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Accumulated Crosstalk Enhancement of Array Waveguide Grating with Different Channels (32) Spacing

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ABSTRACT: This articlepropose cascadedconfigurations of AWGs filters in multiplexer/demultiplexer with different channels spacing designs by using the WDM_ Phasar simulation. The cascade shows its capability in solving the accumulated crosstalk problem in large scale AWG that allows for hall communication in DWDM systems. Obtaining a good performance of AWGs filters for cascading connection used different channels spacing designs of 32channels (100GHZ, 50GHZ, and 42.27GHZ). The most significant results of all input information are computed first. Running the simulation resulted in the graphical displays of the output power, and in tabulated summaries of the corresponding device performance.

KEYWORDS:Array Waveguide Grating, Multiplexer /Demultiplexer, WDM_ Phasar, Dens Wavelength Division Multiplexer, Accumulated crosstalk.

I. INTRODUCTION

Arrayed waveguide gratings (AWGs) founded on silica-based planar light wave circuit (PLC) technology are playing a key role as practical multiplexers and demultiplexers in high-channel-count DWDM systems with a large transmission capacity. The optical performance of AWGs tends to worsen as their scale is increased because the accumulated crosstalk increases in proportion to channels number[1]. AWG is a cost-effective optical filter that is constructed to make a large-scale wavelength multiplexer/demultiplexer. AWG can be fabricated as a single device which may play an important role in future dense wavelength division multiplexing (DWDM) systems [2]. Array waveguide grating (AWG) is an example of a passive wavelength-selective device[3]. In the fabrication of AWG based on planer lightwave circuit (PLC) technologies the crosstalk performance is mainly affected by the phase errors in the arrayed waveguide region. These phase errors are the deviation from designed optical path lengths of the arrayed waveguides [4].The crosstalk becomes the major limiting factor in the sensitivity of the array in a DWDM optical communication system. Optical crosstalk arises when the light incident on one channel is coupled to another channel (usually the adjacent one) by reflections or poor fiber-to-photodetector coupling [5].The crosstalk in AWG is caused by the sidelobes and scattered light of the focused beam in the interface between the second slab waveguide and output waveguides [6].The cascade connection techniques are used to reduce the crosstalk of conventional AWG filter [1].WDM simulation package is used to speed up the design process, reduce the fabrication runs and device costs. WDM-phasar is a powerful advanced software simulation used for design and modeling Phased Array Grating devices. It provides a number of calculation tools to estimate the device performance before running advanced simulations and fabrication. It is also automates index simulations, estimates quickly the bend loss and crosstalk level, and performs an advanced simulation of the whole device using the beam propagation method (BPM). WDM_ phasar monitors effectively crosstalk level, bend losses, phasar order, dispersion, free spectral range, channel nonuniformity, channel spacing, output channel bandwidth, and diffraction loss. Moreover it also performs other huge variety of important tasks like effective index calculation, design of a WDM device, editing of the WDM device geometry, fast evaluation of the WDM device performance, performing a parameter scan, and run advanced calculations [7].

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II. RELATED WORK

In [8] the authors devoting themselves to further reduce the loss and the crosstalk up to -21dBof the polymer AWG device in order to fabricate this devicewith better featuresand investigated the effects of the fabrication errors on the transmission characteristics of the AWG device, and compensation techniques are proposed. They comparing the theoretical simulation and experimental results, the shift in the transmission spectrum is reduced by 0.028 nm, the 3 dB bandwidth is increased by about 0.036 nm, the insertion loss is reduced by about 3 dB for the central channel and 4.5 dB for the edge channels, and the crosstalk is reduced by 1.5 dB. Also in other related work [9] the authors propose a highly compact and low crosstalk arrayed waveguide grating (AWG) with cascaded waveguide grating (CWGF). The side lobes of the silicon nanowire AWG, which are normally introduced by fabrication errors, can be effectively suppressed by the CWGF. Moreover the author in [10] demonstrated, in the simulation of AWG transmission characteristics, that finite photomask resolution is themajor cause of AWG crosstalk problems when other design parameters, such as waveguide geometry, power truncation, and number of grating waveguides, are properly selected. Field-amplitude fluctuation introduced by material impurity and processing imperfection will be a noticeable factor and must be carefully controlled as well. This is particularly true when photomask resolution is better than 25 nm and less than 35 dB crosstalk is required. Using AWG demultiplexers patterned and fabricated by different photomasks, the measured crosstalk performance of all of these devices agreed well with calculated results. All measured transmission spectra are used to verify the precision of data from phase and field amplitude measurements. The match between the values of photomask resolution and path-length error confirms the former as the dominant factor that affects AWG crosstalk performance. By improving the photomask resolution, it is believed that the AWG crosstalk performance can be better than 40 dB with necessary path length correction technologies.

III. RUNNING ADVANCED SIMULATIONS

First AWG is designed,which has an eight input ports and the same number of output ports. Second changed the input port to 1 obtained the device that working in a demultiplexing regime.At the end of this step, a device with one input port and eight output ports isobtained. After that setting up the parameters for advanced simulation and run it, at the end of this step the following run time graphics appear figure (1).The left-hand quadrant shows the effective index and the field distributions in the end of the propagation for all eight channels, the right-hand quadrant shows the output power (dB) for all eight channels.Once the simulations are performed, enlarge the graphic showing the output power in the channels, which it contains the most important results, in this step, the summary of the device performance amplitude (indB), width, spacing, and cross-talk level for all eight channels are obtained after choosingstatistics from the menu.

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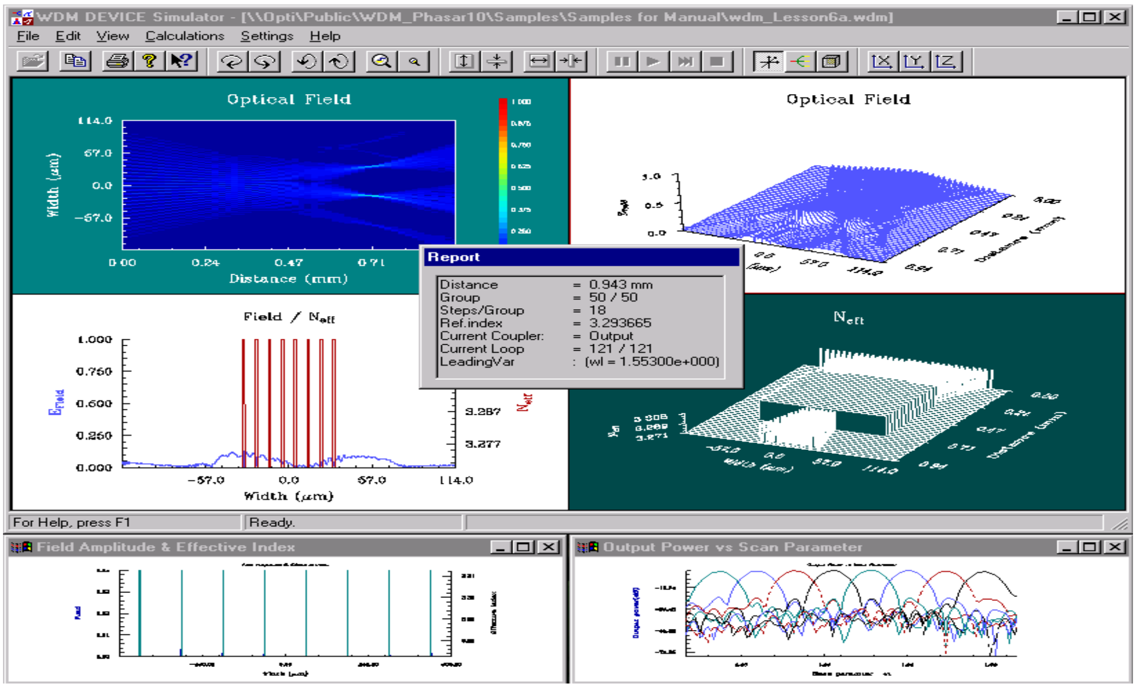

Fig.1. Graphics appear at simulation end

Table1:Information in the Statistics dialog box.

Statistics

Channel	Amplitude	Width	CrossTalk
1	-4.973324	0.001003	-29.216834
2	-4.417054	0.000963	-28.921708
3	-3.956224	0.000948	-29.114058
4	-3.731089	0.000940	-29.391477
5	-3.946152	0.000937	-29.673149
6	-4.162486	0.000948	-29.538424
7	-4.366012	0.000962	-28.502909
8	-4.874898	0.000993	-28.024551

Channel b...	Spacing
Between 1 ...	0.000700
Between 2 ...	0.000700
Between 3 ...	0.000650
Between 4 ...	0.000700
Between 5 ...	0.000700
Between 6 ...	0.000650
Between 7 ...	0.000700

Bandwidth level [dB]

-25

Recalculation

Help

Save   Save As   Close

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IV. WDM_PHASAR SIMULATOR-BASED AWG UNITS DESIGN

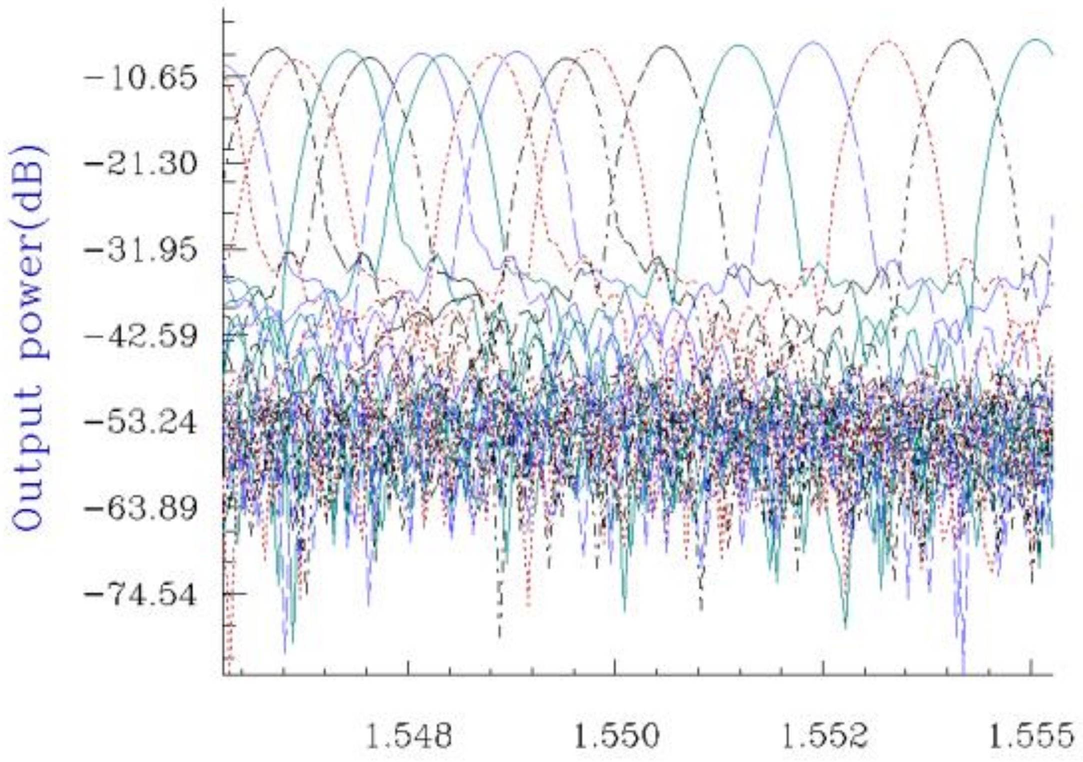
Now WDM_ Phasar simulator is used for designing 32-channels unit as DWDM multiplexers/Demultiplexerswith different channel spacing. The simulation is run for design unit to obtain the crosstalk of each channel. Then the simulation is run in cascading manner by activating the cascading tool for design unit, and after taking about twenty four hours the simulator provides the resulting crosstalk [11].

V. DESIGN OF 32 CHANNELS WITH DIFFERENT CHANNEL SPACING

The device design procedures of 8 channels are repeated here for 32 channels and running the simulation for different channel spacing (100GHZ, 50GHZ, 42.27GHZ) and it gave the graphical displays of the output power, and summaries of the device performance, shown in the figures (2, 3, 4) and tables (2, 3, 4,5).

Table 2: Calculation results of input information for 32ch with different spacing

Central frequency (nm)	Crosstalk level (dB)	Channel spacing (nm)	channel spacing (GHZ)
15460	-35.479761	0.79901358	100.21952
1560	-34.97449	0.4058877	50.000441
1550	-35.334416	0.33876124	



Wavelength in micron
Fig.2. Output power vs wavelength (scan parameter) of 32 channels with 100GHZ spacing

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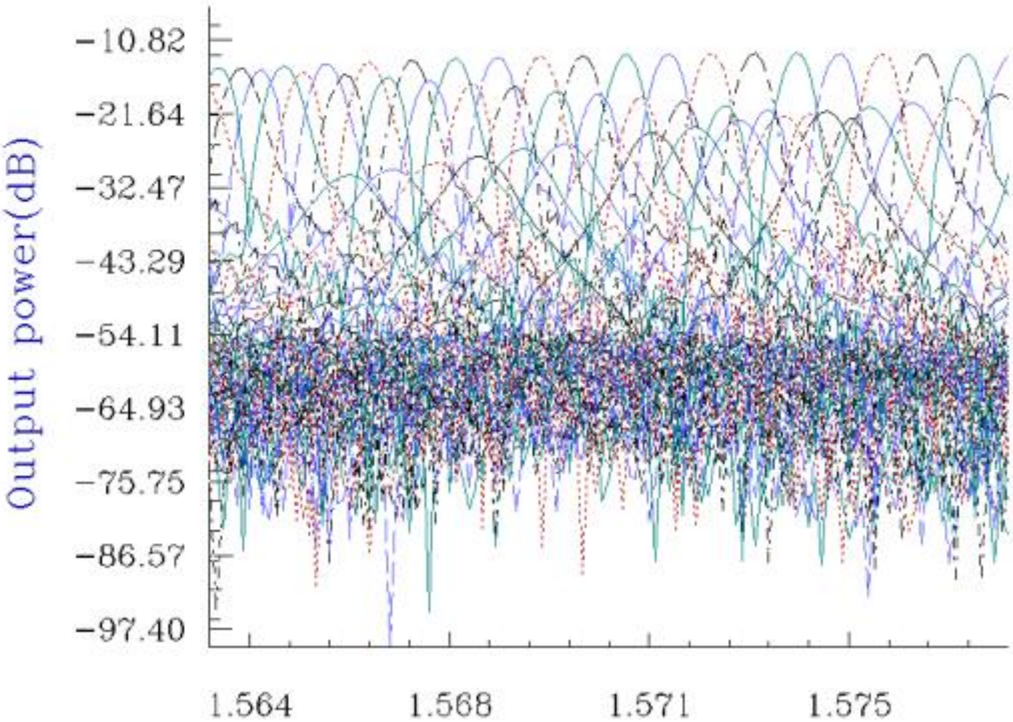
Table:3 Summary of the device performance of 32 channels with 100GHZ.

Channel	Channel spacing(nm)	Amplitude In dBs	Crosstalk In dBs
3	0.825	-7.697004	-34.706123
4	0.750	-7.377909	-34.900788
21	0.825	-6.118366	-33.191893
22	0.825	-6.250925	-33.720983
24	0.825	-6.744763	-33.863560
26	0.825	-7.21374	-33.812049
28	0.825	-7.849551	-34.125619
30	0.750	-8.621063	-32.421272



Wavelength in micron

Fig.3. Output power vs wavelength (scan parameter) of 32 channels with 50GHZ spacing

Table 4 Summary of the device performance of 32 channels with 50GHZ

Channel	Channel spacing(nm)	Amplitude In dBs	Crosstalk In dBs
2	0.733	-29.217508	-28.799605
3	0.733	-27.565760	-27.201027
13	0.733	-15.846232	-16.634269
19	0.733	-15.344952	-15.937855
29	0.733	-24.256448	-24421969
31	0.733	-27.521780	-27.830279
32		-29.325353	-29.465999

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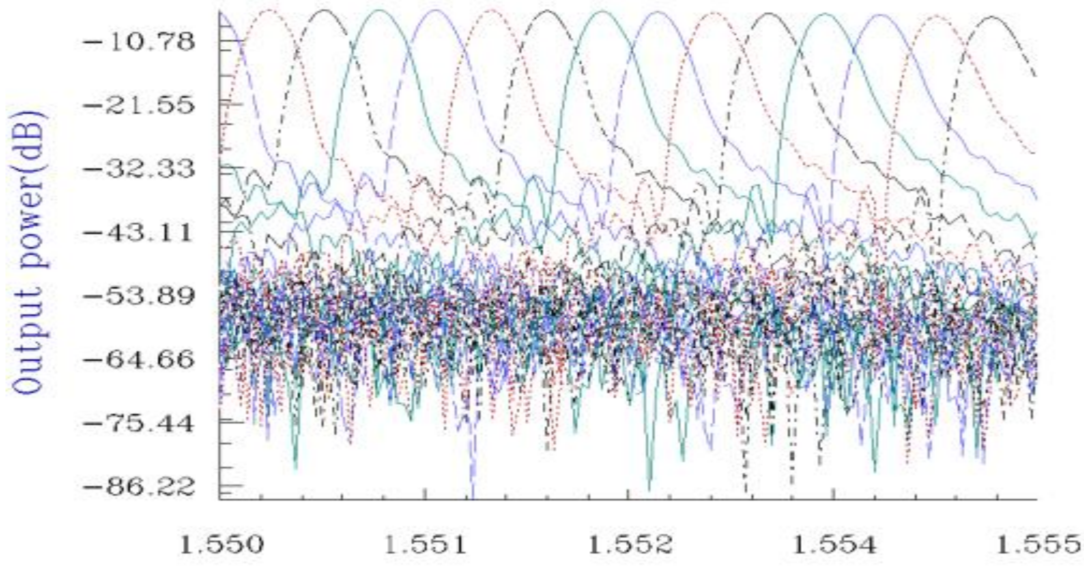

Wavelength in micron

Fig.4. Output power vs wavelength (scan parameter) of 32 channels with 42.27GHZ spacing

Table: 5Summary of the device performance of 32channels with 42.27GHZ.

Channel	Amplitude In dBs	Channel spacing(nm)	Crosstalk In dBs
2	-6.535082	0.333	-21.885378
3	-6.281570	0.333	-22.747959
4	-6.181277	0.333	-23.629251
6	-5.980716	0.333	-23.539268
7	-5.787955	0.333	-24.613300
9	-5.610742	0.333	-26.591508
13	-5.465998	0.333	-28.636114

VI. CONCLUSION

AWG cascade connection that used in optical DWDM multiplexes/demultiplexers systems is a possible solution to the problem of crosstalk accumulated in large-scale arrayed-wave-guide grating. Simulation designs of 32channels unit with different channel spacing obtained, this concludes that the series of simulation of AWG cascading in which channel crosstalk is maintained within a sizable margin of safety from the accepted standard level.

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