Low-cost in-fiber WDM devices using tilted FBGs

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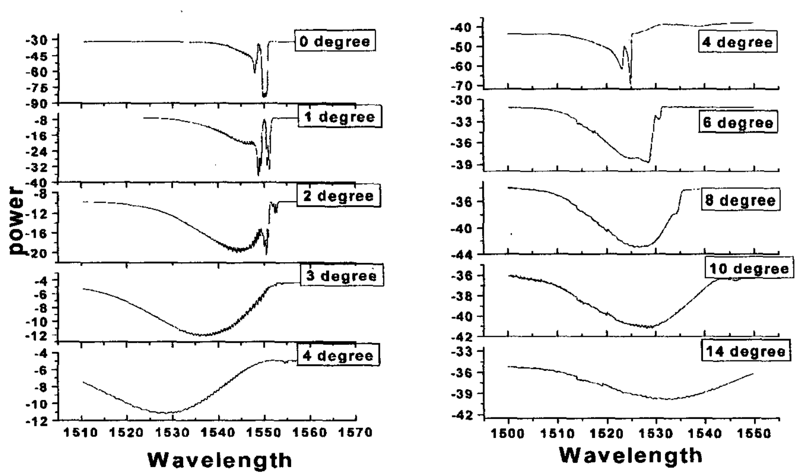
Abstract: We report the realization of low-cost in-fiber WDM device function utilizing efficient side-detection of strong radiation mode out-coupling from tilted FBGs. The spatial-to-spectral conversion efficiency as high as 0.32mm/nm is demonstrated.

1. Introduction

Radiation mode out-coupling from tilted (or blazed) fiber Bragg gratings (FBGs) has been demonstrated for applications in WDM channel monitoring[1], gain flattening of EDFAs[2] and polarization discrimination[3]; there are, however, very few reports to date on radiation modes being side detected at the grating's location within the fiber. Side-detection of radiation modes offer many application-specific advantages, for example; in conjunction with the use of CCD array detectors, the function of side-tapping light with high spectral resolution from tilted FBGs may be utilized to implement low cost devices for use in WDM applications. In this paper, we report the realization of in-fiber optical spectrum analyzer function utilizing effective side-detection of strong radiation mode out-coupling from tilted FBGs.

2. Transmission loss profiles of tilted gratings

In order to realize strong radiation mode out-coupling, we fabricated tilted FBGs using both phase-mask and holographic techniques. Figures 1a and 1b show the transmission spectra for two sets of tilted gratings fabricated in single-mode fiber by the phase-mask and holographic methods respectively.



(a) (b)

Fig.1 Transmission loss profiles of two sets of tilted FBGs in single-mode fiber fabricated using (a) phase-mask and (b) holographic techniques.

3. Side-detection

If radiation mode out-coupling can be detected from the grating's position within the fiber, an optical spectrum analyzer function may be easily realized. This function is of enormous utility since it can easily implement low-cost WDM devices for applications in telecommunications and optical sensing. To this end, we have developed a system to detect the out-coupled field created by the radiation modes of tilted gratings. A cylindrical lens was used to focus the light on to the detector. The radiation field measurement along x-axis was performed using the set-up sketched in Figure 2a. The light from a tunable laser was launched into fiber. A scanning detector mounted on a motorized translation stage was used to measure the spatial distribution of the radiated light side-coupled out from the tilted grating.

Figure 2b shows the measured power distribution along the *x-axis* for different wavelengths. When the wavelength changes, the corresponding focus point on the *x-axis* moves, giving a clear spatial-to-spectral relationship. The squared curve in Figure 2c plots the peak power position against the wavelength, exhibiting a linear characteristic with a conversion coefficient of 0.17mm/nm. The conversion efficiency as high as 0.32mm/nm was also demonstrated. The top and bottom curves in Figure 2c are the radiation mode out-coupling profiles from side-detection and from end-detection respectively.

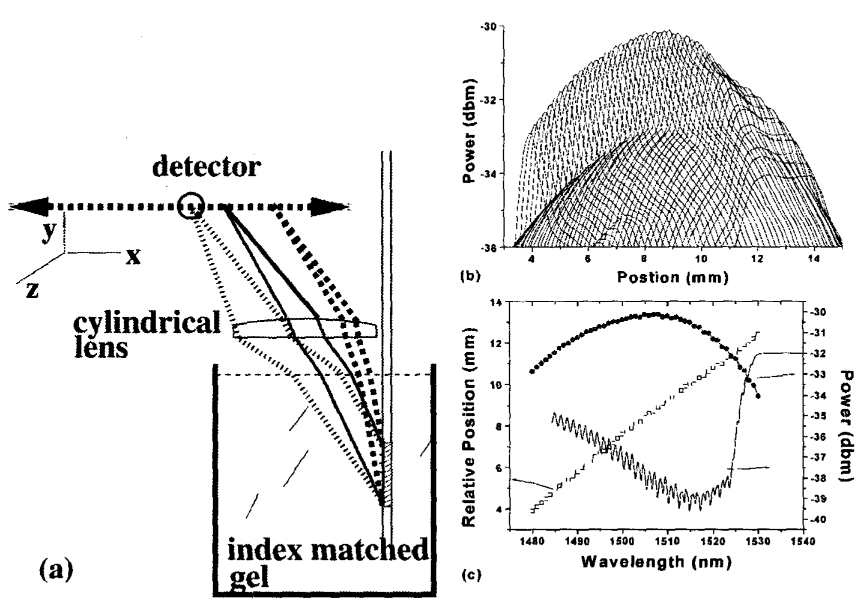


Fig. 2 (a) Schematic diagram of the side-detection system; (b) radiation power distribution measured using the side-detection technique; (c) plots of spatial-to-spectral relationship (squared curve) and radiation mode out-coupling profiles measured using side-detection (top curve) and end-detection (bottom curve) methods.

4. Conclusions

The radiation mode out-coupling of tilted gratings has been effectively measured from the physical grating position within the fiber using the side-detection technique, showing the realization of in-fiber optical spectrum analyzer function. It is foreseeing that in conjunction with the use of CCD detector, the side-detection of the spatial-to-spectral encoded radiation mode out coupling from tilted FBGs can be exploited to implement low cost WDM devices for applications in telecommunications and optical sensing.

5. References

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