A Demultiplexer with Blazed Waveguide Sidewall Grating

A. Delâge[1], P.J. Bock[1,2], P Cheben[1], J.H. Schmid[1], D.-X. Xu[1], S. Janz[1], and T.J. Hall[2]

[1]*Institute for Microstructural Sciences, National Research Council Canada, Ottawa, K1A 0R6 Canada*
Andre.Delage@nrc-cnrc.gc.ca
[2]*University of Ottawa, Centre for Research in Photonics, Ottawa, Canada*

We propose a new type of waveguide diffraction grating demultiplexer with a very small footprint, designed for the silicon-on-insulator platform.

Summary

Integrated waveguide de-multiplexers as AWG's and etched echelle gratings (EEG) have been designed in the last decade to accommodate the specifications of telecommunication for narrow channel spacing. Now, with new applications with relaxed specifications (such as FTTH, optical sensing, etc.), new designs have emerged for compact coarse WDM devices. Among them we have been interested in the performance of the dispersive waveguide grating recently published by Hao et al [1], and we propose the use a sub-wavelength antireflection structure to improve its design.

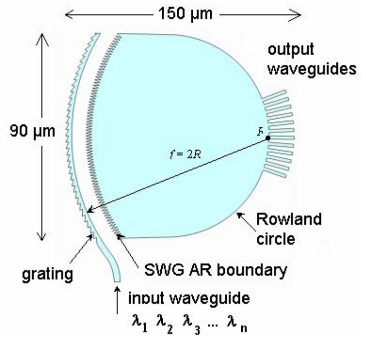

Fig 1: Waveguide grating demultiplexer

The device is presented in Fig. 1; it consists essentially of a curved waveguide on the left of the picture, in which the external wall is etched as a first order grating in order to diffract the light, originally in the waveguide, towards the output waveguides at the right. The arrangement is based on a Rowland circle (RC) configuration, with the radius of curvature of the waveguide equal to twice the Rowland radius. The focus point of the diffracted light is expected to lie on the RC in front of the output waveguides. The light is confined in the vertical direction, justifying the 2D simulations that are used to describe the device. To be efficient, this demultiplexer should also include an anti-reflection boundary that could be provided by a sub-wavelength grating as described in reference [2]. Contrary to AWG and EEG, the size of the focused spot in front of the output waveguides is not related to the input waveguide nor the grating waveguide width or mode profile; but rather to the total span of the grating and to the apodisation brought to the shape of the grating. This paper will present the properties of this device and its performance as a coarse wavelength de/multiplexer.

These properties have been studied by two different approaches: a two dimensional Kirchhoff-Huygens diffraction integral and by FDTD to account for more specific details. The first method is particularly adequate to establish the fundamental properties and limits of an ideal device. For R=70 um in silicon, it indicates the possibility of more than 10 channels separated by 25 nm with cross-talk of -40 dB. More realistic results have been then obtained with a 2D-FDTD technique that includes the grating shape and the AR-layer. This model uses a straight waveguide on a 100 μm × 3 μm calculation window from which the far-field is calculated using a standard Fourier transform. Our present design produces a 15 channel configuration with 25 nm spacing with only a supplementary penalty of –10 dB in cross-talk compared to the ideal case.

References

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[2] J. H. Schmid, P. Cheben, S. Janz, J. Lapointe, E. Post and D.-X. Xu, *Opt. Lett*. **32**, 1794-1796 (2007).