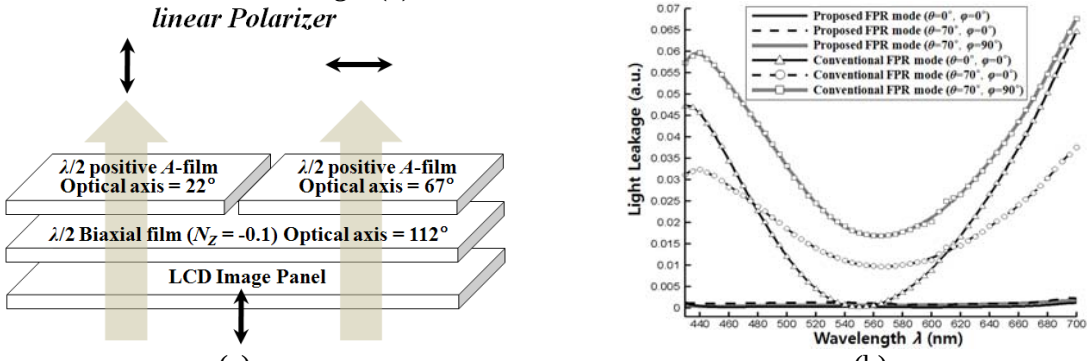
A Wide-View Film Patterned Retarder for Three-Dimensional Liquid Crystal Display

Byung-June Mun,[1] Wan Seok Kang,[1] Sung Ho Youn,[1] Joun Ho Lee,[2] Byeong Koo Kim,[2]
Hyun Chul Choi,[2] and Gi-Dong Lee[1*]

1 Department of Electronics Engineering, Dong-A University, Busan 604-714, Korea
2 Mobile Product Development Department, LG Display Co., Gumi, Gyungbuk, 730-350, Korea

Recently, many display devices have begun to require three-dimensional (3D) effects to replace two-dimensional (2D) flat images. Among many techniques for displaying 3D images, the stereoscopic displays need to wear the 3D glasses in order to separate left and right images. In particular, the stereoscopic display of passive type with film patterned retarder (FPR) is proposed as the better selection for home application and 3D cinema because they are low cost, use lightweight glasses, have a simple fabrication process, are flicker free, and have wide-viewing angles [1]. The FPR are manufactured using reactive mesogen (RM) materials which have phase difference. Retardation film not only has properties in the oblique direction, such as change of optical axis and phase retardation, but also can cause color differences due to wavelength dispersion. Thus, the drawbacks for the FPRs are image quality deterioration and crosstalk at off-normal axis, which is the overlap of left and right images.

In this paper, we design a novel FPR structure for the stereoscopic 3D display with the outstanding optical properties of wide-band image quality and wide-viewing angle using the linear polarizer in the oblique direction. This optical structure used a plain $\lambda/2$ biaxial film and stacked a patterned *A*-plate $\lambda/2$ plate for the left and right images over a biaxial film as shown fig. 1(a). We have achieved the wide-band property of the left and right images by applying two $\lambda/2$ retardation films and obtain the wide viewing angle characteristic by using a biaxial film at the first retardation film. Based on the Stokes vector and the Muller matrix method, we calculate the phase retardation of each film and simulate the optical configuration on the Poincaré sphere over the entire visible wavelength spectrum using the TECHWIZ LCD made by SANAYI system. Specifically, we found optimized value for the N_Z parameter and the optical axis of biaxial $\lambda/2$ film by the parameter space method and optimized the proposed configuration in the horizontal and vertical viewing angle (polar angle θ = 70°) simultaneously, for applications to TV and notebook designs. We compare the calculated results of the proposed method to those of the conventional optical configuration to confirm optical enhancement. As a result, we observed that the proposed configuration effectively blocks the off-axis light leakage for the opposite images compared to the conventional mode as shown fig. 1(b).



(a) (b)

Fig. 1. (a) The optical configuration of the proposed FPR cell. (b) The comparison of the calculated light leakage of conventional and proposed configuration in each viewing angle.

References:

[1] J. H. Oh, W. H. Park, B. S. Oh, D. H. Kang, H. J. Kim, S. M. Hong, J. H. Hur, and J. Jang, *Stereoscopic TFT-LCD with Wire Grid Polarizer and Retarder, SID* Symposium Digest **39**, 444 (2008)

* presenting author; Byung-June Mun E-mail: mbj1101@naver.com