Spot Size Conversion Using a Graded-Index Waveguide Segment

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Silicon on insulator- (SOI-) based silicon photonics in which a silicon or silicon nitride wire guides light through the chip is considered as one of the most promissing approach to address future computaional and communication needs. The high index contrast between the Si or SiNx core and SiO2 cladding provides useful features such as small mode and low bending losses. Single-mode condition usually requires waveguide Silicon core dimensions of 0.3 μm × 0.3 μm. The dimensions are slightly larger when silicon nitride cores are used as waveguide. To efficiently connect a SOI waveguide to a single-mode optical fiber (SMF) with mode diameters of about 9 μm conversion of mode size is required. A spot-size convertor is the device that provides this function by enlarging the modal area wih minimal losses.
Here we repot on using full-wave electromagnetic calculations to show that a waveguide with a gradually decreasing refractive profile along the light propagation direction can function as a spot-size converter. The high-index or input waveguide is basically an SOI waveguide in which light is travelling and then it is coupled to the graded index spot size converter (GISSC) section. The GISSC on teh other side is connected to a lower refractive index waveguide denoted as output waveguide. We found that the reflection from this spot size converter is negligible even with segments as short as 1 μm however low loss adiabatic conversion still requires spot-size converter lengths as large as 50 μm.