First-Order and Continuous Fréedericksz Transitions in Cholesteric Liquid Crystals

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The Fréedericksz transition in twist cells of cholesteric liquid crystals with a finite surface energy is considered. It is shown that this transition can be either of the second order or of the first order depending on the values of the Frank constants, pitch, surface energies, and the cell thickness. A simple criterion that determines the order of the phase transition is obtained[1]. By numerically minimizing the free energy of the liquid-crystal pattern the distribution of the director in the presence of the external electric field is calculated (Fig. 1). For this purpose the polar angle of the director was presented as a partial sum of the Fourier series and of the appropriate function. The azimuthal angle was eliminated using Euler-Lagrange equations. Calculations were performed for different sets of liquid-crystal parameters which provide the phase transition of the first and of the second order. The numerical results are in a good agreement with theoretical formulas based on the Landau-type theory.

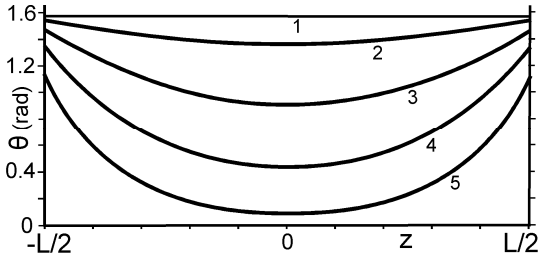

Fig. 1. Profiles of the polar angle of the director θ at different fields above the Fréedericksz threshold.

The performed calculations for the director profile makes it possible to explain the experiment on refraction in 180 degree cell in an external electric field (Fig. 2). It is found that it is significant to take into account the electric field inhomogeneity inside the cell.

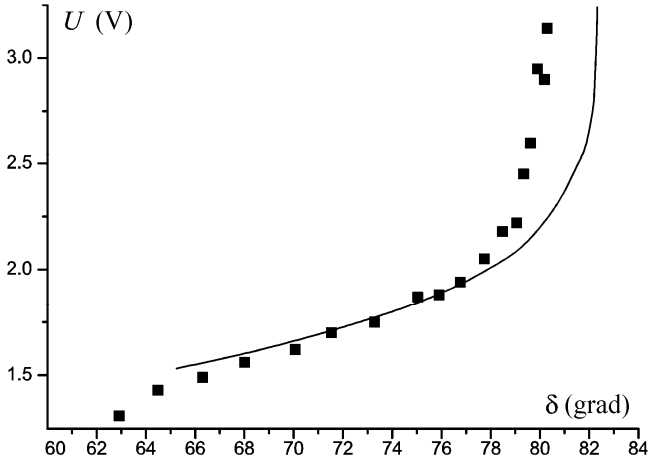

Fig. 2. The limiting angle of the refraction vs. minimum transmission voltage: experiment and theory.

References:

[1] A. Yu. Val'kov, E. V. Aksenova, V. P. Romanov, Phys. Rev. E, **87** (2): 022508 (2013).

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