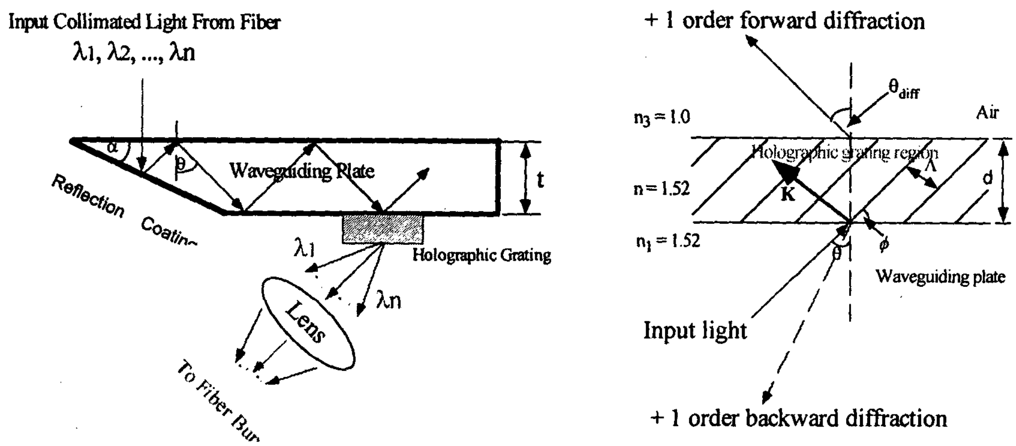
Multi-Mode Dense WDDM for Data Communications

Jian Liu, Jie Qiao, Ray T. Chen, and Brian M. Davies*
Microelectronics Research Center, Department of Electrical and Computer Engineering,
University of Texas at Austin , Austin, Texas 78758
Tel: (512) 471-7035. **Fax:** (512) 471-8575, **E-mail:** raychen@uts.cc.utexas.edu

* Radiant Research, Inc, 3006 Longhorn Blvd., Suite 105, Austin, TX 78758.

In this paper, the authors propose a novel dispersion-enhanced WDDM structure using a path-reversed substrate-guided-wave configuration working at a center wavelength of 1555 nm. This dense WDDM is expected to be cost-effective and is easy to fabricate and package for data communications with $\Delta\lambda$ less than 2 nm.



(a) (b)

Figure 1 A path-reversed substrate-guided wave optical interconnection. (a) structure; (b) guided-wave holographic grating; **K** is the grating vector.

Fig. 1 shows a structure of the proposed path-reversed substrate-guided-wave WDDM. It is path-reversed in reference to the previously reported approach. The input light to the hologram comes from the waveguiding plate and the diffracted light goes into the air. Fig. 1(b) shows the detailed structure of the volume holographic grating with a thickness of d, a period of Λ, and a slanted angle of ϕ. The +1 order backward diffraction can be used for *on-site* channel monitoring of the WDDM device. The grating dispersion and the approximate spectral bandwidth for the first order forward diffraction are simulated. There exists a trade-off between the dispersion and the bandwidth of the guided-wave holographic gratings.

In our experiment, a Coherent Verdi^{TM} laser operating at a wavelength of 532 nm is used to record the output holographic grating. A tunable laser is employed to characterize the performance of the path-reversed holographic WDDM. DuPont photopolymer film HRF 600x001-20 with a thickness of 20 μm is chosen to record the holographic grating. The BK7 waveguiding glass plate has a thickness of 6.3 mm and a beveled angle α of 30^{O}. The incident angle of the grating is thus to be 60^{O}. The diffraction angle is 60^{O} in the air.

The measured diffraction efficiency as a function of wavelength change from the center *wavelength of 1555 nm* of the WDDM and the theoretical results modeled by rigorous-coupled wave analysis (RCWA) are shown in Fig. 3 (a). It is obvious that the experimental results are in good agreement with the theoretical expectations. The dispersion of the grating is found to be insensitive to the states of input polarization. Fig. 3 (b) gives a CCD image of the path-reversed WDDM. A lens of 20 cm focal length is used. There is no crosstalk observed in our experiment. As the dispersion occurs for the output holographic grating, the TEM_{00} mode profile of the dispersed optical signals with different optical wavelengths is well-retained, and this also reduces the difficulty in integration with fiber array/bundles.

It is feasible to select a configuration with a large dispersion and an acceptable bandwidth to achieve standard 100 GHz (0.8nm) channel spacing without degrading the TEM_{00} mode quality and adding more complexity to the system. We are currently working on it, and the results will be presented in the conference.

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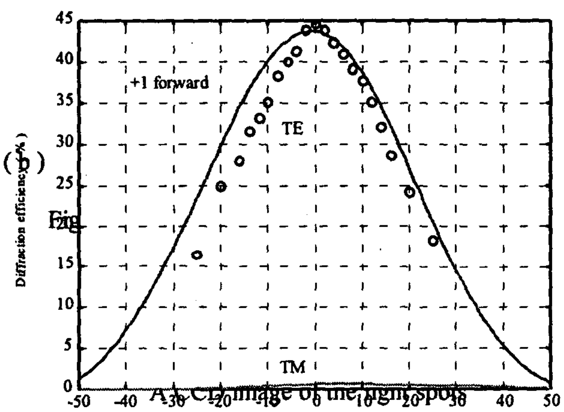

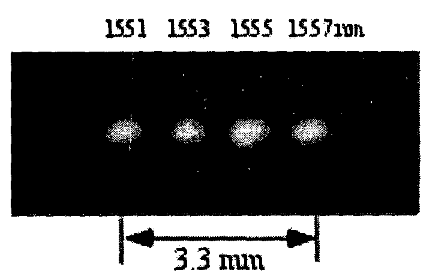

Fig. 3 (b) A CCD image of the light spots for the WDDM of $\theta_{diff} = 60^{o}$ operating at 1551 nm, 1553 nm, 1555 nm, and 1557 nm.