【QS-07】

Prospects of Planar Lightwave Circuit Technology

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The planar waveguide devices have been widely used for varieties of applications in optical communication such as power splitting, switching, hybrid integrations of active devices, wavelength multiplexing, routing and channel add/drop applications in dense wavelength division multiplexing (WDM) networks. In this paper, we briefly survey the current stage and prospects of planar lightwave circuit development. These will includes arrayed waveguide grating multiplexer, add-drop integrated device, thermal switches, power splitter, and polymer-silica hybrid waveguide devices.

Experimental results on the fabricated 80 channel 50 GHz flat-top AWG devices is reported. The most desirable features of AWG devices is a wide and flat spectral response within the passband at each channel. This feature allows high data rates in each channel, and gives the device large tolerance both against the wavelength drift of input signal and against central wavelength error of each channel caused by temperature variations, manufacturing tolerances, etc. It is also highly desirable that the transmission spectrum drops sharply at the edge of the passband at each channel, enabling adjacent channels being closely spaced without causing unacceptable crosstalk. Several techniques have been proposed to flatten and widen the passband; parabolic tapered input waveguides[4], multimode interference couplers (MMI) inserted between the input waveguide and the slab region[5], and phase-dithering technique[6]. Generally, with the increase of the flat passband, the insertion-loss increases and the crosstalk performance degrades. The MMI passband flattening technique was employed for flattening the passband at each channel.

A preliminary 80 channel 50 GHz flat-top arrayed waveguide grating filter was fabricated using the planar lightwave circuit technology. For flattening the passband, the multimode-interference coupler was inserted between the input and the slab waveguides. The fabricated device showed that the average insertion loss at ITU passband was 5.9 dB with the 3 dB bandwidth of 0.33 nm, non-adjacent crosstalk of 32 dB. The loss uniformity over the channels was 1.3 dB.

Device performance of various types of thermal switches such as symmetric Mach-Zender, asymmetric Mach-Zender, Cascaded switch, digital optical switch and matrix switch will be introduced. Two types of waveguide coupler used in Mach-Zender switch will be introduced, which is coupler waveguide type and MMI waveguide type. Typical performance of swich shows device insertion loss of about 1 dB and extinction ratio of 30 dB.

Splitter performance from 2 to 32 channel power splitting will be introduced. Typical performance of splitter shows device added loss of 0.5 dB only and low polarization dependent loss of 0.1 dB.