

Chiral-nematic cells with conical anchoring for wide-range adjustment of light polarization parameters

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Chiral-nematic liquid crystals (CLCs) are of wide application in the optical and photonic devices due to their unique physical properties provided by the helicoidal orientational structure of director. This allows using CLCs to control the polarization of transmitted light. However, the complete control of light polarization in the typical LC devices is not possible because of the strong tangential or homeotropic anchoring of LC to the substrates.

In the present paper, the continuous tuning of the orientation of photosensitive LC under hybrid tangential-conical surface anchoring has been demonstrated owing to the control radiation and electric field [1]. CLC cells based on the nematic mixture LN-396 doped with the left-handed chiral dopant S5011 and the right-handed composite photosensitive chiral dopant cChD [2] have been studied. The strong tangential anchoring on one substrate and the conical boundary conditions on another one [3] allow for smoothly changing the twist angle φ_{dir} of CLC structure. The director twist angle and, consequently, the polarization azimuth ψ of the probe beam passing through the CLC cell was operated by the balance of ultraviolet (365 nm) and blue (430 nm) radiation. The ellipticity ξ of light polarization was controlled by the applied voltage. When the linear polarization of light is perpendicular to the director at the input of LC cell (Figure 1, *Scheme 1*), the system can operate as a photo-controlled achromatic rotator (Mauguin regime) of light polarization over the entire visible range. If the polarization of the incident probing light is oriented at an angle of -45° to the director at the input of LC cell (Figure 1, *Scheme 2*), then it is possible to smoothly adjust the polarization parameters of transmitted light ψ in the range $[-90^\circ; +90^\circ]$ and ξ in the range $[-45^\circ; +45^\circ]$.

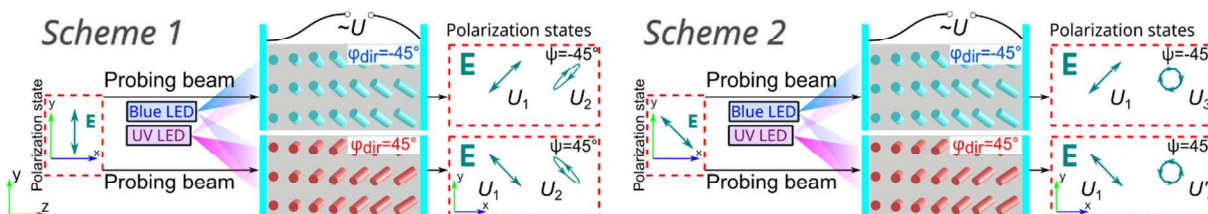


Figure 1: Schemes to control polarization of light transmitted through the CLC layer

References:

- [1] A. Abdullaev, et al., *Optical Materials*, **146**, 114521 (2023).
- [2] D. Chepeleva, et al., *Doklady BGUIR*, **7** (125), 28 (2019).
- [3] D. Kostikov, et al., *Polymers*, **13**, 2993 (2021).