Design Report: Chip #1

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Abstract
The goal of the project is to design an interferometer with 2 outputs, achieving 25 GHz spacing at 1310 nm. Ensuring minimal loss with design parameters and effective indexes. This report will present the background, modeling and simulation for the fabrication of the interferometer, noted by the course we will do so for a Mach-Zehnder Interferometer (MZI). Modeling is done using Ansys Lumerical MODE and INTERCONNECT, while the layout is designed with KLayout.

Introduction

A quick description of integrated photonics, the MZI is a fundamental photonic device enabling phase-based optical processing. Below the design and configurations for the MZI will be examined. Some components included in this design are listed below, they are found under the SiEPIC-EBeam-PDK library on KLayout:

- GC_TE_1310_8degOxide_BB
- Waveguide (350nm x 220nm @ 1310 nm)
- Ebeam_splitter_swg_assit_te1310

Model and Simulation

The waveguide properties were simulated and data for the selected material was collected in the Lumerical MODE software. For fabrication we will be working with Si and Si02 in this project, the materials have been defined as properties dimensions are set for simulation.

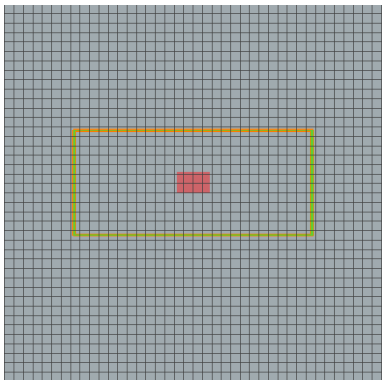
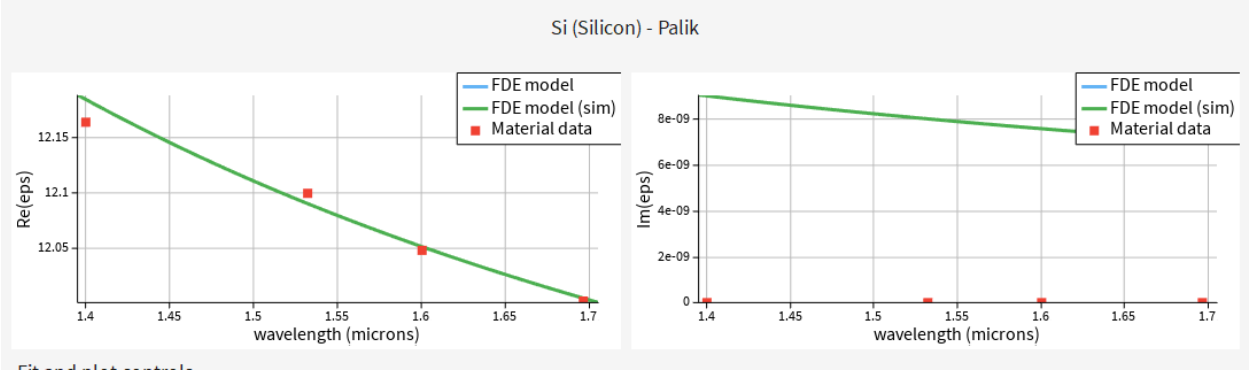
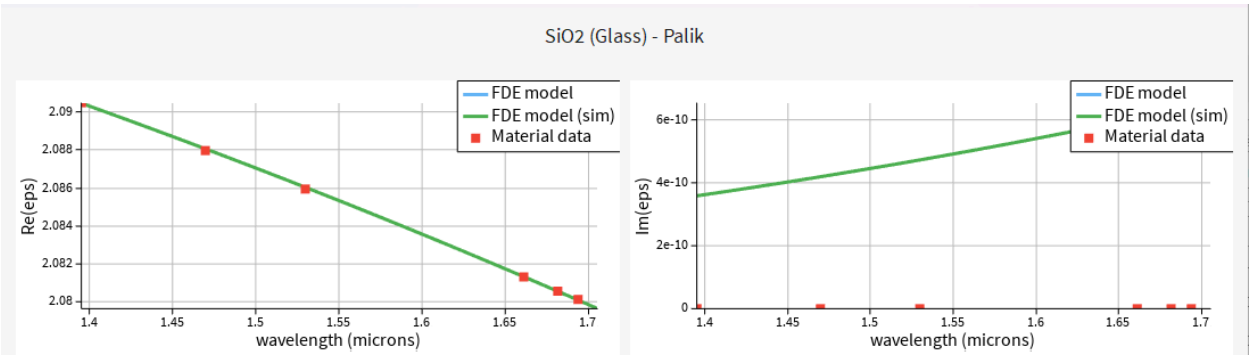


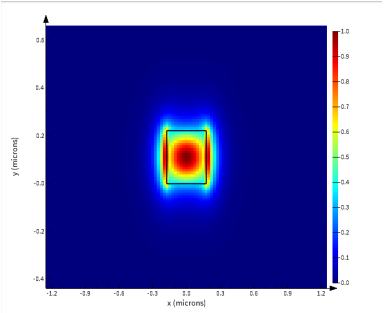
Figure 1: Material Selection for waveguide

Following this a FDE model of both materials are configured and plotted to compare with reference values, confirming the correct set of data points.

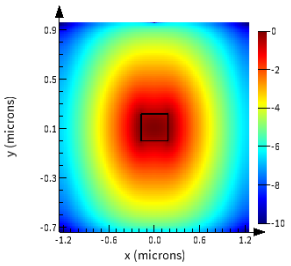


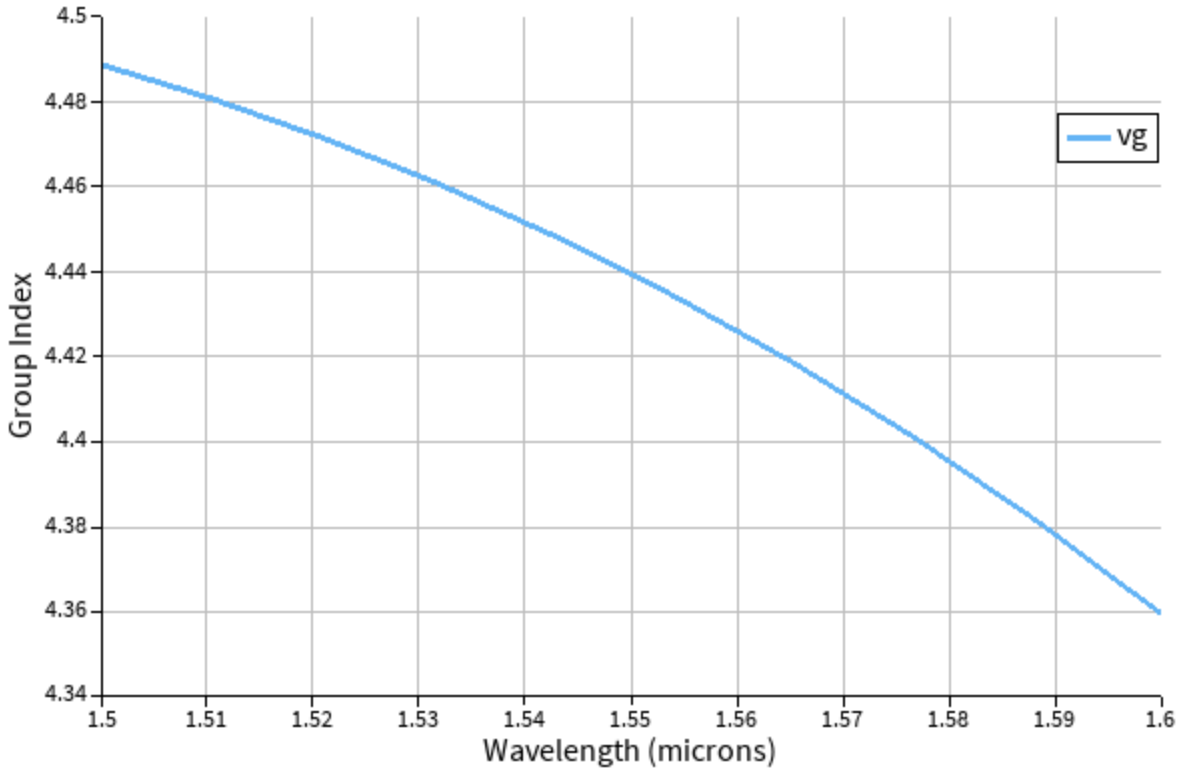


Saving this data will ensure accurate results when determining the group and effective index. By performing a mesh structure and using Lumerical MODE, the two indexes are found, the group index is 4.501 and the effective index is 2.1318 with minimal loss.



In the image above we can observe that a majority of the light is concentrated in the respective waveguide. By expanding our simulation data on the Y direction we are able to observe the decay of light in both X and Y directions below.

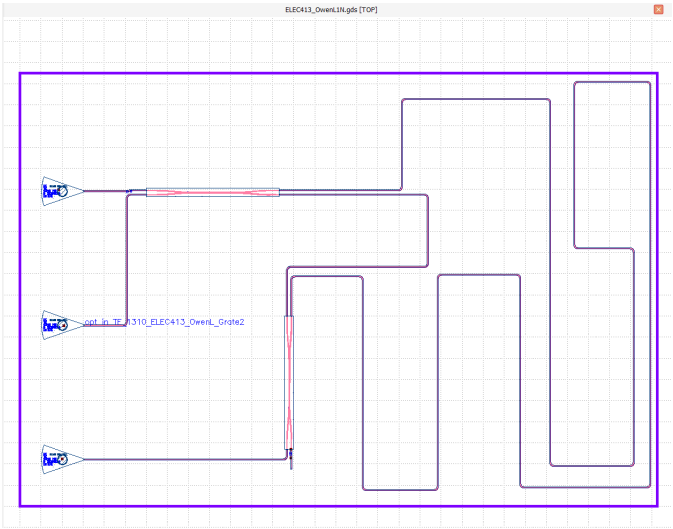




By using Lumerical Mode and the FSR formula for FSR = 25 GHz.

$$FSR = \frac{c}{ng \cdot \Delta L}$$

We can calculate the delta L to be approximately 2.664 mm. Using this information we can now design our circuit layout on KLayout with a path difference of 2.664 mm.



Using Lumerical Interconnect within KLayout, the circuit can be simulated to look into the free spectral range. Choosing the middle grating coupler as the input, there are now 2 outputs top and bottom of the coupler.