalized output power (NOP) for 1550 nm and 1480 nm wavelength respectively. Moreover, the minimum of S-bend spacing between the two cores is 0.9 μm for both 1550 nm and 1480 nm. Therefore, asymmetrical waveguide with two different dimension arc and 0.9 μm of S-bend spacing are chosen. This analysis is important to determine the right parameter in order to design the SOI passive devices. However, future work should be done to see the performance by designing the coupler and implement in the real system.

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Corresponding Author:

Nurdiani Zamhari,

Department of Electrical, Electronic & System Engineering, Faculty of Engineering & Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM, Bangi, Selangor, Malaysia.

Email: znurdiani@feng.unimas.my

1. INTRODUCTION

Apart from being used as a material for designing transistors [1], silicon-on-insulator is also widely used as a material in optical waveguides. Silicon-on-insulator waveguide is one of the basic elements of silicon photonic devices including straights and bends waveguide which need to have extremely low propagation loss and low power consumption for large-scale integration [2]. Bend waveguide is well known to change optical propagation direction and allow reduction in device length. It is the most critical part in the design of large cross section rib silicon-on-insulator (SOI) coupler, splitter or taper. In fact, the mode profile inclines to shift toward the outer edge of the waveguide in a waveguide bend which creating loss. Fortunately, the high index contrast (HIC) in SOI allows the low bending loss due to the strong mode confinement if compared to a conventional low index contrast waveguide thus reduce the total size of the planar lightwave circuit (PLC).

Large-cross section SOI rib waveguide (LCRW) is tended to bend with millimeter (mm) scale dimensions which leads to even several centimeter scale circuits. The rib waveguide has low lateral index contrast which limits the minimum bending radius but enables single-mode operation. Even though the bending radii of LCRW is larger than silicon wire in SOI waveguide, the benefits of having LCRW are such as robustness to fabrication errors, minimum roughness of the etched surface, small birefringence, low-loss