ABSTRACT

The purpose of this thesis is to design and enhance the thermal efficiency of integrated heaters designed for Mach-Zehnder Interferometer. The methodologies used for our work was conduction of heat, thermo-optic effect, and finite element method. The work was to be done by computer simulation. For that, we arranged a software named SOLIDWORKS for design and simulation. First designed a MZI device having an aluminum heater, waveguide and slab in a SiO_2 box. The height of the box is 10.44μm, width is 20μm and length is 320μm. beneath there is a silicon substrate box having length and width same but height is 20μm. Did meshing for finite element analysis of the device. After giving different values of input heat power, we ran the simulation on our software to observe the values of heater and waveguide average temperature. The heat would flow from heater to the heat sink which is provided at the bottom of the silicon substrate. After getting the values, the thermal efficiency of the integrated heater was calculated but the values were too low. To enhance the thermal efficiency, designed another heater with different parameters. The simulation was run again and values of thermal efficiency were noted. The newly designed heater had an increase of thermal efficiency.

To improve the thermal efficiency, created an air gap in the silicon substrate. The air gaps were of the width of 2.05μm and its multiples. The idea was first implemented with the first heater and then the second heater. For the first heater, as we increased the width of air gaps, the thermal efficiencies were increased. Then we done it with the second heater, and got the same by increasing the width of air gap the thermal efficiency increases. However, the idea of creating an air gap in silicon substrate has worked very well, because it can increase the stability, vii

performance and reliability of the Mach-Zehnder interferometer devices. So, the best results came with an air gap in the silicon substrate when the second heater was used for input.