11P-33

Self-Written Micro Optical Pin for Optical Interconnect

Takuya Tokuhara, Osamu Mikami
School of Information Science and Technology, Tokai University
1117 Kitakaname, Hiratsuka, Kanagawa, 259-1292 JAPAN,
TEL: 0463-50-2016
6adgm014@keyaki.cc.u-tokai.ac.jp

Abstract – An easy fabrication method of micro optical pin using Self-Written Waveguide (SWW) having a 45-deg mirror was proposed and fabricated. An optical pin with a short length of 160 μm was fabricated successfully. Positional tolerance of SWW-optical pin is compared with that of the fiber optical pin theoretically.

INTRODUCTION

An optical coupling scheme using optical pins has attracted much attention to realize board to board and chip to chip optical interconnection. Conventionally, the optical pin is fabricated using a multi-mode fiber (MMF) and the tip is cut by a rotating blade[1,2]. This may induce a difficulty in adjusting the length, controlling the positional alignment and handling. On the other hand, self-written waveguide (SWW) optical pins using UV curable resin by a photo-mask transfer were also studied[3]. However, this has a problem in positional alignment just on the optical devices.

In this paper, we have proposed a new fabrication method of SWW micro optical pin. Much reduction in the implementation cost and much improvement in the productivity can be expected by using this technology.

APPLICATION OF OPTICAL PIN

We have proposed an optical surface mount technology for optoelectronic (OE) printed wiring boards (PWBs) as an optical interconnection technology [1]. An OE-PWB has optical and metallic wiring inside the board, and optical and electrical devices are mounted on the board. Most laser diodes (e.g., vertical cavity surface emitting lasers (VCSELs) and laser diodes (LDs)) and photodetectors (PDs) are mounted face down. Therefore, the optical paths of optical devices (e.g., between a VCSEL and a PD) and optical wiring are crossing at right angles. In this case, 90-deg path redirection devices such as a 45-deg mirror, prism, and 45-deg-ended waveguide are needed for optical signal transmission. One effective redirection device is an optical pin, which is a waveguide having a 45-deg mirror on its end-face.

The optical pin has a mirror on the tip and has a function of beam path conversion by 90 degrees. However, fabrication of optical pins is difficult and it takes a lot of time for processing. Especially, short optical pins with a length of 100-200μm are needed in applying into the board level.

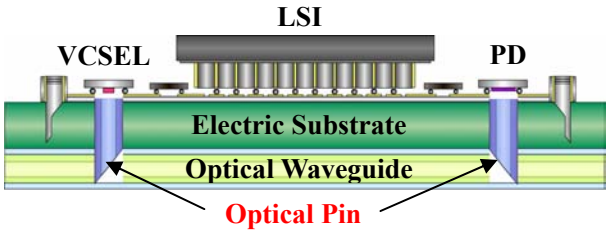

Fig.1 Application of optical pin in OE-PWB

The application of an optical pin is schematically shown in Fig. 1 for optical interconnection inside an OE-PWB. We have already demonstrated this type of optical model and its performance characteristics [2]. The optical pin has a large positional tolerance along x, y, z-axes and rotation. Therefore passive alignment is possible.

EASY FABRICATION METHOD

We have proposed a new method to fabricate a very short SWW optical pin having a 45-deg mirror. The proposed method has following advantages. An optical pin with very short length less than 100 μm and a precise length can be easily obtained. The short SWW optical pin can also be fabricated just on the window of such as VCSEL and PD.

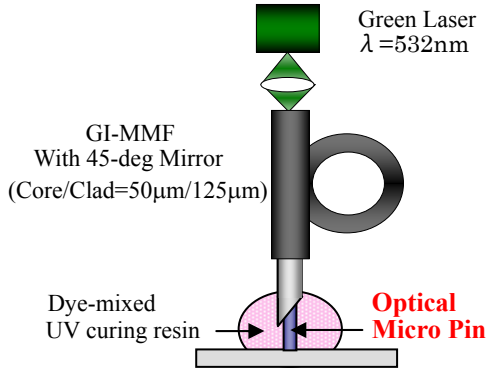

Fig.2 Experimental Setup

Fig. 2 is the experimental setup. We used dye mixed UV curable resin and a green laser beam. We put a GI-MMF having a 45-deg mirror at the tip vertically to the glass plate. Distance between the glass plate and the GI-MMF was set to be about 150 μm. Next, we filled the dye mixed resin into the space between the GI-MMF and the glass plate. After that, by launching a green laser beam into the GI-MMF, an SWW grew and reached the glass plate. Finally, non-hardened resin was removed off.

A micrograph of fabricated SWW micro optical pin is shown in Fig. 3. A 45-deg mirror was successfully fabricated on the tip and the total length was 160 μm. The results are summarized in Table 1.

Coupling efficiency and positional tolerance of optical pins having a conventional fiber structure and SWW are compared theoretically. In the case of making an optical pin just on the window of VCSEL, the positional alignment point of SWW pin can be reduced and the clad-less structure has a great advantage in coupling between the 45-deg mirror and a fiber. One dimensional array micro pins can be fabricated by using a taped fiber and/or multi-channel waveguide with a 45-deg at the tip.

Fig.3 Fabricated SWW micro pin

Table 1 Experimental Result

Height[μm]	Diameter[μm]	Tip angle[deg]
156	**45**	**44**

CONCLUSION

New fabrication method of SWW micro optical pin was proposed and the feasibility was investigated. The positional tolerance of conventional fiber pin and SWW pin was compared theoretically. Effectiveness of the easy fabrication method was confirmed.

REFERENCES

[1]O. Mikami and T. Uchida, "Optical Surface Mount Technology based on Optical Pin," Inter'l Semiconductor Technol. Conf. ISTC2002, Electrochemical Society, #72, 2002.

[2]O. Mikami, "A New Architecture for Board-level Optical Wirings applying Optical Pin and Self-Written Waveguide," SPIE, Optics East 2005, Boston, 6014-22, Oct. 2005.

[3]H. Hanajima, etc. "Self-Written Waveguide Optical Pin Fabricated Using Photo-mask Transfer Method", IEEE Photon. Technol. Lett., Vol. 18, No. 9, pp.2020-2022, Oct-1, 2006.