Fabrication of Sampled Fiber Grating and Measurement of Its Characteristics

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Abstract

We fabricated sampled fiber grating by double-exposure method. First, a short-period grating was written into the hydrogen-loaded single mode fiber and then the refractive index was modulated over it by an amplitude mask. It was observed that several transmission dips appear due to the index modulation. The thermal and strain responses were measured over 40 -180°C and 0-1800με, respectively. The dips have the same and linear sensitivity to both physical quantities over the range of measurement.

1. Introduction

The fiber grating written by ultraviolet(UV) light into the core of an optical fiber has developed into a significant component for many applications in fiber-optic communication and sensor systems[1]. Advantages of fiber gratings over competing technologies include all-fiber geometry, low insertion loss, and high return extinction. The optical properties of a fiber grating are essentially determined by the variation of the induced index change along the fiber axis. Several index modulations are employed to obtain a specific spectrum.

In this paper, we fabricated the sampled fiber grating whose refractive index was modulated by an amplitude mask. First, we have written a short-period grating into a fiber and then exposed UV light to it. We also measured the temperature and strain characteristics.

2. Fabrication of Sampled Fiber Grating

The short-period fiber grating was made by a phase mask. We used to form the grating with the KrF excimer laser producing 220 mJ/cm^2 of 248nm at the repetition rate of 15 Hz. The conventional single mode fiber was used with hydrogen-loading for 48 hours at 100atm and 100°C. The time taken to write the grating was 2 minutes. After the grating was formed in the fiber core, we exposed it to UV light through an amplitude mask to modulate the refractive index.

Figure 1 shows a schematic diagram of double-exposure method. The period of the amplitude mask is 500μm and the duty ratio is 50%.

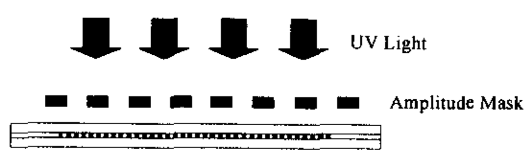

Fig. 1. Schematic diagram of fabrication of samled fiber grating.

3. Measurement of Thermal and Strain Responses

Figure 2 shows the transmission spectrum of the fabricated sampled grating. The Bragg wavelength of the short-period grating was 1542nm and after the exposure several transmission dips appeared. These dips resulted from the index modulation by the amplitude mask.

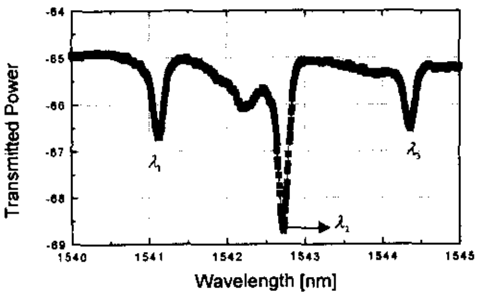

Fig. 2. The transmission spectrum of fabricated sampled fiber grating.

Figure 3 shows the Bragg wavelengths of transmission spectrum (λ_1, λ_2, and λ_3) versus temperature in the range of 40-180°C. Three dips had the same sensitivity of 0.0129 nm/°C and the wavelength shifts were linear.

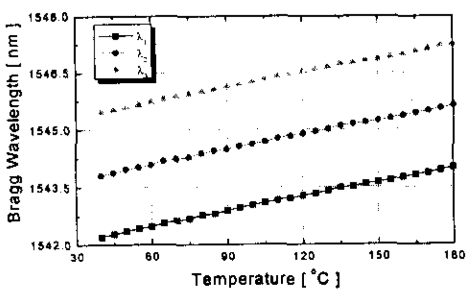

Fig. 3. Bragg wavelengths shift versus applied temperature

Figure 4 shows the strain response of the sampled grating. In the range of 0-1800με, the wavelength shifts were linear and three dips also had the same sensitivity of 0.0011 nm/με.

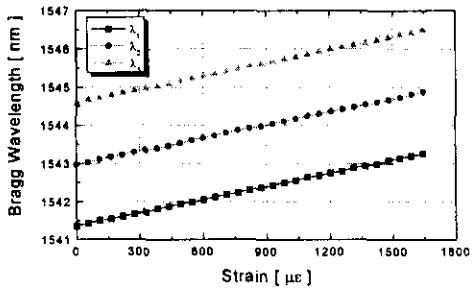

Fig. 4. Bragg wavelengths shift versus applied strain

4. Conclusions

We fabricated a sampled fiber grating by the double-exposure method. It had three transmission dips and it was observed that the responses to both temperature and strain are the same and show linear characteristic in the range of measurement. These characteristics of sampled grating could be employed in demodulation components of sensor systems.

Acknowledgment

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References

[1]T. Erdogan, "Fiber grating spectra," J. Lightwave Technol. vol. 15, pp. 1277-1294, 1997.