

# RSoft Application: Spot Size Converter

## Optimization of Coupling Efficiency

### Overview

A leading telecommunications company in Japan had plans to develop an ultra-low loss Spot Size Converter (SSC) for edge coupling of rib-type Si wire waveguides using an inverted taper with an ultra-narrow tip.

### The Challenge

The project goal was to develop an effective SSC between a silica fiber and a rib Si-wire waveguide with ultra-low coupling loss. In addition, the design was required to minimize the converter footprint while reducing manufacturing and production costs. In order to evaluate multiple SSC configurations, an efficient tool to model the structure was needed. RSoft™ BeamPROP™ is the ideal tool for this design challenge.

### The Solution

BeamPROP provides rigorous, fast simulations of light propagation in the taper structure. FDTD is too slow due to large taper size. (BeamPROP is ~1300x faster than FDTD in simulating this SSC.) Eigenmode expansion requires modes to be computed at a large number of junctions.

### The Result

BeamPROP yielded the following results:

- Obtained SSC output field distribution and coupling loss
- Optimized the structure to achieve <math><0.22\text{dB}</math> fiber-to-waveguide coupling loss with a 300 $\mu\text{m}$  taper length and 80nm tip width
  - Produced dimensions compatible with CMOS processes to reduce fabrication costs
  - Coupling loss was seen to increase for reduced taper lengths

The design files for this application case study can be accessed at the Customer Support Portal at <https://opticsportal.synopsys.com>.

For more information, please contact Synopsys' Optical Solutions Group at (626) 795-9101, visit <https://www.synopsys.com/optical-solutions/rsoft.html>, or send an e-mail to [rsoft\\_sales@synopsys.com](mailto:rsoft_sales@synopsys.com).

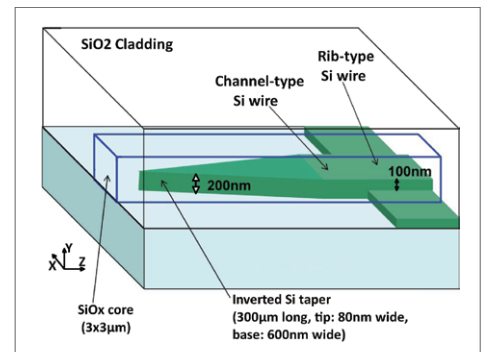


Figure 1. Spot Size Converter (SSC). Image source: Tsuchizawa, Tai, et al. Selected Topics in Quantum Electronics, IEEE Journal of 17.3 (2011)

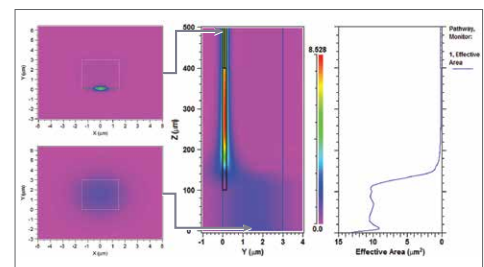


Figure 2. BeamPROP optimized results for the SSC design