Design, Simulation and Evaluation of AWG Based Demultiplexers

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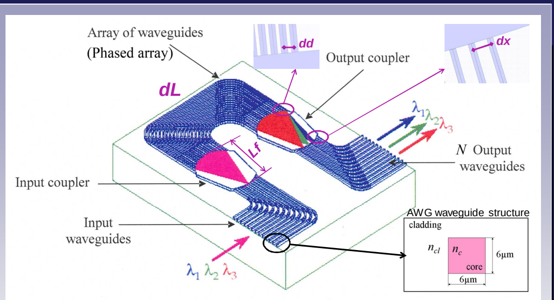
Motivation

To design optical demultiplexers based on Aarrayed Waveguide Gratings (AWGs) the various photonic tools are commercially available on the market. Although the design procedures are very similar to each other the obtained simulation results can vary strongly from one tool to another. Therefore, the optical design companies prefer to develop rather their own photonic design tools. In this work we present the design, simulation and evaluation of 8-channel, 100 GHz AWG that was designed using our in-house developed **AWG-Parameters tool**, simulated using three commercially available photonic software tools (**Optiwave, Apollo Photoni**cs and **R-Soft**), evaluated using our stand-alone **AWG-Analyzer tool** and also technologically verified.

Design of 8-channel 100 GHz AWG

When designing AWGs a set of geometrical parameters must be first calculated from input design parameters. These parameters were calculated using AWG-Parameters tool.



Input design parameters:

Technological parameters are taken to design AWG waveguide structure:

- waveguide size: waveguide structure is 6 µm x 6 µm
- refractive index of the core, n_c = 1.456
- refractive index of the cladding, n_{cl} = 1.445

AWG type parameters:

- number of output waveguides (channels) N = 8
- AWG centre wavelength λ_c = 1.55012 µm
- channel spacing: df = 100 GHz

Transmission parameters :

- adjacent channel crosstalk between output waveguides (channels): Cr = -30 dB
- adjacent channel crosstalk between arrayed waveguides: $CRaW$ = -10 dB
- uniformity over all the output channels (also called non-uniformity): Lu = 0.7 dB

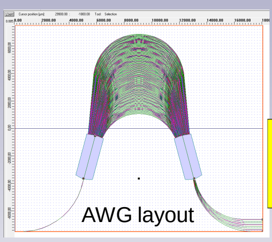
AWG-Parameters Tool

AWG geometrical parameters:

- number of arrayed waveguides: Na = 122
- minimum waveguide separation between input/output waveguides: dx = 18 µm
- minimum waveguide separation between phased array waveguides dd = 9 µm
- coupler length: Lf = 3264.62 µm
- arrayed waveguide length increment: dL = 95.96 µm

Simulation Results and Discussion

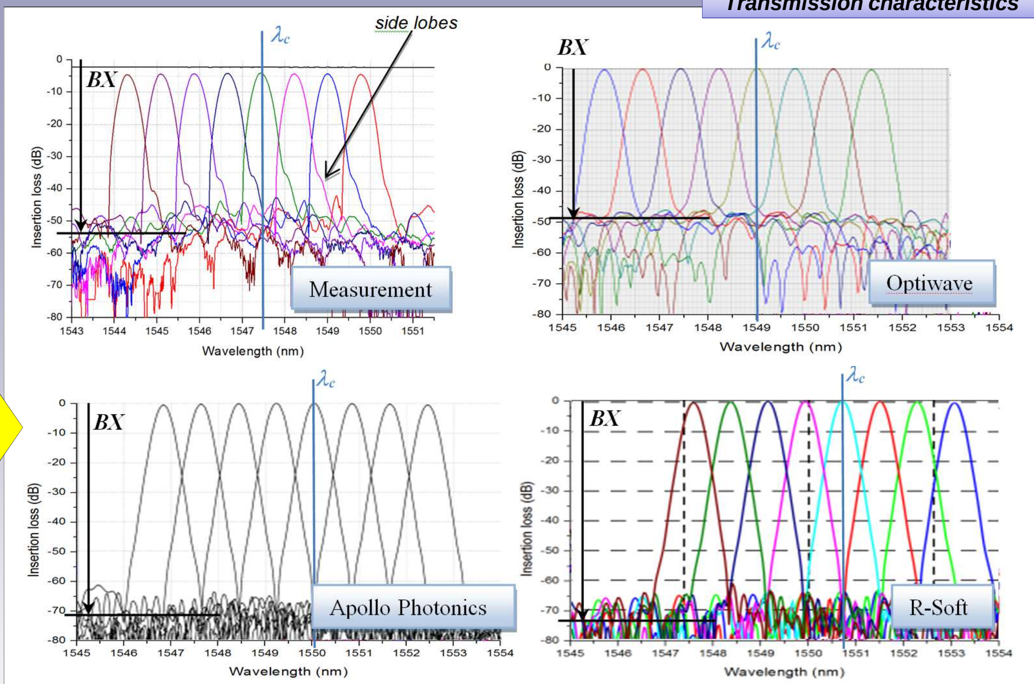
The AWG geometrical parameters (output from AWG-Parameters tool) were used to create the AWG layout. The layout was simulated using all 3 photonic tools.
For all simulations, the same calculation conditions were used.
The AWG design was fabricated and measured on a chip.
The output of the simulations/measurement are the transmission characteristics.



AWG layout

Apollo
Optiwave
R-Soft

Transmission characteristics



AWG-Analyzer Tool

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Transmission parameters

All transmission characteristics were evaluated using our in–house developed software tool called AWG-Analyzer.
The calculated transmission parameters show very similar results however, **the best agreement was achieved between the measurement and the Optiwave simulation.**

Transmission parameters	Measurement	Optiwave	Apollo	R-Soft
AWG central wavelength (λ_c)	1547.50 nm	1549.00 nm	1550.12 nm	1550.70 nm
Insertion loss	6.438 dB	2.624 dB	2.306 dB	2.000 dB
Insertion loss uniformity (Lu)	0.694 dB	0.520 dB	0.760 dB	0.529 dB
Adjacent channel crosstalk (Cr)	32.476 dB	42.024 dB	50.426 dB	50.264 dB
Background crosstalk (BX)	54.793 dB	49.458 dB	71.050 dB	73.309 dB
Channel spacing (df)	100 GHz	100 GHz	100 GHz	100 GHz

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