Multicolor Polymer-dispersed Cholesteric Liquid Crystal Device using a Multi-pitch Stabilization

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Cholesteric liquid crystals (CLCs) have attracted a great deal of interest in fundamental research as well as for device applications due to their wavelength-selective reflection. The wavelength of the selective reflection from the CLC is directly governed by the helical pitch of the CLC under a planar alignment [1]. However, because the CLC pitch is intrinsically varied by temperature, the stabilizations of the CLC pitch by the photopolymer has been explored in order to use device applications such as the multicolor displays in a single-layered configuration [2-6,9-10]. Polymer-dispersed CLC (PDCLC), which is composed of a low-molecular-weight chiral nematic in a non-mesogenic polymer, has been widely used for stabilizing the chiral pitches of the CLC. The helical structure selectively reflects the light of specific wavelengths controlled by the helical pitch, and the polymer structures sustain the droplets of the CLC. However, to fix the different colors within a single-layer, the PDCLC system needs additional polymer materials and structures to stabilize the tuned helical pitch.

In this paper, we present a color controlling method for a PDCLC device within a single layer by controlling the anisotropic diffusion of the CLC molecules without an additional functional layer. Our PDCLC device was manufactured with CLCs and a UV curable prepolymer. Because the phase separation process between the prepolymer and the CLC molecules during polymerization are affected by the UV exposure intensity, we could get different sized droplets of CLCs. In this phase separation process, the LC molecules and chiral agents have different diffusion speeds due to the material properties. As a result, the helical pitches within the droplets of CLCs were modulated by the UV exposure intensity. To verify the mechanism of the color variations, we analysed the reflective wavelength of the only CLCs which are extracted from the PDCLC layer, and compared the quantities of the remaining chiral agents within polymer structures using FT-IR. We expect that our multi-colored PDCLC device can be applicable for reflective display applications with good color performance.

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