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Active beam steering by cholesteric layer with tangential-conical boundary conditions

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Cholesteric liquid crystals (CLCs) are characterized by twist-structure of the director field causing their unique orientation-structural and optical properties. The structure features depend on the boundary conditions at the substrates and the ratio of CLC layer thickness d to the cholesteric pitch p. So, the untwisted nematic or various soliton structures are observed at relatively low d/p under homeotropic anchoring at the substrates [1]. In this work we have considered the cholesteric structures forming in the cells under tangential anchoring at one of the substrates and the conical anchoring with the tilt angle of director 50° at the second substrate. The cell with the CLC layer thickness $d = 6$ µm and ratio $d/p = 0.6$ was fabricated [2]. Such a structure performs as a phase diffraction grating with efficient parameter controlled by external electric field. Figure 1 shows photographs of the CLC cell with a periodic structure of defect lines formed at various voltages in range from 0.1 to 1.1 V. The photographs were taken after the complete formation of structures with the voltage switched off. It can be seen that a sufficiently homogeneous periodic structure is formed. The lines are oriented at an angle $\gamma = 58°$ to the rubbing direction ***R*** of the substrate with tangential anchoring at 0.1 V voltage. An increase in voltage leads to a gradual decrease in γ and at 1.1 V, the angle γ is 19°. Unlike a conventional diffraction grating, in which the polar angle of the diffraction maxima changes, the rotation of the defect lines allows for a change in the azimuthal angle, which is undoubtedly of interest to active beam steering.

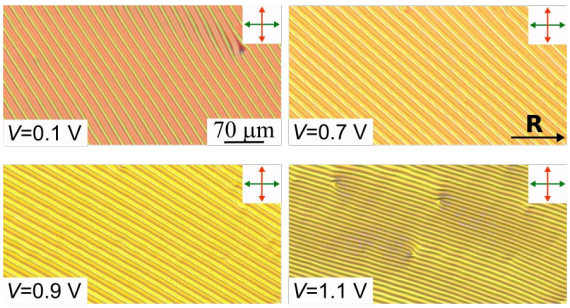

Figure 1 - Photographs in crossed polarizers of the CLC cell with $d = 5$ µm, $d/p = 0.6$ after switching off the indicated voltage.

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References:

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[2] Prishchepa, O. et al., Sci.Rep, 11, 8409 (2021).

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