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# Monolithic InP Grating-Based Wavelength Division Multiplexing Components

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The past year saw breakthroughs in a new component technology that promises to provide wavelength-specific devices for future wavelength division multiplexed (WDM) networks that have a high degree of wavelength control and a low manufacturing cost. To date, one of the greatest challenges facing implementation of proposed WDM networks is the practical realization of low-cost wavelength-specific opto-electronic components (lasers, detectors, etc.) that possess and maintain the wavelength accuracy needed for effective network operation. While many components are available or under development, there is no technology that provides these devices with the required wavelength accuracy, tolerance, and stability at low enough cost to make many of the networks commercially viable.

The new component technology uses a single-chip semiconductor wavelength multiplexer/demultiplexer integrated with different active elements to form a wide range of compatible wavelength-specific components.

The heart of the mux/dmux is a planar waveguide grating spectrometer into which a diffraction grating and stripe waveguides have been etched.[1,2] When a multi-wavelength signal is fed into an input stripe guide, it enters the body of the device and is dispersed by an etched diffraction grating; the wavelength-demultiplexed signals then exit the device via output stripe guides. Wavelength multiplexing is achieved by operating the device in reverse. Because wavelength selection relies on the device geometry, highly accurate specification of the wavelengths is possible.

The basic InP grating mux/dmux was reported in 1991; 1992 saw its integration with active elements to form WDM sources and receivers.

WDM detector arrays were formed by integrating waveguide p-i-n photodetectors with the output waveguides. Devices with both 42 and 92 channels were reported.[3,4] Channel separation was 4 nm and 1 nm, respectively, with 2 nm and 0.6 nm channel passbands. The detector arrays operated in the 1.5 μm fiber band and employed highly efficient (90%) waveguide photodetectors.

A 16-wavelength WDM laser, called the "MAGIC" (Multi-stripe Array Grating Integrated Cavity) laser, was also reported.[5] This has active gain elements integrated with the grating-based cavity. The planar guide body and the pumped stripes form the laser cavity, while the grating provides the wavelength selective intra-cavity element. By injection pumping one output stripe and different "second" stripes, lasing was obtained from the single output at different wavelengths. Like the dmux and detector array, the laser operated at wavelengths precisely determined by the device geometry.

The basic trio of WDM devices—source, filter, receiver—has now been demonstrated using the integrated grating technology. Their development and combination is expected. The great potential of the semiconductor grating-based technology, which arises from its ability to set the wavelengths accurately and the fact that fabrication is readily scalable to large-volume manufacture, assures that it will be actively pursued in the years to come.

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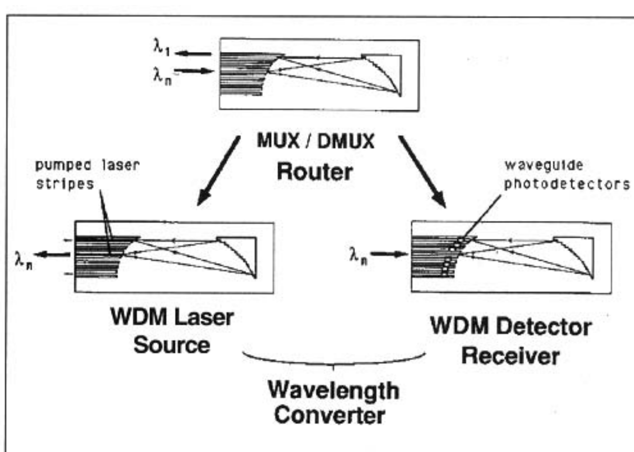


WDM components based on the InP grating mux/dmux. The combination of detector and laser yields an "electronic island" or node capable of intelligent wavelength conversion or translation.