Title: Optical Wave-Guide

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Overview

In the 21st century, a Broadband Internet services has become a booming business since it offers a high speed, wide bandwidth and low loss data transmission. In this technology, signals are transmitted optically rather than electronically. An optical waveguide is the material to ‘guide’ optical signal in data transmission, just as copper wire conducts electricity. The invention of optical wave-guides is a milestone in the development of optical data transmission.

The most appealing aspect of a optical fiber telecommunication system is that many different wavelength channels can be transmitted along a fiber simultaneously in a particular wavelength range. The technology used to combine numerous of wavelengths into the same fiber is known as WDM wavelength-division multiplexing [1]. The implementation of WDM networks requires different kinds of passive and active devices to multiplex, distribute, isolate, and amplify optical power at various wavelengths. Active WDM devices, including tunable optical filters, tunable sources, and optical amplifier, are controlled electronically. In contracts, external operation is not essential in passive devices. These components are mainly applied to split and combine optical signals. Traditionally, the operation of most passive devices is based on a star-coupler concept involving the conversion of N independent wavelength channels to one output through evanescent power and vice versa.

Micro-cavities provide another alternative for passive devices in wavelength channels Multiplexing and De-multiplexing. In this project, squared shaped micro-cavities were investigated for their potential in the application of optical add-drop filters. Experiments to simulate the wavelength de-multiplexing were designed and carried out.
Project Description

We developed three experimental approaches to carry out the investigation. The motivation of the first approach, optical fiber coupling experiment, is to indicate the sensitivity decreases exponentially as fibers are moved away from the filter. In second approach, resonance mode characterization experiment, the relationship between the propagation angle and resonant mode was found. In the third approach, microchips experiment, a simulation of optical devices in different dimension was carried.
Result

i) Optical fiber coupling experiment

The result shows the improvement of the spectrum and the coupling efficiency after the adjustment of the gap spacing. Figure 1 shows that the 30dB power drop at the wavelength from 1550nm to 1565nm.

Figure 1, The resonance of wave-guide coupling from wavelength 1530nm to 1580nm

ii) Resonance mode characterization experiment

Spectrums with incident angle  a) smaller than  b) equal to  c) greater than critical angle in the square shaped cavity

iii) Microchips experiment

Square shaped micro-cavity  8-degree edge at the end face of wave-guide