Project 1 Design Review

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1 Design Process:

1.1 FDTD Results:

The FDTD results ensure that we have a central wavelength of 1310. For the purposes of Project 1 the structure is Oxide cladded. This led to a Bragg Period of 270nm. Figure 1 shows the XY View of the Bragg grating.

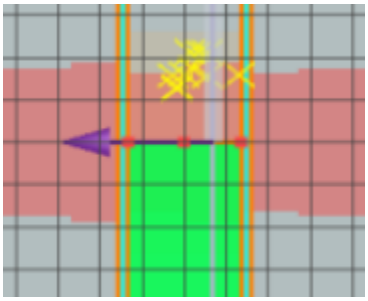

Figure 1: Bragg Grating XY View

Mesh cells was set to 4 to ensure clean results were used

```
mesh = 4;

# higher resolution mesh in the waveguide region
mesh_y = 5e-9;
mesh_x = 5e-9;
mesh_z = 20e-9;


############################
# Device geometry          #
############################

W = 350e-9; # average waveguide width
dW = 25e-9; # waveguide corrugation
period = 269e-9; # corrugations period

sinusoidal = false; # enable or disable sinusoidal, versus rectangular
rib = false; # enable or disable rib layered waveguide type (do not ena
sidewall_angle = 90;

thickness_device = 220e-9; # waveguide full thickness
thickness_rib = 90e-9; # waveguide rib layer thickness
thickness_superstrate = 2e-6; # superstrate thikness
thickness_substrate = 2e-6; # substrate thickness
thickness_handle = 1e-6; # handle substrate thickness

mat_device = 'Si (Silicon) - Dispersive & Lossless'; # device material
mat_superstrate = 'SiO2 (Glass) - Palik'; # superstrate material
mat_substrate = 'SiO2 (Glass) - Palik'; # substrate material
mat_handle = 'Si (Silicon) - Dispersive & Lossless'; # handle substrate
```

Figure 3: Parameters used for FDTD simulation

The plot shows the results of the FDTD simulation which illustrates the central wavelength of 1310nm. Figure 3 is shown below

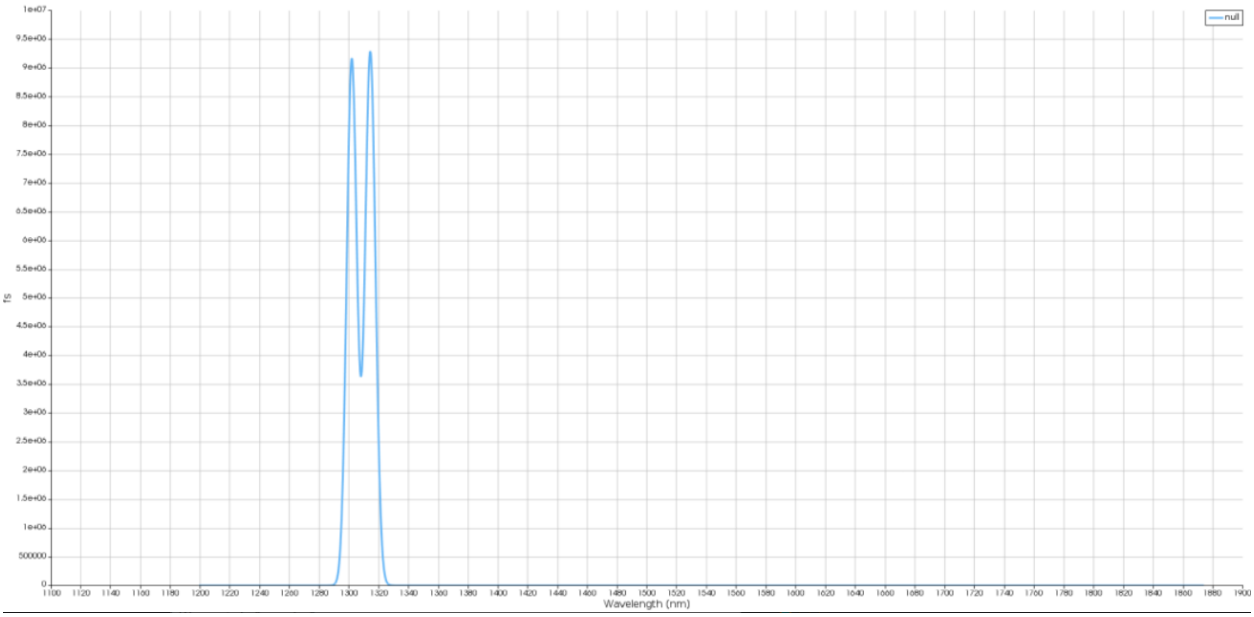

Figure 3: FDTD Simulation

$$\kappa = \pi n_g \frac{\Delta\lambda}{\lambda_B^2}$$

The κ obtained from the FDTD simulation was 149,706 using the formula this is the coupling coefficient we will use for our INTERCONNECT coupling coefficient for our Bragg Gratings. FDTD also gives the delta lambda and the group index can be found using mode discussed further.

1.2 Mode Results:

After finding the Bragg period MODE gives us the effective index and group index for our structure. We define the simulation region and select the option “near n” for the purposes of Project 1 the structure is Oxide cladding

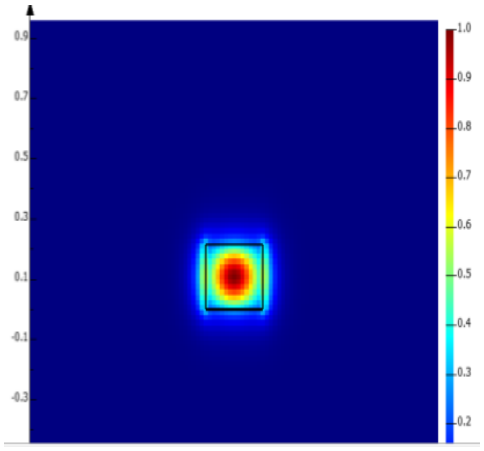

Figure 4: Simulated cross-section of silicon strip waveguide at 1310nm

Finally we can use these parameters from FDTD and Mode to transfer to interconnect and view the results in Interconnect of the Transmittivity and Reflectivity and obtain Quality Factor results.

3.1 Interconnect Results

κ 1/m	n_g	n_{eff}	# $of\ periods\ (Bragg)$	$Bragg\ period$	Loss db/m
149706	4.43159	2.408	60	0.270nm	300

Table 1: Parameters for Interconnect

With the parameters described we can setup an Interconnect Circuit with a cavity and 2 Bragg gratings and utilize the parameters to get a graph of the transmittivity and reflectivity. Figure 5 shows the Circuit:

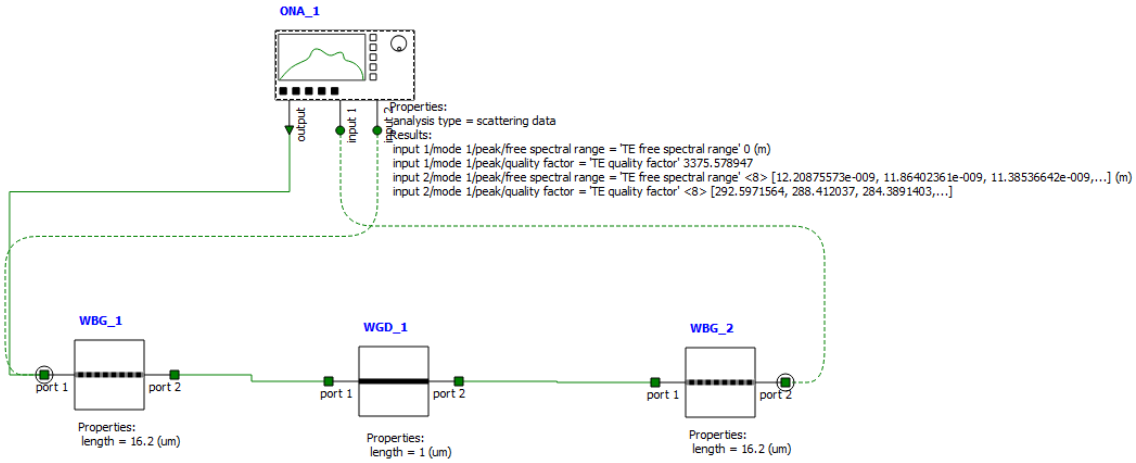

Figure 5: Interconnect Circuit

Notably the Bragg length is 16.2μm and the Cavity for this design is 1μm. This yields the following plot shown in Figure 6:

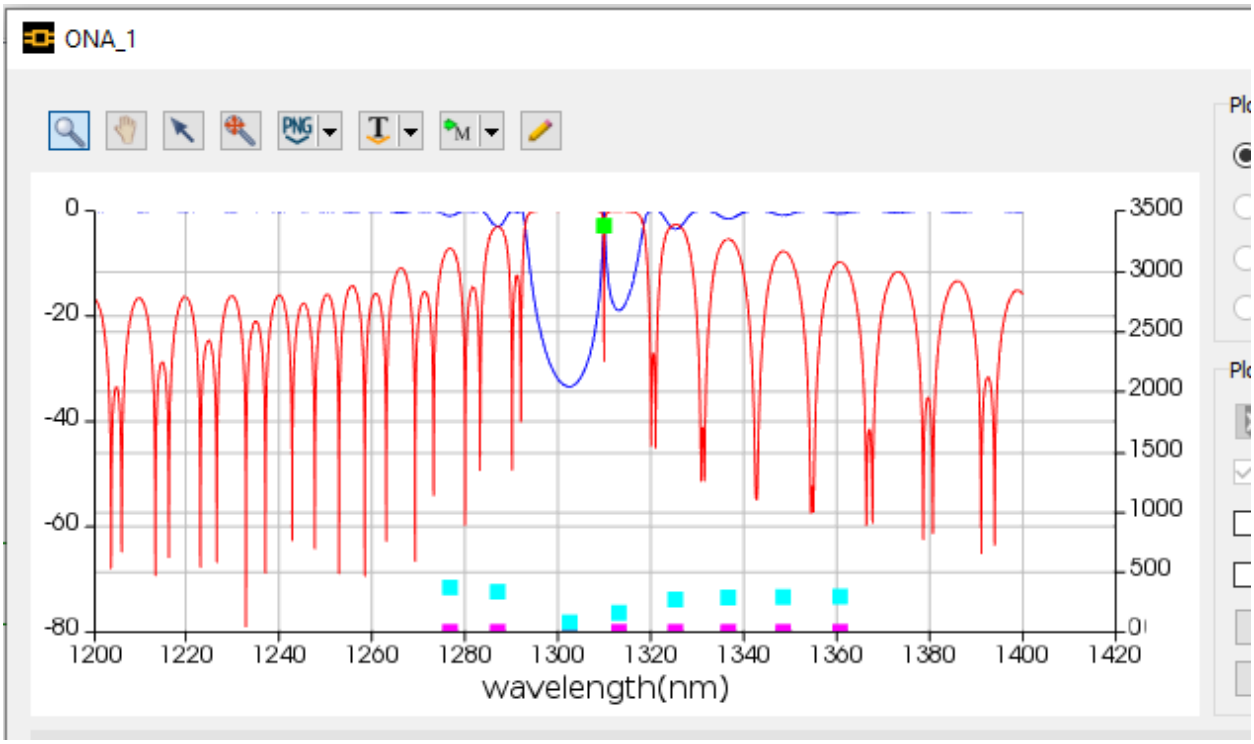

Figure 6: Lumerical Results dW = 50nm

Notably we notice that at approximately 1310nm the transmittivity is above -10dB which ensures the signal will be captured

Finally, we can make the Structure in KLayout

4.1 KLayout:

In KLayout I made the circuit with 3 1310nm Grating couplers spaced 127μm apart and used a Y-Branch to connect the couplers and a cavity of a variety of lengths such as 1, 10 and 25 μm

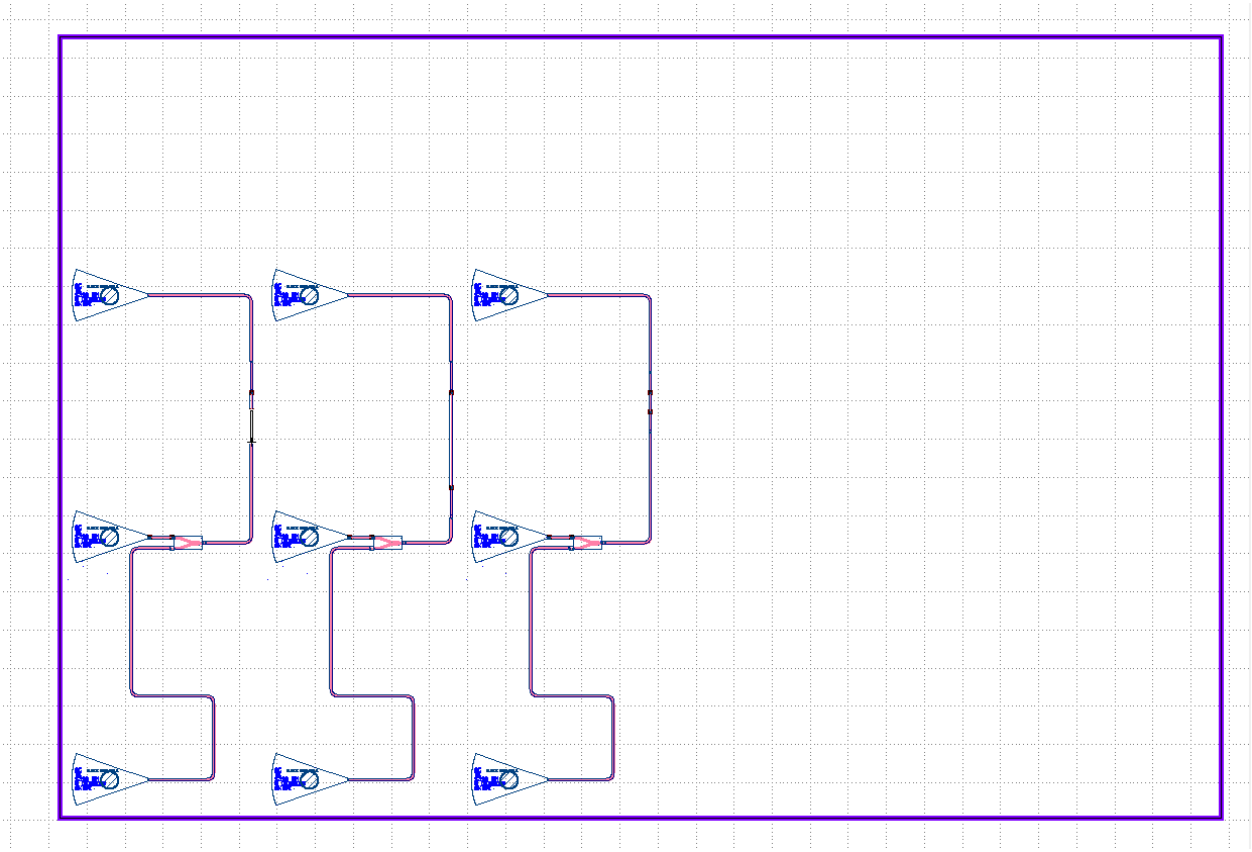

Figure 7: KLayout Floor Plan Mask Layout

Figure 7 shows 3 structures with varying cavity lengths and bragg grating lengths