FDTD based investigation of Bragg reflection in blue phase liquid crystals

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In this article we present preliminary results of finite difference time domain simulation of blue phase liquid crystal using commercial software (Lumerical FDTD Solutions). Blue phases exist in highly chiral liquid crystals just below the clearing temperature. Natural temperature range of this phase is very small (~1° C) which severely limits their finding any practical application. After polymer stabilization significantly increased the temperature range they have emerged as a potential candidate material for future displays [1].

Finite difference time domain (FDTD) method solves Maxwell equations by discretising them in time and space and evaluating them in a leap frog manner. Starting from the director field model of BP-II [2], we deduce the direction cosines of all the molecules in the unit cell, which is composed of double twisted cylinders (DTC) Fig. 1. (a). As a first order approximation space in the unit cell outside any DTC is assumed to be isotropic.

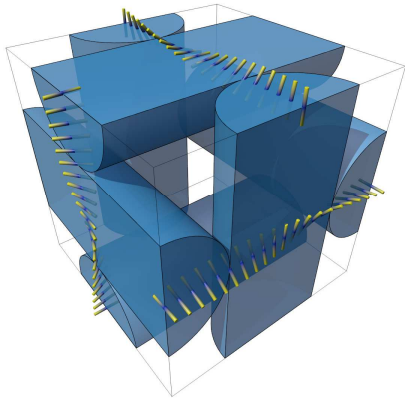

Fig.1(a). Director field of BPII inside DTC

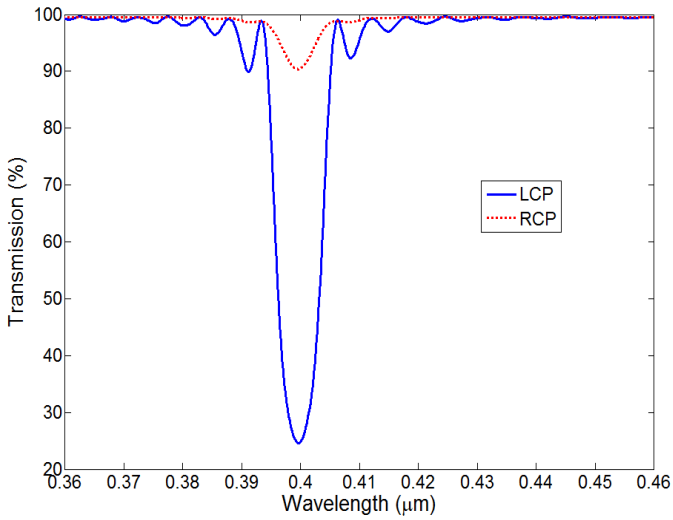

Fig.1(b). Polarization dependent transmission spectrum

Transmission spectrum for two circularly polarized lights is shown in Fig. 1. (b). It can be clearly seen that the light with same handedness as that of helical twist get strongly reflected whereas the other handedness does not see the bandgap. The work on extension of this model is ongoing.

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References:

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