Super-IPS 액정셀의 시야각 개선

Improvement of the viewing angle for a Super-IPS liquid crystal cell

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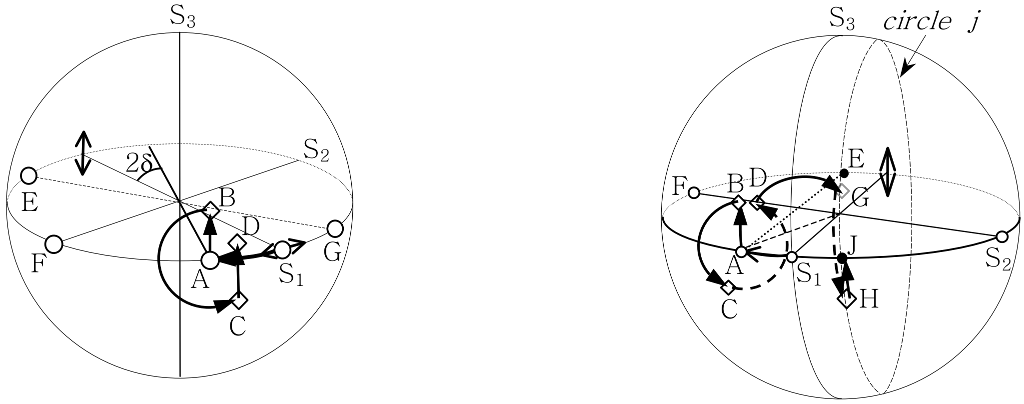
We propose an optical configuration of an IPS liquid crystal cell, consisting of uni−axial films, to improve the viewing angle characteristics by compensating the phase dispersion in diagonal direction. The optical design of the proposed configuration was performed on a Poincare sphere with geometric calculations. In general, Super−In Plane Switching (S−IPS) mode shows intrinsically excellent viewing angle characteristics. But, the contrast ratio in the oblique diagonal direction becomes lower because the effective angle between the absorption axis of a polarizer and an analyzer in the diagonal direction increases in proportional to the observation direction(1).

In this work, we proposed an optical configuration of an IPS liquid crystal cell for wide viewing angles in all directions. The proposed optical configuration consists of uni−axial films, two *A*−plates and a +*C*−plate. Optimization of the optical retarders has been performed on a Poincare sphere(2).

The conventional S−IPS cell consists of a liquid crystal cell and two *Tri−Acetyl−Cellulose* (*TAC*) films (−*C* plate ≅ −42 nm) on upper and lower polarizers. In crossed *O−type* polarizers, the effective angle between the absorption axis of the polarizer and the analyzer increases as the oblique incident angle in the diagonal direction increases. In oblique incidence, the absorption angle of the polarizers deviates angle δ from normal incidence. The light leakage in the dark state due to a change in the effective angle between the two polarizers can be effectively described on the Poincare sphere.

Figure 1 (a) shows the polarization state of the light obliquely passing through the cell in the diagonal direction on the Poincare sphere. We can assume that the deviation between *D* and *G* will cause serious light leakage in the dark state. Compensation for the deviated polarization by oblique incidence can be achieved by adding several retarders to the conventional mode. Figure 1 (b) shows the polarization state of the proposed optical configuration of the IPS cell, which can improve the viewing angle in the diagonal direction. The optical configuration of the proposed liquid crystal cell consists of two *A*−plates, a +*C* plate. The optical axis of lower *A*−plate and S−IPS liquid crystal cell is aligned parallel with the absorption axis of the incident polarizer. And the optical axis of the upper *A*−plate is aligned along that of the absorption axis of the analyzer. The application of the Poincare sphere is particularly simple as it lends itself to graphical analysis by spherical trigonometry. Optimization of the optical configuration in this paper has been performed at the diagonal direction, ϕ = 45° because the light leakage in the dark state is maximized at ϕ = 45°.



(a) (b)

Fig. 1 Polarization path on the Poincare sphere; (a) conventional S-IPS liquid crystal cell (b) proposed S-IPS liquid crystal cell.

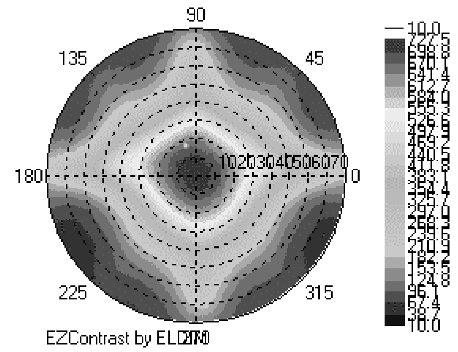


Fig. 2 Measured iso-contrast contour of the proposed S-IPS cell (measured by *ELDIM*).

By applying uni-axial films including two *A*-plates and a +*C*-plate, we could achieve wide viewing angle characteristics as shown in figure 2. As a result, we found out that the contrast ratio in the diagonal direction can be increased by 80% by applying the proposed S-IPS LC cell.

References

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