Influence of alignment layers on the electro-optic properties of blue phase liquid crystal cells

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Blue phases [1] are interesting candidates for display technology because they are optically isotropic without application of electric field and therefore have a good dark state between crossed polarisers. Stabilization techniques, such as polymer-stabilization introduced by Kikuchi et al. [2], enhance the temperature range of blue phases from a few degrees up to 60°C so that applications become feasible [3]. However, driving voltage, hysteresis and degeneration of the cell resulting from memory effects have still to be reduced for practical applications.

In spite of the self-organising properties of blue phases, a higher degree of ordering may be of interest to improve the electro-optic properties of the blue phase liquid crystal cells. Initial studies on polymer-stabilized blue phases [2-3] emphasized that alignment layers were unnecessary because blue phases are optically isotropic. However, earlier studies [4] and more recent investigations [5-6] revealed the field-induced biaxiality and the advantage of blue phase mono-domains. The latter can be generated by thermal annealing, annealing in electric fields or by application of alignment layers.

In this work, the influence of alignment layers is studied. In comparison with time-consuming annealing recipes, their use may be beneficial to fabricate large mono-domains in a short time. For this purpose, we study different cells promoting either planar or homeotropic alignment. To ease the detection of platelet sizes, we investigate blue phase mixtures with relatively low chirality as a model system, which show beautifully coloured Bragg reflections in the visible spectral range.

Fig. 1. Blue phase textures. (a) Platelet texture without uniform alignment. (b) Uniformly aligned blue phase without applied voltage (to the left) and with applied voltage (to the right).

References:

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