Effect of chirality on the lattice plane of BPI

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In a strong chirality system, there are three thermotropic phases, blue phase I (BPI), blue phase II (BP II) and blue phase III (BP III), may show up in the cholesteric phase and isotropic phase. In BPI and BP II, the double-twist cylinder and the disclination line form body-centered cubic symmetry and simple cubic symmetry. The lattice parameters of BPI and BP II are approximately 200 to 300 nm, and then the Bragg diffraction of them is in the ultraviolet and visible region [1]. A full-color-reflective BP display is proposed and demonstrated in recent paper [2]. They made red, green and blue sub pixels of the polymer-stabilized BP with different pitch of the BP, but not mention about the relation between the pitch length and the reflection colors. Combining the relation with Bragg’s law, the reflection wavelength of BP with cubic structures can be expresses as [3] \( \lambda = 2n a \sin \theta \sqrt{h^2 + k^2 + l^2} \) where \( n \) is the average refractive index of LC, \( a \) is the lattice constant and \( h, k \) and \( l \) are the Miller indices of a crystal plane. The lattice constant is the distance between unit cells. It can be determined by the diameter of the double-twist cylinder (a quarter of the pitch length) in blue phase [4]. It means that the reflection color of BPs is dominated by the lattice constant and lattice plane. In this work, we would like to discuss the relationship between the reflected color and the chiral concentration in the BPI cell. Empty cells with anti-parallel alignment layers are used to arrange the crystal plane in order. Here, we record the reflected color of the BPI in different concentration of chiral dopants. The preliminary observation shows that when the chiral concentration is over a value, the reflection wavelength may red shift due to the lattice plane changed (as shown in Fig. 1). We repeat the experiment in other LC material (M8) and determine the lattice planes by Kossel lines of BPI as shown in Fig. 2. The complete results will be shown later.

Fig. 1 Reflection peaks and lattice planes in LC05/S811 system.

Fig. 2 Kossel line taken at BPI in M8/S811 when the viewing direction is along (2, 2, 0).

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References:

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