Design and Investigation of Step-Index Core Polymer Directional Coupler for Board Level Optical Circuitry

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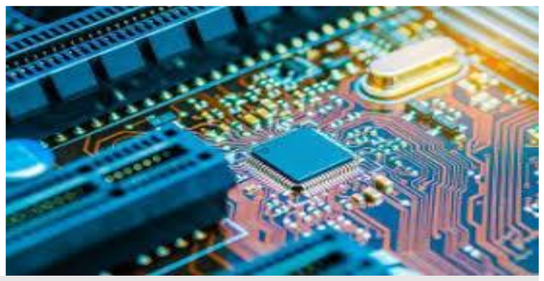
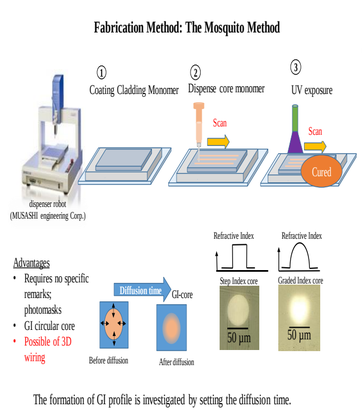
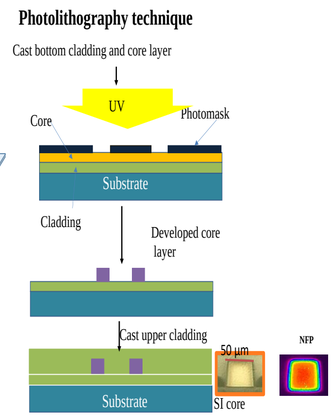
Background:

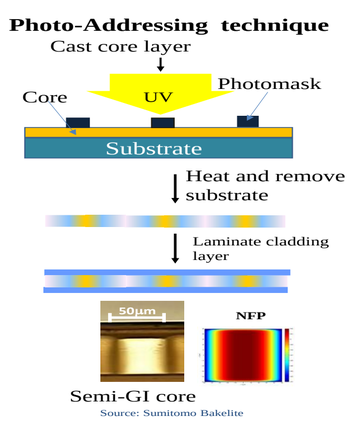


https://www.gigalight.com/blog/why-do-we-need-pcb-board-level-optical-

- High bandwidth capacity
- Low energy consumption
- Low dependence on transmission distance



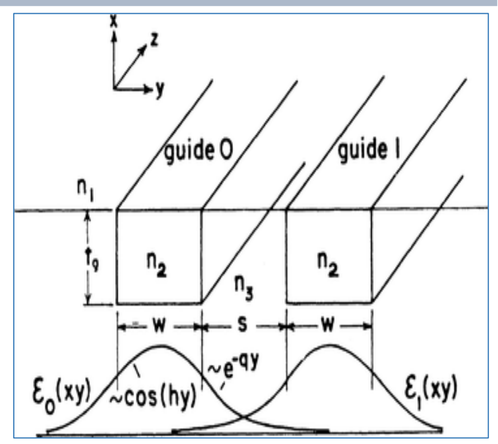




Couple Mode Theory

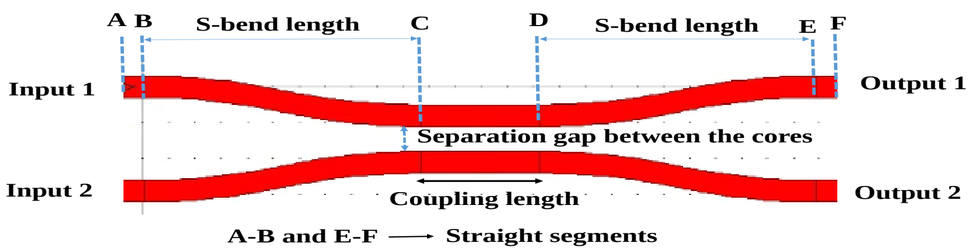
$$\frac{da1}{dz} = -j\beta 1a1$$

$$\frac{da2}{dz} = -j\beta 1a2$$



Materials, Structural Design and Methods:

Organic-inorganic Hybrid resins:
SUNCONNECT® materials
Core Material: **NP-005 (**Refractive Index: **1.575 @1550 nm)**
Cladding Material: **NP-211 (**Refractive index: **1.567 @1550 nm)**

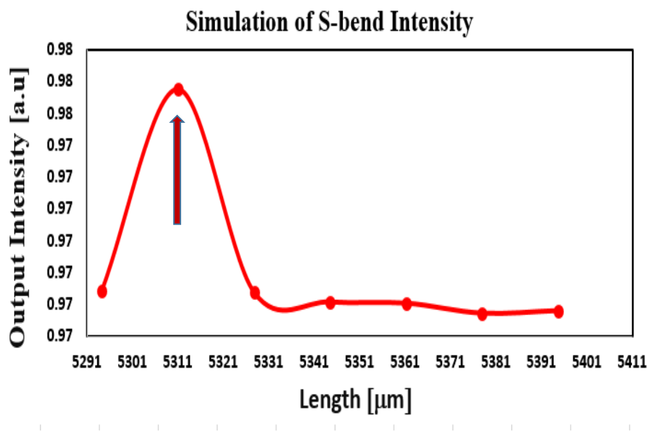


Technique: Beam propagation method
Solver: Rsoft CAD beamprop

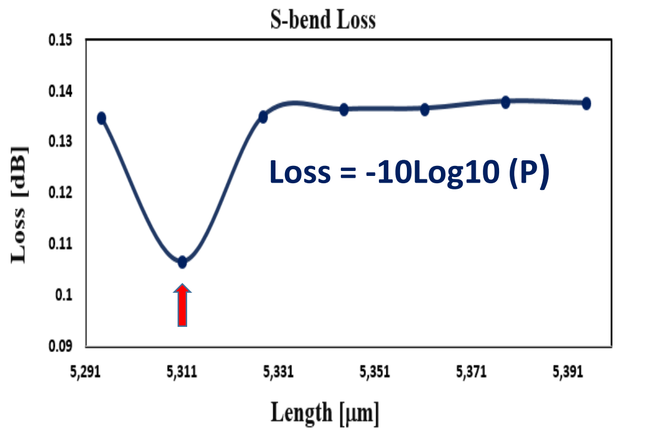
$$\frac{\partial u}{\partial z} = \frac{i}{2\bar{k}}\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)(k^2 - k^{-2})u$$

Basic BMP equation for 3D

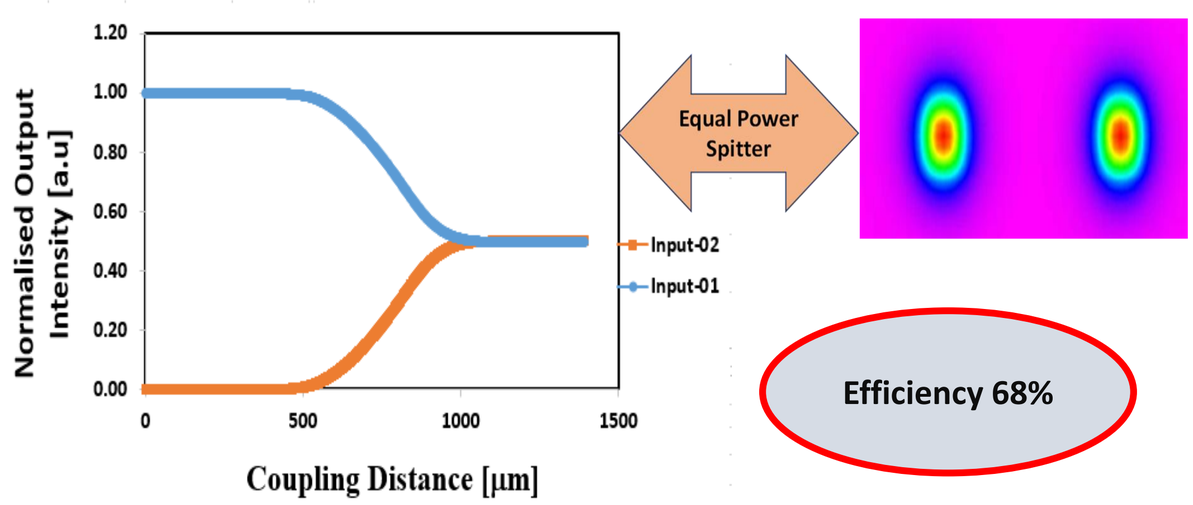
Optimization and Performance Analysis:

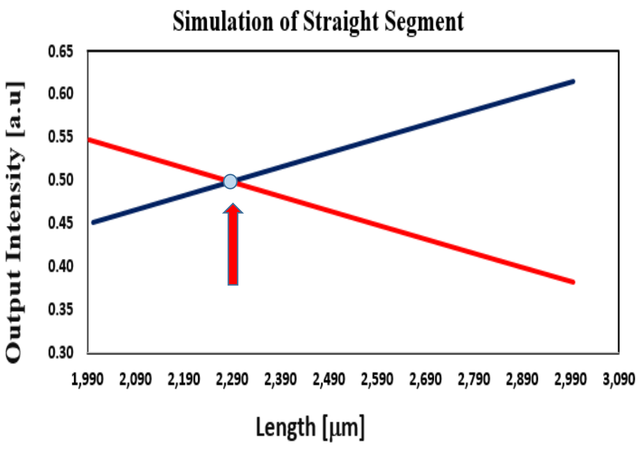


- **Intensity is highest at length 5311 μm.**

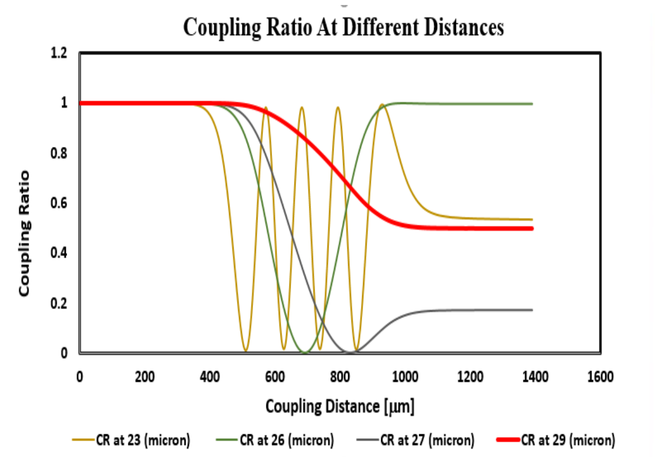


- **Loss is lowest at 5311μm.**

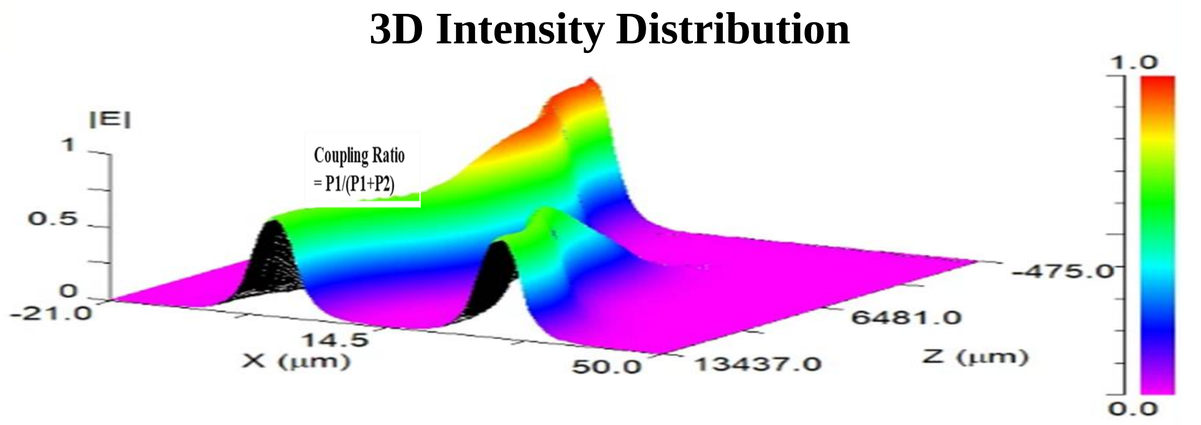




- **Optimized length is 2290μm**



- **29 μm- maximum distance for equal power splitting.**



Conclusion: The index profile of this polymer Splitter is step-index (SI) and it exhibits excellent uniformity with the same power splitting ratio.
Future Plan: We are trying to demonstrate graded-index (GI) core directional polymer splitter using Beam Propagation Method and compare its optical properties to the SI counterpart**.**