第 17 卷　第 12 期　　　　光　学　学　报　　　　Vol. 17, No. 12
1997 年 12 月　　　　ACTA OPTICA SINICA　　　　December, 1997

Wavelength Conversion Using a Light-Injection DBR Laser Diode at 2.5 Gbit/s

Xiang Wanghua　　Zhang Guizhong
(*College of Precision Instrument and Optoelectronics Engineering, Tianjin University, Tianjin* 300072)
Y. Yano　　T. Ono　　K. Emura
(*Opto-Electronic Network Research Laboratory*
Opto-Electronics Research Laboratories, NEC Corporation, Japan)

Abstract　The experimental results of the wavelength conversion by employing a light-injection DBR laser diode at 2.5 Gb/s are presented, which can be used in optical communications.

Key words　wavelength conversion,　WDM,　semiconductor laser.

1　Introduction

High-speed all-optical wavelength conversion is a key technique for high capacity optical routing switching system and advanced WDM-based network. Various conversion schemes have been studied, and the functions have been recently demonstrated at 2.5 Gb/s with a DBR Laser[1] and at 5 Gb/s with an interferometric Y-laser[2], wavelength conversion with four-wave mixing in semiconductor optical amplifier (SOAs)[3~5] and in optical fibers[6]. Here, an experiment of wavelength conversion using a light-injection Distributed Bragg Reflector (DBR) laser diode is reported.

2　Experimental

Fig. 1 shows the experimental setup. A signal LD light ($\lambda_1 = 1.552\ \mu m$) was intensity-modulated with an NRZ bit pattern of $(2^{11}-1)$ at 2.5 Gbit/s. The wavelength converted light ($\lambda_2 = 1.554\ \mu m$) was output from the DBR laser diode which had passed through an optical fiber with 1 nm of bandwidth and was detected.

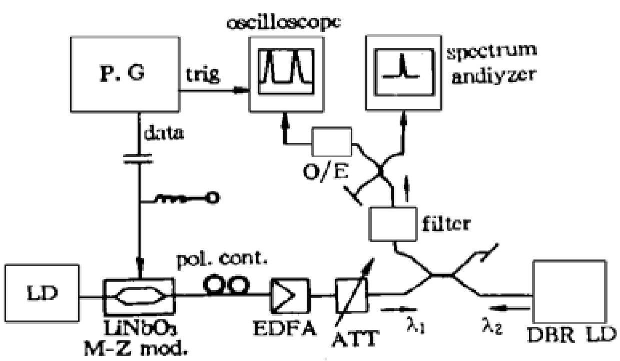

Fig. 1 Experimental setup

Received 25 November 1996

3 Discussions

The wavelength of DBR laser diode can be scanned from 1.552 μm to 1.558 μm by changing the bias current to the current gain (I_g) region and the Phase Control (P.C.) region. When the wavelength of the DBR LD was fixed, the polarization state and the wavelength of the signal light (λ_1) must be adjusted to match the wavelength of DBR (λ_2). The input signal was provided with a 1.552 μm sigle-mode LD modulated by a 2.5 Gbit/s NRZ ($2^{11}-1$) signal and the injection power was 4~ 15 mW. The experimental results are shown in Fig. 2. Fig. 2 (a) is the signal light and Fig. 2 (b) is the wavelength converted light after the filter from DBR LD. As shown in the figure, the pulse waveform was successfully converted. The mark and space were all inverted.

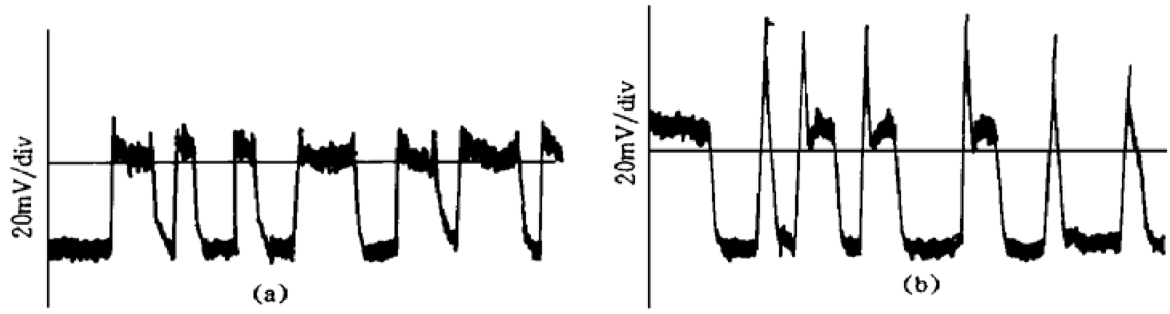

Fig. 2 (a) signal light before filter, (b) wavelength converted light after filter

The eye-pattern diagrams were also recorded. The eye-pattern diagrams of the input light and the wavelength converted light are shown in Fig. 3. In this measurement, the wavelength converted light from DBR LD was set to 1.554 μm (I_g = 56 mA, $V_{P.C.}$ = 1.1 V, V_{DBR} = 1.2 V), but it could be scanned from 1.553 μm to 1.558 μm by changing the bias current (here it was I_g, $V_{P.C.}$ and V_{DBR}).

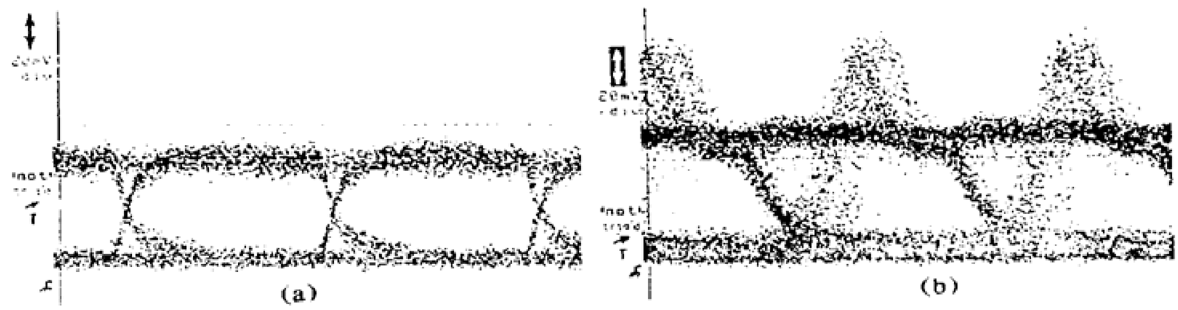

Fig. 3 Eye-pattern diagrams for (a) input light and (b) wavelength converted light. (a) Input signal (λ_1) 2.5 Gb/s, (b) output signal (λ_2) 2.5 Gb/s

Authors have also tried to use a signal light at 10 Gb/s injection, but the observed waveform and the eye-pattern diagrams of the wavelength-converted light from DBR-LD are not very clearly reshaped.

4 Conclusion

In summary, authors have realized the wavelength conversion using a light-injection (DBR) laser diode at 2.5 Gb/s. However, this method is sensitive to injection light wavelength and polarization state, and the wavelength converted light is unstable.

Acknowledgements: Authors thank M. Yamaguchi for supplying the DBR LD, and F. Fukuchi for his helpful discussion. Authors also thank Drs. K. Kobayashi, M. Shikada and J. Mamiki for their continuous encouragement throughout the work.

References

[1] P. Ottolenghi, A. Jourdan, J. Jacquet *et. al.*, All-optical wavelength conversion with extinction ratio enhancement using a tunable DBR laser. ECOC'93, Paper Tuc 5.5, *Proc.* 1993, **2**(1) : 141~ 144

[2] E. Lach, D. Daums, K. Daub *et. al.*, 5 Gb/s wavelength conversion with simultaneous regeneration of extinction ratio using Y-laser. ECOC'93, Paper Tuc 5.4, *Proc.* 1993, **2**(1) : 137~ 140

[3] R. Schnabel, W. Pieper, M. Ehrhardt *et al.*, Wavelength conversion and switching of high speed signals using semiconductor laser amplifiers. *Electron. Lett.*, 1993, **29**(23) : 2047~ 2048

[4] I. Glesk, J. P. Sotoloff, P. R. Prucal *et al.*, Demonstration of all-optical demultiplexing of TDM data at 250 Gbit/s. *Electron. Lett.*, 1994, **30**(4) : 339~ 341

[5] D. M. Patric, A. D. Ellis, D. A. O. Davies *et al.*, Demultiplexing using polarisation rotation in a semiconductor laser amplifier. *Electron Lett.*, 1994, **30**(4) : 341~ 342

[6] K. Inoue, Polarization-insensitive wavelength conversion using fiber four wave mixing with two orthogonal pumps at different frequencies. *Tech. Dig. of OFC'94*, San Jose, Feb. 1994 : 251~ 254

利用光注入分布布拉格反射激光二极管实现 2.5 Gbit/s 的波长变换

向望华 张贵忠
(天津大学精仪学院, 天津 300072)
Y. Yano T. Ono K. Emura
(日本 NEC 光电研究所光电网络研究室, 日本)
(收稿日期: 1996 年 11 月 25 日)

摘 要 给出利用光注入分布布拉格反射激光二极管实现 2.5 Gbit/s 的波长变换的实验结果。本结果实用于超高速光通信。

关键词 波长变换, 波分复用器, 半导体激光器。