The Study of High Brightness Prism Patterned LGP using Optical Simulation Analysis

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We have designed high performance prism light-guide plate (LGP) in 17 inch TFT-LCD. In test result to embody high brightness BLU in case of LGP of base and upper surface with 17 inch, thickness 8 mm adding prism construct, it is superior brightness improvement than previous that of printing form about some 20 % and in this course to embody actual material it succeeded prism LGP production by 17 inch injection form process.

Keywords : LGP(light guide plate), Backlight, Prism LGP, Optical simulation, High brightness backlight

1. INTRODUCTION

Recently, the use of the TFT-LCD increases recently rapidly. Including the portable Note PC and tablet PC, which save the strong point of compactness and the use of the business monitor spreads rapidly. Price of the LCD monitor is higher than that of the CRT monitor of identical size and after several years more positive price depreciation will be advanced by the production industry [1]. In the center of the TFT-LCD production industry the tendency of this original cost curtailment is deepened as time is past, recently the generation competition of manufacturing equipment is advanced. About the BLU occupied some 10~15 % in manufacturing cost of the TFT-LCD, progress of the technical development for a positive original cost curtailment was delayed.

It is increase that the demand of the market about the BLU of the higher performance and it is important to satisfaction of the product feature in the user center and the development of the high brightness product. Even though the original cost curtailment against a fundamental material arrives already to a limit in the present BLU market, the market demand of efficiency against focus parts surpasses the level of the technical development progress.

This research does not use the function characteristic optical sheet of high price like prism or the polarized prism and it uses only the diffusion sheet and as the focus parts manufactured the BLU of the high performance. It verifies probability through optical simulation for prism LGP(Light Guide Plate) and embodies actual material and focused on certification for reappearance of construct[2,3].

So, we estimated prediction of efficiency and realization of the object realization to architect and make of prism LGP which is the core parts using optical simulation.

Likewise Fig. 1 and Fig. 2, prism LGP increased efficiency of concentrate light through the arrangement of the same pitch prism on upper surface and controlled overall light density in addition to intaglio direction of lamp and horizontal prism on lower surface. Also we used injection molding an engineering method in order to realize of the object and achieved the cost reduction through shortening the length of the process. It compared with existing application process of printing after cutting the PMMA sheet. The optical simulation carried by SPEOS (OPTIS CO. Ltd.) and the optical simulation condition is same as before.

It predicts efficiency of LGP in construct stage through the optical simulation and it produced stamper using injection molding process to embody actual object. It produced metal material master reflected construct condition to produce stamper and produced stamper using this master through Ni plating processing. Injection molding used injection forming machine (Meiki Co., Ltd.) and injected after it attached stamper in both faces. It was progressed by dividing the bottom of the optical disk into relief and intaglio, in result it was able to predict the performance.

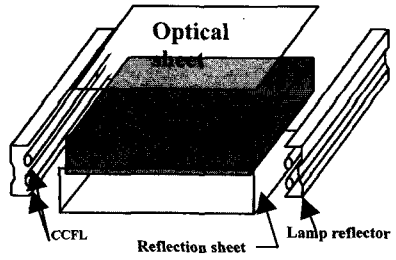

Fig. 1. Backlight unit structure.

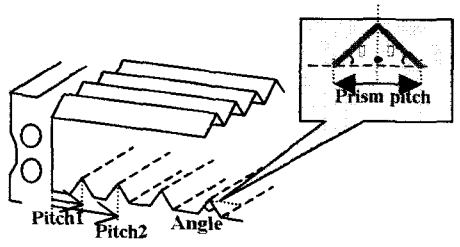

Fig. 2. Structure of upper prism and lower prism.

2. EXPERIMEMTAL

2.1 Optical simulation and design

In simulation, it accomplished the plan which leads an optical simulation assuming the bottom of the optical disk to be intaglio as shown in Fig. 1 and Fig. 2. It applied a condition of Table 1 against the prism form of upper or bottom part of the optical disk.

With the optical simulation, there was a whole brightness distribution result as shown in the Fig. 3 and Fig. 4.

Figure 3 show which luminance result of optical simulation in the LGP. Emission light is concentrated through the center. It shows high brightness in incident plate where the lamp in top and bottom part stands. It was predicted with brightness result in a line following to the center of horizontal axis in Fig. 3. So, Figure 4 show that result of optical simulation of application diffusion sheet in BLU. It shows that uniformity is increased using diffusion sheet.

Table 1. Simulation condition.

		Width	Height	n	Thickness
LGP		345	281.4	1.49	8
Lamp		340		1.5	2.4
Prism	Upper	Angle : 90 degree			
	Lower	Angle : 80~90 degree			
Simulation Condition		Ray : 2000000, Detector : 0.5 m			

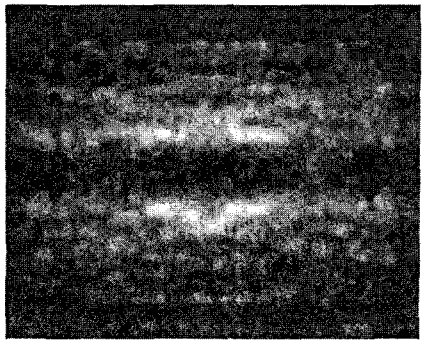

Fig. 3. Result of LGP optical simulation.

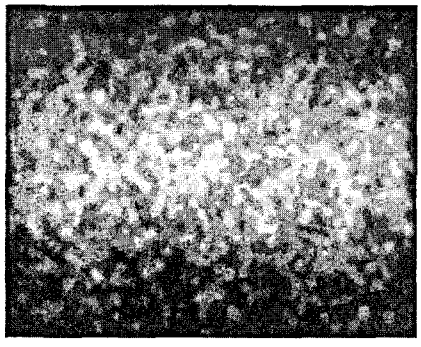

Fig. 4. Result of BLU optical simulation.

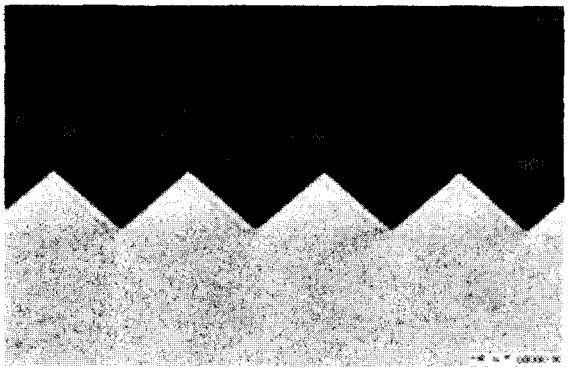

Fig. 5. Vertical shape of stamper.

2.2 Measurement result of specimen

On based the plan of simulation produced stamper processing Master of Stainless quality, and it embodied actual object through Injection molding using this stamper[4-8].

For complete reappearance of plan, molding product is applied to molding condition that can be formed a shape above 90 percentages in comparison of plan. In result, we obtain the complete molding product on based plan like Fig. 5 and Fig. 6. The actual object which is made by

Fig. 6. Vertical shape of injected LGP.

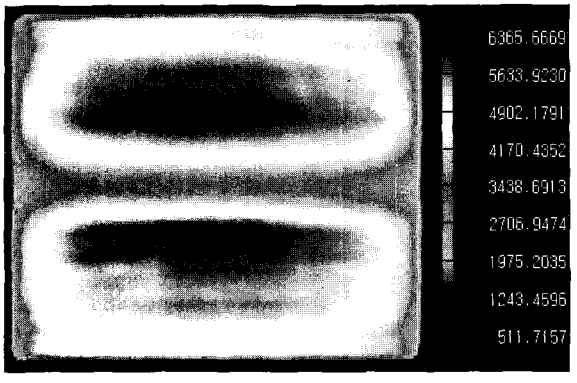

Fig. 7. Optical result of LGP surface measurement.

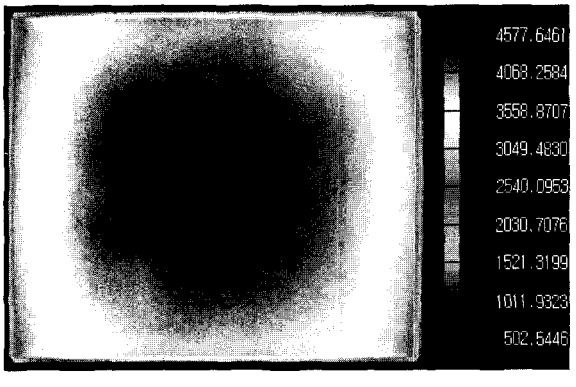

Fig. 8. Optical result of BLU surface measurement.

an injection molding process observed by brightness meter CA-1500(Minolta co., Ltd.), the brightness of surface is measured from the hand weaving normal direction falls from the optical disk. So, this measurement result compared with initial simulation result.

The result which it shows from Fig. 7 and Fig. 8, it shows the tendency which is identical with the result of optical simulation of initial design. With reference, in case when compared in priority top of brightness, there is a possibility of knowing the fact that the brightness of the case which it sets in intaglio comes out being high, in both intaglios. Thus, we accomplished of same luminance that is compared high brightness BLU with existing BLU.

3. CONCLUSION

In this research we suggested high brightness 17 inch LGP with 8 mm thickness with injected prism shape from optical simulation to actual object embodiment and then investigated about high efficiency LGP which can be used with high brightness BLU. We could know that the prediction with using an optical simulation had a high accuracy in forecasted about brightness trend and it was identical with the result of actual object embodiment and without using high price functional optical sheet. It was possible to manufacture low price, high efficiency BLU. From these results, when accomplishing an optical simulation to reduce an expense and the hour as it follows in actual object embodiment and it was possible to predict accurate result prediction and confirmed that it was useful to apply substantially in plan of the optical disk. Using injection molding, it was successful to manufacture the LGP of ratio above 90 %. It was confirmed that it could be manufactured high reliability plan with high transfer process. By the actual object and optical simulation, in underneath form intaglio had advantage than relief in making effective brightness because of high output angle. When considering above result, it was possible to confirm by using the actual object and optical simulation that it can be achieved brightness above 4700 nit and uniformity 75 % without high price functional optical sheet. So hereafter we could know it possible to realize prime cost curtailment and high performance of TFT-LCD for 17 inch monitor.

REFERENCES

[1] H. Zou, K. W. Beeson, J. Willson, S. Zimmerman, and M. McFarland, "Requirement and achievable backlight luminance for CRT-requirement LCD monitors", SID Digest 1997, p. 373, 1997.

[2] M. Born and Wolf, "Principles of optics", Pergamon Press 6 th. Edition, p. 188, 1983.

[3] M. Gebauer, P. Benoit, P. Knoll, and M. Neiger, "Ray tracing tool for development LCD-backlights", SID Digest 2000, p. 58, 2000.

[4] S. M. Lee, H. W. Choi, M. G. Lee, J. H. Min, J. S. Choi, J. H. Kim, S. I. Kim, Y. S. Choi, and K. H. Lee, "New concept for improvement of white color balance in hologram backlight units", SID Digest 2003, p. 1361, 2003.

[5] A. G. Chen, K. W. Jelly, G. T. Valliath, W. J. Molteni,

P. J. Ralli, and M. M. Weyon, "Holographic reflective liquid crystal display", Journal of SID, p. 159, 1995.

[6] H. J. Cornelissen, H. Greiner, and M. J. Dona, "Frontlights for reflective liquid crystal display based on lightguides with micro-grooves", SID Digest 1999, p. 912, 1999.

[7] J. M. Tedesco, L. A. K. Bardy, and W. S. Colburn, "Holographic diffuser for LCD backlights and projection screens", SID Digest 1993, p. 29, 1993.

[8] T. J. Trout, W. J. Gambogi, K. W. Stein, and S. R. Mackara, "Volume holographic components for display applications", SID Digest 2000, 2000.