Waveguide

Last Updated: August 2019

Description

Waveguides are components that guide waves. Although these are individual components that can be adjusted for use, it is recommended to draw paths in KLayout and convert them to waveguides using the built-in SiEPIC features.

Waveguide_bump is specifically used to make a slightly longer waveguide within the same amount of space, e.g., 20 µm, plus 50 nm.

Model Name

Waveguide & Waveguide_Bend & Waveguide_SBend & Waveguide_Straight & Waveguide_bump

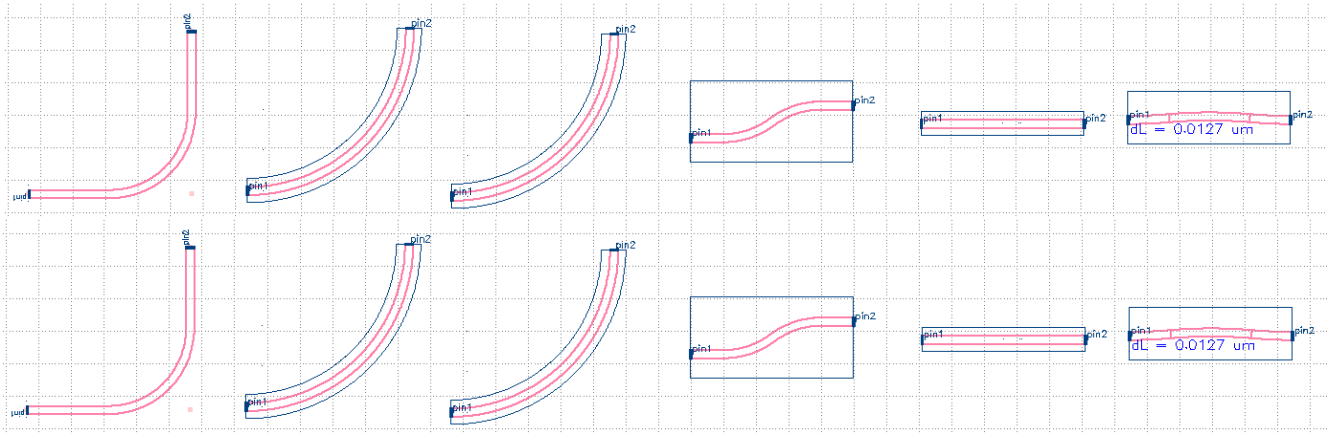

Fig. 1: Compact Model of all Corresponding Models
(L to R): Waveguide & Waveguide_Bend & Waveguide_SBend & Waveguide_Straight & Waveguide_bump

Compact Model Information

- Support for TE and TM polarization
- Operating around 1550 nm wavelength
- Performance (September 2019 from https://www.appliednt.com/nanosoi/):

Polarization	Straight Waveguide Loss	Curved Waveguide Loss
TE	1.5 dB/cm	3.8 dB/cm
TM	2.4 dB/cm	3.0 dB/cm

- Waveguide Width ranging from 0.4 µm to 3.5 µm
  - SiEPIC & UBC researchers typically use 500 nm for TE and TM
- Waveguide Height ranging from 210 to 230 nm
- Drawn in KLayout using Waveguide Type = ROUND_PATH

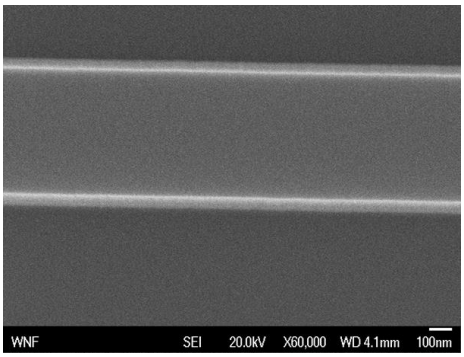

Fig. 2: SEM Picture of Waveguide_Straight

Parameters

Model Name	Parameter	Default Value
Waveguide	Radius (microns)	5
	Width (microns)	0.5
	Adiabatic	No
	Bezier Parameter	0.35
	Layers	Waveguide
	Widths (microns)	0.5
	Offsets (microns)	0
Waveguide_Bend	Radius (microns)	10
	Waveguide Width (microns)	0.5
Waveguide_SBend	Waveguide Length (microns)	10
	Waveguide Offset Height (microns)	2
	Waveguide Width (microns)	0.5
	Waveguide Bend Radius (microns)	5
Waveguide_Straight	Waveguide Length (nm)	10000
	Waveguide Width (nm)	500
Waveguide_bump	Regular Waveguide Length (microns)	10
	Waveguide Angle (degrees)	5
	Waveguide Width (microns)	0.5

http://github.com/lukasc-ubc/SiEPIC_EBeam_PDK/

Simulation Results

From [Source]:

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Fig. 3: Simulation Results for Waveguides

Experimental Results

From [Source]:

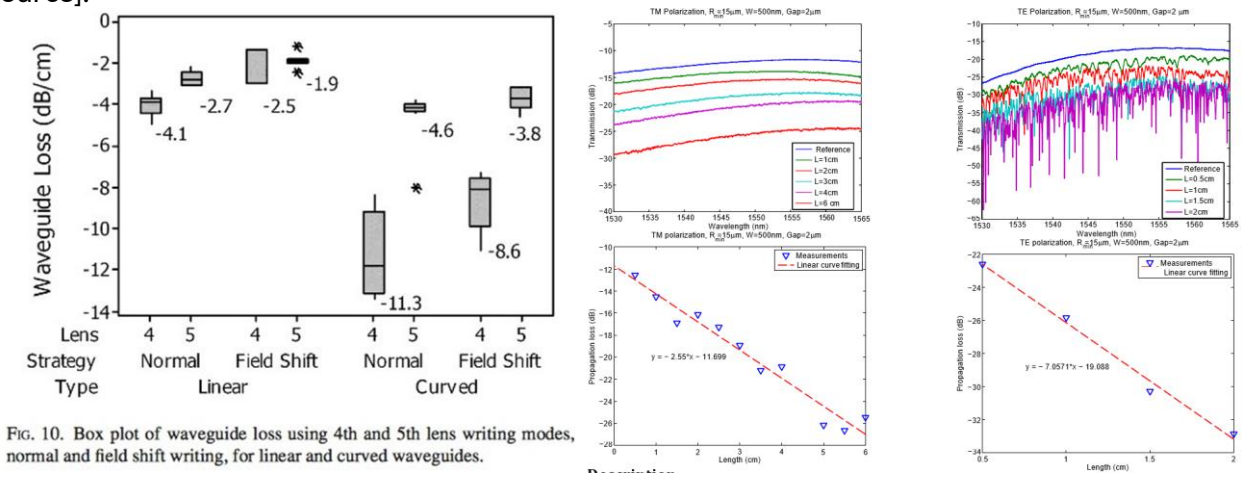

FIG. 10. Box plot of waveguide loss using 4th and 5th lens writing modes, normal and field shift writing, for linear and curved waveguides.

Fig. 4: Experimental Results for Waveguides

Additional Details

- Support for Monte Carlo using wafer map
- Model uses interpolation for geometries not in the database
- In "Electron beam lithography writing strategies for low loss high confinement silicon optical waveguides," 400 nm waveguide width was used. A variety of write methods were explored which had trade-offs of write-time vs. loss.
- SiEPIC runs use 4th Lens, 2-pass field shift writing, with default 6 nm shot pitch, 8 nA beam current.
- Design tools & methodology: Cut-back method for determining loss from "Electron beam lithography writing strategies for low loss high confinement silicon optical waveguides"

Reference

1. R. J. Bojko, J. Li, L. He, T. Baehr-Jones, M. Hochberg, Y. Aida, "Electron beam lithography writing strategies for low loss high confinement silicon optical waveguides", J. Vac. Sci. Technol. B, vol. 29, no. 6, Oct. 2011.
2. Performance Results: https://www.appliednt.com/nanosoi/