Reduction of 2D/3D Image Cross-talks with Micro-optical Elements by Nano-imprint

Chia-Hung Yeh [a], Fuh-Yu Chang [b], Hsuan-Cheng Wang [b], Eric Chung [a], Hong-Tsu Young [a]
[a] Department of Mechanical Engineering, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei 106, Taiwan, ROC
[b] Department of Mechanical Engineering, National Taiwan University of Science and Technology

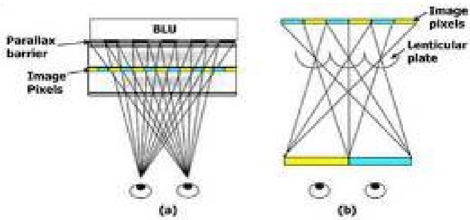
Corresponding author's email address: *d97522015@ntu.edu.tw*

Abstract

A new micro-optical structure, enabling single LCD screen display information to 2D separation of single-turn 3D stereoscopic display, was proposed in this research. The design of this micro-optical structure was made with the use of Tracepro software to simulate optical light panel and the differential between the structure change. The key method mainly combines processing V-Cut techniques used in precision electroforming micro-molds to produce nano-imprint splitting capacity for the optical film. The confocal microscopy investigation shows the transfer rates are higher than 98 %.

Introduction

Wearing special 3D glasses is prone to a lot of inconvenience to the viewer. Therefore, free naked eye 3D technology was applied in the current study. The principle idea is to divide the 2D screen into odd and even pixels that reach left and right eyes, respectively, to achieve 3D reception effects. Current commercial products emerged can be divided into grating (Parrallax Barrier) and the cylindrical lens (Lenticular Lens) as shown in figure 1. In contrast to the principle of grating with a parallax barrier, which lowers brightness due to the introduction of a slit, lenticular lens method was adopted in the present research to obtain better 3D viewing results.



Source: New electronic journal sites

Figure 1 The principle of (a) Parralax Barrier Type (b) Lenticular Lens Type

Method

A 4.3 inch LCD panel (tab.1) was selected in the present study. The detailed specifications of microstructures of Lenticular Lens Array were determined to achieve accurate image separation. For instance, the lenticular pitch and the thickness were found to be 0.228 mm and 1.017 mm respectively when aiming at the primary red, green and blue wavelength in sub-pixel resolution.

Table 1. Optical specifications for the proposed microstructure

4.3" Panel	
Display Area (mm x mm)	91 (W) × 54 (H)
Pixel Pitch (mm)	0.038 (×3) × 0.114
Resolution	800 (×3) × 480
Lenticular Lens Array	
Lens Area (mm x mm)	92 (W) × 55 (H)
Lenticular pitch (mm)	0.228
Number of View	2-View
View Distance (mm)	400
Radius of Lenticular (mm)	0.38
Thickness of Lenticular (mm)	1.017

Simulation Results

The simulation results shown that it could be successfully separated information through lenticular lens to two eyes as shown in figure 2. It is found that generated the crosstalk of the image was over 65 mm in this simulation, but the people who watching a video will forward on the front panel general, therefore, the factors is negligible as shown in figure 3.

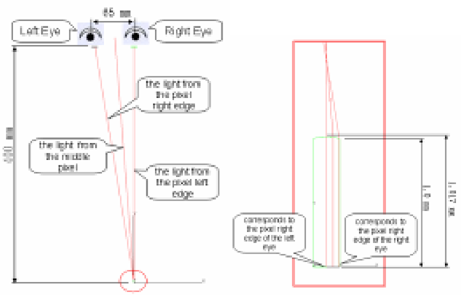


Figure 2 Ray trace for single structure

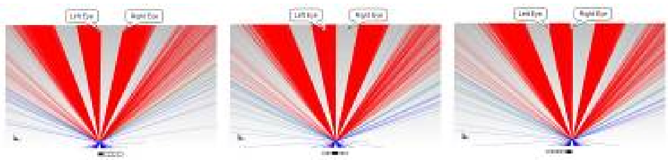


Figure 3 Simulation of ray trace

Experiments and Discussions

The nanoimprint equipment used in this experiment is made by Micro/Nano Fabrication Lab of National Taiwan University of Science and Technology. The PDMS mold we used was casted from a Ni mold and its SEM images are shown in figure 4. The Ni mold, PDMS mold and imprinted structures were investigated by a confocal microscopy and the results are shown in figure 5 and table 2. The difference of pitch and height between Ni mold and PDMS mold are 0.416 % and 0.94 % respectively. The difference of pitch and height between PDMS mold and imprinted structures are 0.418 % and 1.497 % respectively. The confocal microscopy investigation shows both the casting process for PDMS mold fabrication and the imprinting process for micro-optical structures are very successful, since the transfer rates both from Ni mold to PDMS mold and from PDMS mold to micro-optical structures are higher than 98 %.

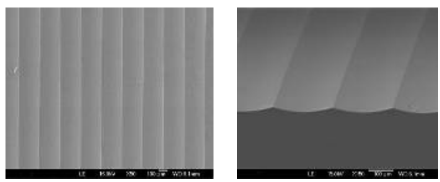


Figure 4 Micro Lenticular Lens array by SEM photos

Table 2 Micro Lenticular Lens measurement by Confocal Microscopy

	Pitch (um)		Height (um)		error (%)	
	Measured value	Designed value	Measured value	Designed value	Pitch	Height
Ni	227.912	228	17.328	18	0.039 %	3.73 %
PDMS	226.962		17.165		0.455%	4.64 %
UV	227.912		17.422		0.039 %	3.21 %

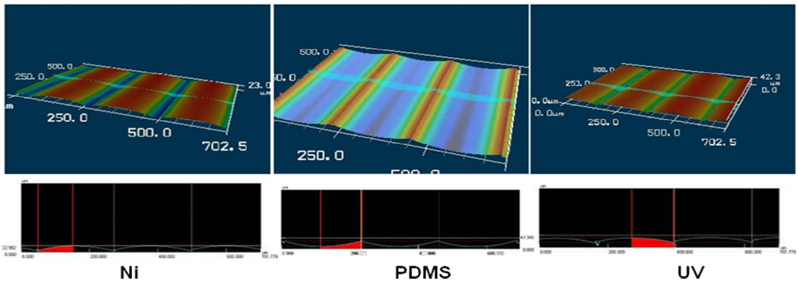


Figure 5 Micro Lenticular Lens array by Confocal Microscopy photos

Conclusions

In this paper, a stereoscopic viewing display with lenticular lens array film was proposed. Simulation results were shown that information could be successfully separated through lenticular lens structures to left and right eyes. Each lenticular lens size has successful manufactured by the v-cut process, micro-electroforming, and tnano-imprint process. The replication rate achieved in this project was higher than 98 %.

References

[1] Tseng, et al., “A Study of Liquid Molding Process on the manufacture of Novel Micro-Prism Array Optical Films”, APCOM (2009).

[2] Kao, et al., “An Auto-Stereoscopic 3D Display Using Tunable Liquid Crystal Lens Array that Mimics Effects of GRIN Lenticular Lens Array”, SID (2009).

[3] Lee, et al., “Roller-Based Laser Assisted Direct Imprinting for Nanofabrication”, Nano/Micro Engineered and Molecular Systems (2008).

[4] Huang, et al., “Novel forming for fabrication of micro V-cut grooves using the optical-element”, Microprocesses and Nanotechnology (2007).