

RSoft Application: Silicon-Based Optical Interconnect

Design Optimization of a Vertical Grating Coupler

Overview

Technical University of Denmark, a leading research institute in silicon photonics, had a novel idea to maximize the coupling efficiency between a fiber and a silicon chip by apodizing a vertical grating coupler with meta-materials formed by nano-holes.

The Challenge

Very complex theories are needed to analytically determine the optimum size of the subwavelength nano-holes. With so many design parameters, it is hard to perform the simulation and optimization efficiently. Several RSoft™ products can handle this design challenge.

The Solution

The complex optical interconnect model (figure 1) can be decomposed into several simpler design steps, each handled by a specific RSoft tool:

- ▶ ModePROP™ efficiently simulates the light propagation in the grating coupler
- ▶ MOST™ effectively optimizes the refractive indices of the metamaterials and determines the size of the holes in each period
- ▶ BeamPROP™ determines the optimum width of grating coupler
- ▶ FullWAVE™ validates the performance of the structure

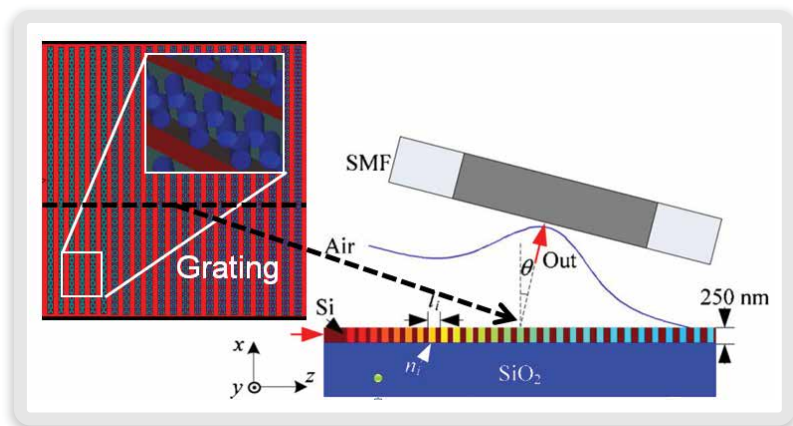


Figure 1. Silicon-based optical interconnect with vertical grating coupler. Image source (right): Ding, et al., *Optics Letters* 39.18 (2014): 5348-5350.

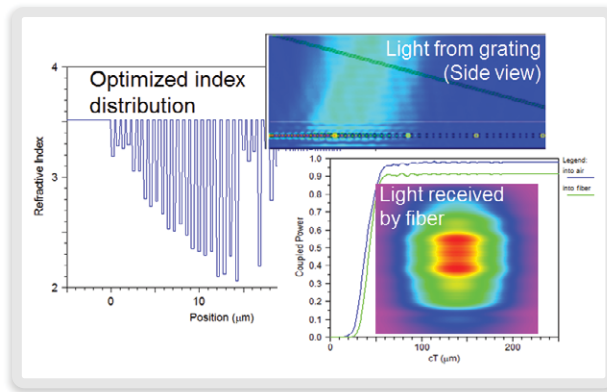


Figure 2. Optimized index distribution produced in MOST (left); FullWAVE validated the performance of the grating coupler's structure (right)

The Result

The optimized distribution of refractive index of the metamaterial for each grating period is hard to imagine without the help of an optimization tool. Figure 2 shows the coupling efficiency and output field distribution. Validation of the final design by the FullWAVE simulation showed that -0.4dB coupling efficiency was achieved.

For more information, please contact Synopsys' Optical Solutions Group at (626) 795-9101, visit <http://optics.synopsys.com/rsoft/>, or send an e-mail to rsoft_sales@synopsys.com.