Comparison of High Precision and Performance of AWG Wavelength Division Multiplexer



Overview

We compare the performance of two grating based wavelength de/multiplexers in silicon: ar-rayed waveguide gratings and echelle gratings.

Key Takeaways

AWG wavelength division multiplexers offer high precision and low crosstalk, making them ideal for dense WDM systems, with performance metrics often surpassing alternative technologies like TFF and echelle gratings. High Precision in AWGsAWGs achieve high center frequency accuracy (CFA) through precise design of the waveguide array and star couplers. Advanced optimization methods, such as adjusting the geometric positions of output waveguides, can achieve a CFA of up to 0.

04 times the output channel frequency spacing, compensating for manufacturing errors and temperature fluctuations. This precision ensures that each wavelength channel is accurately separated, which is critical for DWDM systems with high channel counts.

Performance Metrics

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Insertion Loss: Typical AWGs exhibit low insertion loss, often below 2 dB, with uniformity across channels maintained through careful design. Crosstalk: Crosstalk in standard AWGs can reach 27 dB, while optimized designs, such as S-shaped AWGs, can improve crosstalk to better than 19 dB. Recent designs combining inverse-designed AWGs with distributed Bragg gratings have demonstrated ultra-low crosstalk below -40 dB for 15 nm channel spacing.

Channel Spacing and Scalability: AWGs are highly scalable, supporting a large number of output channels and adaptable to different spectral windows, making them suitable for high-resolution DWDM applications. Comparison with Other WDM TechnologiesTFF (Thin-Film Filter): TFF modules are simpler, compact, and cost-effective, with ultra-low latency due to short optical paths. However, they are better suited for coarse WDM (CWDM) and have limitations in high-channel-count DWDM systems.

Echelle Gratings: Echelle gratings perform well for low-resolution applications but generally exhibit higher crosstalk (19–23 dB) compared to optimized AWGs, making AWGs preferable for high-resolution DWDM. SummaryAWGs excel in high-precision wavelength separation, low insertion loss, and minimal crosstalk, particularly in dense WDM systems. Their scalability and adaptability make them superior to TFF and echelle gratings for applications requiring high channel counts and precise wavelength control.

Optimized AW

G designs continue to push the limits of performance, enabling reliable, high-capacity optical networks for modern telecommunications and data center applications.

Article Content

Comparison of AWGs and Echelle Gratings for Wavelength Division ...

We compare the performance of two grating based wavelength de/multiplexers in silicon: ar-rayed waveguide gratings and echelle gratings. The echelle gratings are the best choice for low resolution

WDM Technology: TFF (Thin-Film Filter) & AWG (Arrayed Waveguide

AWG typically includes an array of parallel waveguides designed to introduce specific phase shifts, enabling precise wavelength separation. Compared with TFF, AWG provides higher

Comparison of AWGs and Echelle Gratings for Wavelength Division ...

We compare the performance (insertion loss and crosstalk) of silicon-based arrayed waveguide gratings (AWGs) and echelle gratings for different channel spacings. For high-resolution

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[2509.07233] High-Performance Wavelength Division Multiplexers

Here, we develop a novel design approach that co-optimizes inverse-designed wavelength division multiplexers and distributed Bragg gratings to achieve ultra-low crosstalk without

Optimization Method for Center Frequency Accuracy of High ...

This paper presents a design and optimization approach for a high-channel-count AWG based on the silica platform and the finite difference beam propagation method (FD-BPM).

High-Performance Wavelength Division Multiplexers Enabled by Co ...

Here, we develop a novel design approach that co-optimizes inverse-designed wavelength division multiplexers and distributed Bragg gratings to achieve ultra-low crosstalk without compromising

WDM Wave Lengths Multiplexing Technology: TFF & AWG

Each channel''s wavelength is guided out by a specific waveguide, allowing for signal multiplexing and separation. Compared to TFF technology, AWG technology offers higher

Design and fabrication of E-band silica based dense wavelength

Abstract A E-Band,48 channels flat top silica based dense wavelength-division multiplexing (DWDM) arrayed waveguide grating (AWG) was designed and fabricated with 0.75 %

Ultra-Low-Crosstalk Silicon Arrayed-Waveguide Grating

A silicon arrayed-waveguide grating (AWG) with 1.6-nm channel spacing is proposed and realized with high performances for dense wavelength-division (de)multiplexing systems.

SKYLIGHT: A Scalable Hundred-Channel 3D Photonic In-Memory

Design of a hybrid mode and wavelength division (de) multiplexer based on contra-directional grating assisted couplers on the SOI platform. Applied Optics 60, 9 (2021), 2640–2646.

High-Performance Wavelength Division Multiplexers Enabled by Co ...

Abstract Wavelength division multiplexers are fundamental to the functioning and performance of integrated photonic circuits, with applications ranging from optical interconnects to sensing and

Optical performances analysis and structure parameters optimization ...

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Finally, Based on the influence laws, mechanisms and sensitivities of structure parameters on optical performances, an optimization scheme including some innovative and improved

High-speed transmission and dispersion characteristics of an arrayed ...

We show here that in presence of loss, the AWG dispersion is no longer negligible and can have variations of the order of 40 ps/nm in the 10 dB transmission bandwidth. In this paper we

Custom Arrayed Waveguide Gratings with Improved Performance

Custom AWG designs have been developed to provide a high-performance AWG device while addressing the needs of each application. [10 - 60] Compared to computational spectrometers,

APN-24-100501 1..8

Abstract. A high-performance silicon arrayed-waveguide grating (AWG) with 0.4-nm channel spacing for dense wavelength-division multiplexing systems is designed and realized successfully. The device

Integrated multi-wavelength lasers: a design study

Multi-wavelength lasers (MWLs) play an important role in wavelength division multiplex-ing networks, and also in photonic radar beam steering applications. In this paper we study different options for

Review Paper of Array Waveguide Grating (AWG)

Abstract – An array waveguide grating multiplexer and demultiplexer in particular is one of most successful optical filters and it is a key component of photonic networks and it is cost-effective

Arrayed waveguide grating

Arrayed waveguide gratings (AWG) are commonly used as optical (de)multiplexers in wavelength division multiplexed (WDM) systems. These devices are capable of multiplexing many wavelengths

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