Multicolor Reflective Cholesteric Liquid Crystal Display on a Single- layer by controlling temperature

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Abstract

Cholesteric liquid crystals (CLCs) have a helical structure induced from the chiral molecules. The director of CLCs is uniformly twisted along a perpendicular axis called the helical axis [1]. Due to a particular LC structure, when external light propagates parallel to the helical axis, a specific wavelength of the light associated with helical pitch the of CLCs is reflected under Bragg condition. This characteristic has an attraction for reflective-type color display devices that do not need any optical components, such as polarizer, backlight, and color filter. Color reflective-type cholesteric displays can be obtained by using either a single-layer or stacked-layers method. The stacked-layer technique provides a realistic solution of reflective-type cholesteric liquid crystal displays (CLCDs) to achieve a full color display. Although this approach using stack-layer structures gives maximum brightness to the color reflective displays, volume fabrication of CLCDs requires overcoming the high cost and low yield. To solve the demerits, many technologies which provide multicolor reflective-type CLCDs on a single-layer have been introduced [2, 3].

In this paper, we proposed a new concept for realizing multicolor reflective-type CLCD on a single-layer. As the temperature of the CLCs cell increases, the selective reflection band of CLCs shifts toward a shorter wavelength. With this characteristic of the CLCs, we fabricated multicolor reflective CLCD on a single-layer. First, to produce initially the reflective wavelength band of the red color, prepared is the CLC which consists of MLC6233 (Merck) of 76wt% and a left-handed chiral dopant, ZLI-811 (Merck) of 24wt%. To fix each helical pitch of CLC related to each color of pixels, UCL001 of 3wt% that consists of a monomer and photo-initiator was mixed with the CLCs. The CLCs cell was formed by filling the mixture between two flat glass substrates by capillary action. The helical pitch of red part corresponds to red by polymerization of monomers through a proper UV irradiation at room temperature. As increasing by 60℃, the reflective color of the CLCs cell was changed from the initial red to the green. Then, the green pixel part is settled as another helical pitch corresponding to green through another proper UV irradiation at the temperature. After this process, although the increased temperature was returned to the room temperature, reflective green part irradiated by UV was settled without any change in the color.

In conclusion, we obtained a multicolor reflective CLCD on a single-layer by controlling temperature and UV irradiation to settle and stabilize the helical pitch of CLC corresponding to each color of pixels.

References

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