

Photoinduced modification of cholesteric structure with tangential-conical boundary conditions

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Cholesteric liquid crystals (CLCs) are optically active media that are widely applied in science and technology. The orientational structures and optical properties of the devices based on cholesterics mainly depend on the boundary conditions and the ratio of space value d to helix pitch p (length at which the director rotates through 2π -angle). Recently, CLCs with light-controlled helix pitch have been actively studied [1] since they allow developing systems with a smooth change in the twist angle of the structure under continuous variation of helix pitch. Photosensitive CLC layer with tangential-conical boundary conditions [2] is considered. Nematic mixture LN-396 doped with a left-handed chiral additive S5011 (Macklin) and a right-handed photosensitive chiral dopant cChD (CNM Institute, NAS of Belarus) was used. The transformation of CLC structures have been studied by polarizing microscopy. Initially, the structure with linear defects was formed in CLC layer (Fig. 1a). These defects are located at the surface with conical anchoring, and the director near the defect is parallel to it. When irradiated with light, the helix pitch varies from $16.9\ \mu\text{m}$ to $88.0\ \mu\text{m}$, which leads to a smooth change in the structure twist angle from -380° to -70° . This causes the defects to become unstable. The defects are transformed in two stages, and at each stage the pairs of reverse points are formed moving in opposite directions along the defect lines (Fig. 1b,c). As a result, the continuous linear defect is transformed into a line with the reverse points located at each 180° -bend.

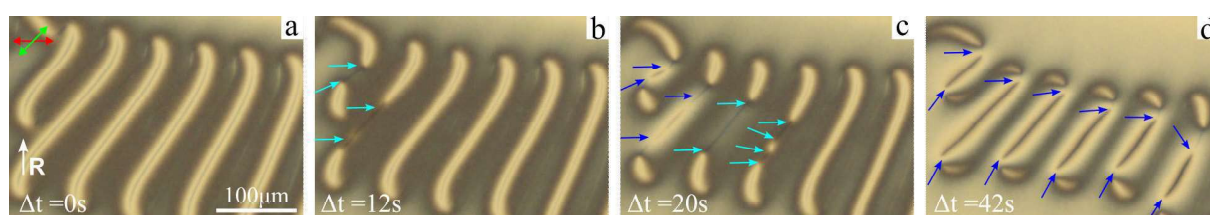


Figure 1: Photos of photosensitive cholesteric layer in crossed polarizers (polarizer and analyzer are shown double red and green arrows) in the initial state (a) and taken in 12 (b), 20 (c) and 42 (d) seconds after switching on the microscope lamp. The director orientation \mathbf{R} on the substrate with tangential anchoring is shown by a single white arrow, and the turquoise and blue single arrows indicate the reverse points for the first and second stages, respectively.

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References:

- [1] Y. Kim, N. Tamaoki, *ChemPhotoChem*, **3**, 284 (2019).
- [2] A.S. Abdullaev, et al., *Optical Materials*, **146**, 114521 (2023)