WAVELENGTH SHIFT AND SPLIT OF CLADDING MODE RESONANCE IN MICRO-BENDED LONG-PERIOD FIBER GRATING UNDER TORSION

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Abstract -- *A resonance wavelength shift proportional to the square of the twist angle has been observed for various cladding modes in micro-bended long-period fiber gratings. The resonance peaks split, reduce their amplitude, and finally disappear with increasing twist rate.*

Recently, a wavelength shift in corrugated and photoinduced long-period fiber gratings LPFG's has been observed in gratings under torsion [1]. It has been shown [2] that the shift is proportional to the square of the twist angle. Therefore, it is important to apply a large twist rate for obtaining a large wavelength shift of a resonance loss band. The maximum twist rate for a photoinduced grating is usually small owing to the photoinduced damage in the fiber. For a pristine fiber, the maximum twist rate allows a much larger wavelength tuning. An LPFG can be made in a pristine fiber by micro bending.

The transformation of transmission loss spectra with increasing twist rate for a micro-bended grating (MBG) made in a dispersion-shifted fiber has been investigated and are shown in Fig. 1a. At zero twist rate, two resonance peaks correspond to the coupling between the core mode and LP_{11}, LP_{12} cladding modes. When the fiber is twisted, both peaks shift to the shorter wavelength side and reduce their amplitude. After the LP_{11} mode resonance shifts about 25 nm, it vanishes. The resonance wavelength of the LP_{12} mode splits when the MBG is strongly twisted (5 rad/cm). The splitting increases with twist rate. At a very large twist rate, high order cladding modes appear and behave in a similar way. The wavelength shift of cladding mode resonances can be utilized as wavelength tunable loss filters. The tuning range of such filters can be more than 100 nm for MBG's. The peaks of resonance wavelengths for different modes are shown in Fig. 1b as functions of the twist rate including the negative values of opposite direction. The dependences are parabolic functions, and some have their vertexes at the same wavelength.

Thus we have investigated spectrum behavior of MBG under torsional load and have shown that several new effects can be observed. Such effects may enable the LPFG's to serve as widely tunable band-rejection filters for some applications. The tuning range for a MBG could be more than a hundred nanometers.

REFERENCES

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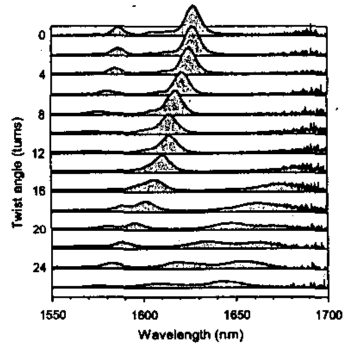

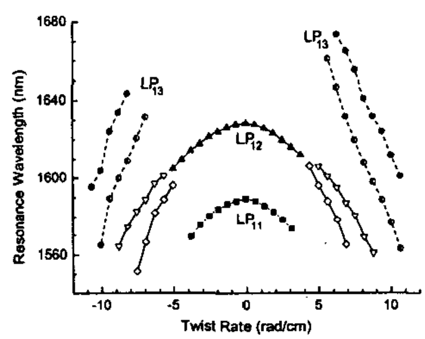

Fig. 1. (a) Transformation of spectrum of MBG G2 in dispersion-shifted fiber and (b) cladding mode resonance wavelengths versus the twist angle.

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