Color variation in chiral liquid crystal displays with high HTP chiral compounds

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Cholesteric liquid crystals (CLCs) have many merits for applying to color flexible displays since the optical components such as polarizer, color filter, and backlight unit are not required in the reflective CLC displays. The reason is that CLCs, characterized by helical structures, can uniquely separate incident light into its left-and right-handed circular components by selective reflection and transmission [1]. Planar-aligned CLCs with preselected helical pitch can only generate light at a single Bragg-reflected wavelength. CLCs have a helical structure due to the helical twisting power of the chiral dopants mixed in host nematic LC. The director of CLCs has the uniformly twisted arrangement along a perpendicular axis called the helical axis [2]. Due to the unique LC structure, CLC can induce the reflected color with a specific wavelength of the light associated with the CLCs helical pitch. The reflected color of CLCs can be changed by the pitch variation by the external factors. For the application to the electronic paper display, various technologies to diversify the reflected color of CLCs have been investigated such as varying the temperature of the cholesteric LC phase [3], adding different amounts of the chiral compounds [4], using phototunable chiral compounds [5], and applying an external field [2]. Recently, the technology of controlling the pitch by the chiral dopant solubility depending on the temperature is reported. As increasing temperature the chiral pitch decreases in the CLCs due to the effective amount of the solved chiral dopant, contributing the twisting power, increases. It was reported that applying voltage on cholesteric liquid crystal molecules enables the color tuning by extending the helical pitches or inducing tilt of helices. Although those approaches give tunable colors for reflective CLC, they require overcoming the blue color issue.

We report a simple approach to tunable color in the reflective cholestric liquid crystal displays depending on thermo-dynamic properties by using mixture of chiral dopant with high helical twist power (HTP). The reflective wavelength can be thermodynamically switched to reflect blue from a cell initially reflecting a red color. The color change is a result that continuous decrease of the pitch is mainly originated from the dopant solubility below the critical temperature and stepwise decrease of the pitch is dominantly affected by the thermodynamic property above the critical temperature.

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