Elimination of off-axis color shift by doping dichroic dyes in a cholesteric liquid crystal device

Jun-Hee Park, Seung-Won Oh, and Tae-Hoon Yoon*
Department of Electronics Engineering, Pusan National University, Busan 609-735, Korea
Tel.:82-51-510-1700, E-mail: jun-heepark@pusan.ac.kr

Until these days, cholesteric liquid crystal (CLC) devices have been of wide interest because they do not require a reflector, polarizers, and complicated optical design. In addition, it can be driven with extremely low power because of the bistable characteristics between the planar and focal conic states [1]. Bistable property of CLC devices allows them to hold images without applying an electric field. In spite of these strong points, they have not been commercialized successfully yet because of some disadvantages, such as slow response time, color shift, and so on. Although fast switching CLC devices has been developed recently to display moving pictures, [2, 3] off-axis color shift still remains as one of the critical issues in CLC devices. The wavelength of the reflected light becomes shorter as the viewing angle is increased.

In this paper, we propose a method to eliminate the color shift in CLC devices by doping dichroic dyes. Dichroic dyes selectively absorb the incident light, which are used to help maintain the designed color at oblique angles. We measured the color coordinates in CIE chromaticity diagram of the fabricated CLC cells for polar angles from 0° to 60°. A CLC cell designed to reflect red color shows severe color shift as the viewing is increased, as shown in Fig. 1(a). The color changed to green at 60°, as shown in Fig. 1(c). On the other hand, a dye doped CLC (DDCLC) cell remains nearly at the same color even for the viewing angle of 60°, as shown in Figs. 1(b) and 1(d). Similar results can be observed in CLC and DDCLC cells designed to reflect other colors.

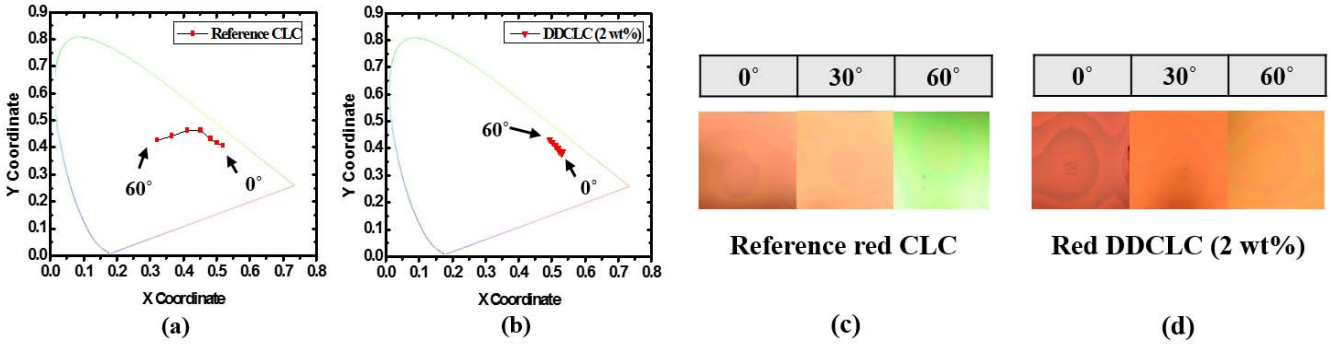

Fig. 1. Measured color shift of (a) reference CLC and (b) DDCLC cells on the CIE chromaticity diagram. Photographs of (c) reference CLC and (d) DDCLC cells at various viewing angles.

We confirmed that higher concentration of dye molecules improve color sensitivity and reduce the off-axis color shift in a DDCLC cell. We expect that DDCLC cells can be applied to outdoor displays that require less off-axis color shift.

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References

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