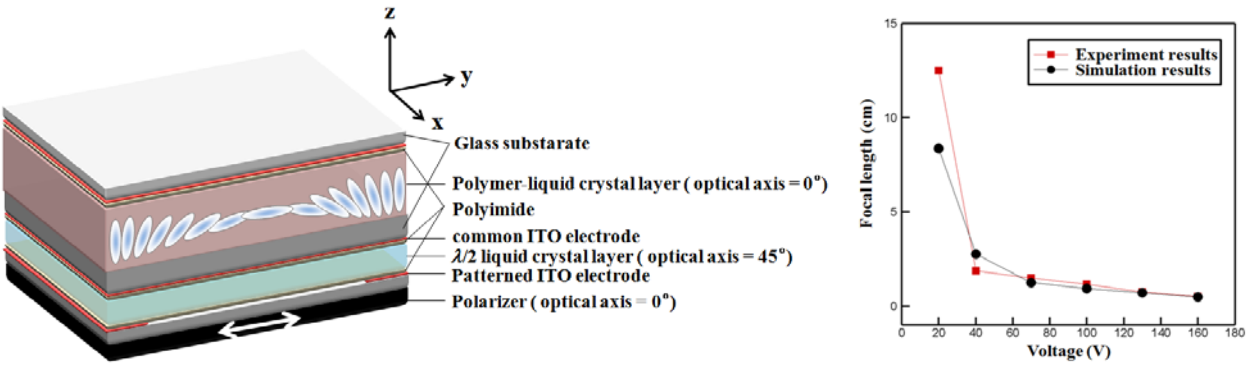
A 2D/3D Switchable Liquid Crystal Lens with Low Cell Gap

***Byung-June Mun*[1]*, Sung-Ho Youn*[1]*, and Gi-Dong Lee*[1]**
[1]**Dept. of Electric Engineering, Dong-A University, Busan, 604-714, Korea**
Tel.:82-51-200-7704, E-mail: gdlee@dau.ac.kr

Today, many researchers are studying for the development of the three-dimensional (3D) display in order to show more natural and realistic image with visual experience. However, the use of a 3D only display in many applications causes much degradation of 2D image quality because most of the display hardware and image sources are still based on 2D display applications. Therefore, technology of 3D displays is required to perform 2D/3D switchable mode in order to minimize loss of the 2D image quality and resolution. The technologies for the 2D/3D switchable mode of the lens type represent three modes such as active LC filled lenticular lens [1], polarization switching LC lens made [2], electric-field-driven LC (ELC) lens made [3]. However, they have many disadvantages. One of the problems of three modes is high cell gap with more than about 45μm. It has caused the low visibility, the high driving voltage, and slow 2D/3D switching speed for applications. In addition, they show the high 3D crosstalk because control of the ideal n_{eff} distributions as like the parabolic curve is very difficult from the complicated manufacturing processes. In this paper, we demonstrated a 2D/3D switchable polymeric LC (PLC) lens, which has the merits of the low cell gap (~4μm) and simple fabrication process, for auto-stereoscopic display in Fig. 1(a). The proposed lens consists of two parts : top layer is the photo-polymerized polymer-LC layer with non-uniform refractive index distribution as like parabolic curve, and the bottom layer is half-wave (λ/2) LC layer with an optical axis of 45° to switch the 2D/3D image mode. By reducing the cell gap of a proposed lens using λ/2 LC cell, we could achieve the fast 2D/3D switching speed for dynamic applications and low driving voltage compared with the conventional switchable lens device. Furthermore, the simple electrode structure and the easy fabrication process can make the exellent neff distribution with low crosstalk. Experiments for varification of the proposed lens have shown a electrically switchng mode between 2D and 3D image when lens is voltage on and off state. And, we proved the lensing effect of a proposed P-LC lens device by comparing its measured and calculated focal length as a function of the applied voltage in lens-on state in Fig. 1(b).



(a) (b)

Fig. 1. The proposed PLC lens device: (a) the schematic diagram showing a lens structure and (b) the comparison of the calculated focal length of the simulation and experiment as a function of the voltage.

Acknowledgment

This work was supported by the Basic Science Research Program through the National Reasearch Foundation of Korea (NRF) funded by the the Ministry of Education, Science and Technology (2012-014485).

References

1. M. G. H. Hiddink, S. T. de Zwart, O. H. Willemsen and T. Dekker, *SID Dig. Tech. Papers* **37**, 1142-1145 (2006).
2. G. J. Woodgate and J. Harrold, *SID Dig. Tech. Papers* **34**, 394-397 (2003).
3. H. K. Hong, S. M. Jung, B. J. Lee, H. H. Shin, J. Soc. Inf. Disp. **17**, 399-406 (2009).