A high-pretilted-twist-nematic director model for a polymer-stabilized blue phase liquid crystal cell

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1. Introduction

The electric-field-induced birefringence (Δn) of a polymer-dispersed blue phase liquid crystal (PS-BPLC) cell is usually described by the Kerr effect or extended Kerr effect [1-2]. However, because of the lattice distortion of the PSBPLC, the induced phase change ($\Delta\phi$) is difficult to obtain by simulation [3-4].

2. Theory

In this study, we propose a double-high-pretilted-twist-nematic (DHPTN) director model to simulate a blue phase liquid crystal cell. As shown in Fig. 1, a DHPTN is a combination of a high-pretilted right-handed twist nematic (HPRTN) layer and a high-pretilted left-handed twist nematic (HPLTN) layer. By means of substituting the PS-BPLC cell by a number of DHPTN layers, the value of $\Delta\phi$ can be calculated.

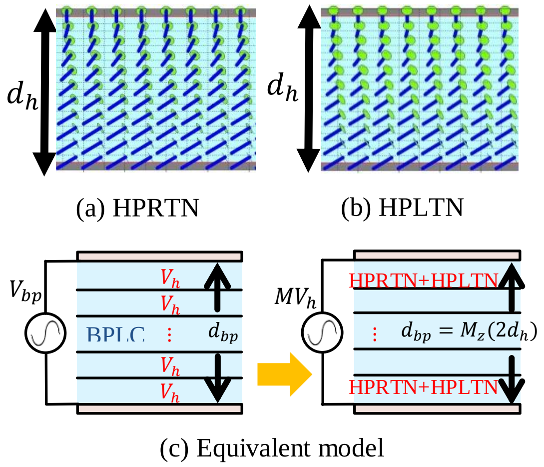

Fig. 1(a) An HPRTN cell. (b) An HPLTN cell. (c) an equivalent model for a BPLC cell.

3. Experiment and Simulation

The experimental result of the simulation is retrieved from the references [2]. In the experiment, the PS-BPLC is composed of nematic liquid crystal (NLC, 49 wt% Merck B-L038), chiral dopant (21% Merck CB15 and 6% ZLI-4572), and monomer (9% EHA and 15% RM257). The NLC birefringence (Δn) is 0.272, and dielectric anisotropy (Δε) is 16.9. The cell gap (d_{bp}) is 8μm and the laser light source is at λ = 633nm. The NLC elastic constants are k_{11} =13.7pN, k_{22} =7.1pN and k_{33} =27.7pN. The simulation software is LCD Master.

Figure 2 shows the relationship between phase retardation and voltage by one-constant-approximation. When DHPTN director model is at the voltage multiplier, M = 90, and the stacked layers, M_Z = 30, the simulation result is in good agreement with the experimental result.

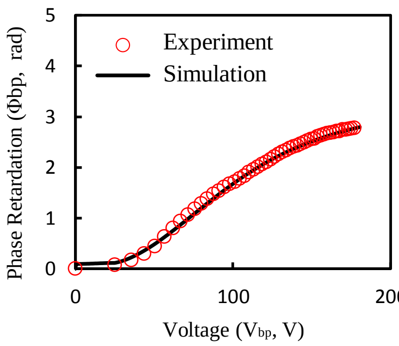

Fig. 2 The relationship between $\Delta\phi$ and V of the PS-BPLC cell.

Acknowledgement

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