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Spatial and spectral characteristics of an optical demultiplexer based on a holographic chirp grating

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Abstract

In this paper, the spatial and spectral characteristics of an optical demultiplexer based on a chirp volume holographic grating are presented. The chirp grating is recorded by illuminating the photopolymer film under the interference of a convergent beam and divergent beam. The dependence of the spatial distance on the grating-focusing lens separation is observed. The bandwidth and the crosstalk between two channels with 0.4-nm spectral interval are 0.13 nm and 12 dB, respectively.

Chirp grating is used for dispersion compensation in fiber Bragg grating, for controlling and shaping short pulses in fiber lasers [1, 2], and for controlling the chromatic dispersion in holographic multiple-channel demultiplexer [3]. In this paper, we present o the spatial and spectral characteristics of an optical demultiplexer based on the chirp grating in a thin film. The Dupont photopolymer with thickness of 100um is used. To create the grating, the film is illuminated by two cylindrical convergent and divergent beams, R and S, respectively as shown in Fig. 1. Their focusing lines are symmetric by the film plane. Therefore, the period of the interference is changed along the position on the film. After recording, the center wavelength of each position on the chirp grating is verified. The result is sketch in Fig. 2.

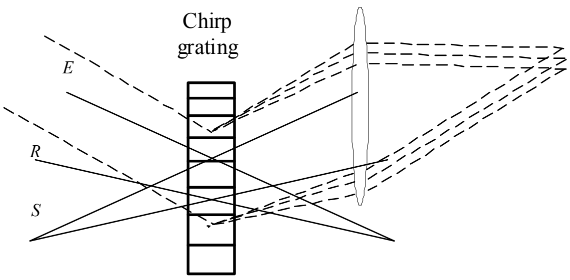

Fig. 1 Chirp grating recording and reading scheme

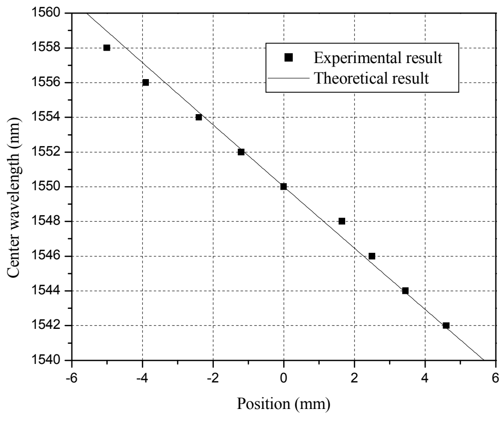

Fig. 2 Chirp grating profile. The grating is recorded by focused and divergent beams with the focal distance of 5 m. The recording angle at center of the film and the recording wavelength is 15 degree and 532nm, respectively.

For testing the spatial and spectral characteristics of the grating system, an experiment is carried out. The experimental setup consists of a collimating lens, volume holographic grating, and an output-focusing lens [3]. The output-focusing lens transforms the angularly dispersed diffractionbeams into the spatial separation on the focal plane, where a single mode fiber is placed. This output fiber is hold and moved along the horizontal direction by a motorized fiber alignment unit. At each position, the diffraction beam is coupled to the fiber and its spectrum is examined by an optical spectral analyzer. For each distance from grating to the focusing lens, the spatial distance of two channels with 0.4-nm channel spacing at 1550-nm region is measured. It is shown that when the lens is moved backward and forward from the grating, the spacing of two focused points is changed, as sketched in Fig. 3. This dependence can be utilized for adjusting the spacing distance of two channels in the optical demultiplexer. Figure 4 shows the spectra of two center wavelengths of 1550nm and 1550.4nm. The bandwidth of 0.13nm and the crosstalk of about 20 dB are obtained. Comparing with the result reported in previous publication [4], it can be seen that the spectral response is not affected by the profile of the grating.

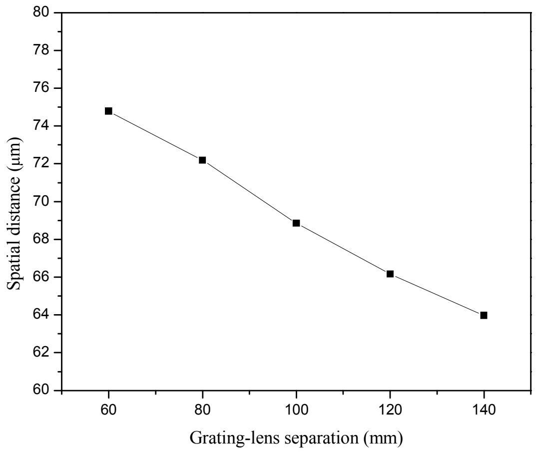

Fig. 3 The spatial distance between two channels with 0.4-nm channel spacing

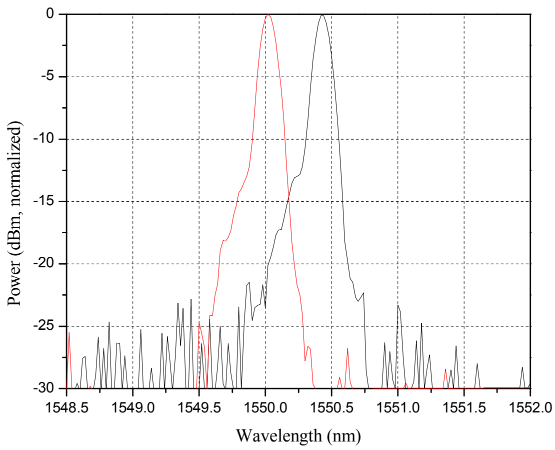

Fig. 4 The spectra of two output channels with 0.4-nm channel spacing

In this paper, we have presented the spatial and spectral characteristics of the demultiplexer using the chirp holographic grating. The output beam is focused not on the focal plane of the lens but on the plane depending on the distance from the grating to the lens. Therefore, we can use the chirp grating in the demultiplexer with adjustable spacing distance.

Acknowledgment

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