

**DESIGN AND CHARACTERIZATION OF A
THERMOOPTIC POLYMER SWITCH BASED ON
DIRECTIONAL COUPLER STRUCTURE**

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ABSTRACT

DESIGN AND CHARACTERIZATION OF THE THERMO-OPTIC POLYMER SWITCH BASED ON DIRECTIONAL COUPLER STRUCTURE

The thermo-optic switch proposed in this project is based on the principle of directional coupler structure to create an optical switching when the existence of heater on top of either one of waveguide. When sufficient heat is supply to the heater, it will disturb the propagation of wave in the waveguide. Hence, the switching between two waveguide will occur. Due to the increasing need of a smaller gadget, thermo-optic switch must be in smaller size. It also need to be low power consumption and with good efficiency. During the fabrication of the device, some errors may occur. Therefore fabrication tolerance analysis was conducted in order to evaluate the damage tolerance during fabrication. Error in fabrication tolerant must not affect the efficiency of the device. In the propose thermo-optic switch design, two $2 \times 2 \mu\text{m}$ PMMA waveguides were used as core with Teflon as cladding layer with thickness of $4 \mu\text{m}$, silica as a buffer layer with thickness of $10 \mu\text{m}$ and silicon as a base that acting as a heat sink with thickness of $2 \mu\text{m}$. Heater is situated at the top of the waveguide. At the waveguide gap of $5 \mu\text{m}$ and cladding thickness of $4 \mu\text{m}$ from the buffer layer ($2 \mu\text{m}$ from top of waveguide), the coupling length of the device is $10616.44 \mu\text{m}$. When no heat applied, the directional coupler is in cross-state. Then at temperature of 26°C switching occur and the directional coupler is in the bar-state. Extinction ratio in the bar-state is 34.08dB . Fabrication tolerance of $\pm 2\%$ in the coupling length produce change in extinction ratio of about 23.77%

CHAPTER 1

INTRODUCTION

1.1 Background

Optical signals distribution network are the optical clock signal distribution in the computer, router and other optical instrument. Optical network has been used by most telecommunication system to transfers information in the internet faster than the conventional copper wire since it used optical fiber. Fiber optics can transfer the information using high wave frequency and very high speed velocity, light velocity 2.998×10^8 m/s. Fiber optics bandwidth is broader than copper wire which enable more information being transferred faster and easier to the user due the technology dependent in everyday works. Optical fiber have small optical lost when two fiber optics cable are fused compare to the lost in the copper wire. In communication system, optical switch is used for routing, cross connection and add-drop multiplexing. The thermo-optic switch belongs to the class of directional couplers. A good thermo-optic switch requires low power consumption and small in length. Performance of the switch should be insensitive to the fabrication tolerances.