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A Different Perspective on Cholesteric Liquid Crystals Reveals Unique Color and Polarization Changes

Kyung Min Lee, Mariacristina Rumi, Matthew S. Mills, Victor Reshetnyak, Dean R. Evans, Timothy J. Bunning, and Michael E. McConney*

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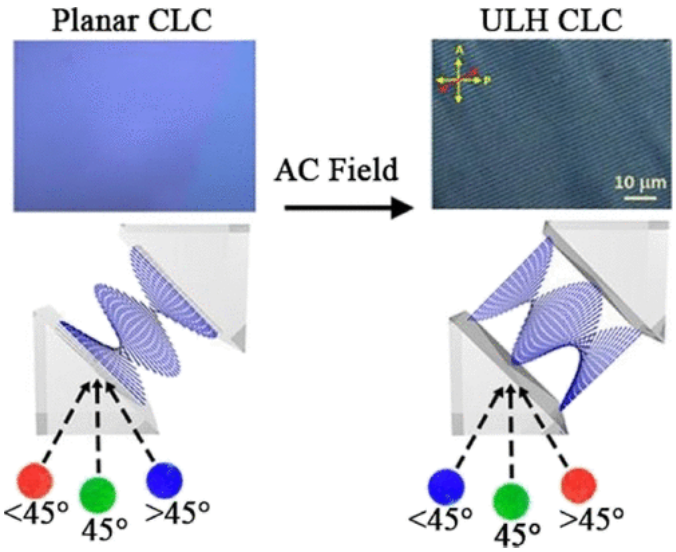

Planar cholesteric liquid crystals (CLCs) are well known for having vibrant reflective coloration that is associated with the handedness and the pitch length of the helicoidal twist of the liquid crystalline molecules. If one observes these films at oblique angles, the reflected colors blue-shift with increasing angles from normal. On the other hand, uniform lying helix (ULH) CLCs, where the helicoidal axis lies in the plane of the substrate, are well-known but are not typically associated with vibrant colors. Here, we examine the unique optical properties of CLCs at oblique incidence angles, specifically the spectral and polarization changes associated with switching between planar and ULH CLCs for various incidence angles. At small angles of incidence ($0° < \psi < 45°$, where ψ is the angle of incidence relative to the surface normal at the substrate–CLC interface), the electrically driven helical reorientation from planar to ULH results in a blue-shifting of the color and circularly polarized to unpolarized switching behavior. At large angles ($45° < \psi < 90°$), the behavior is reversed, with a red-shifting color change occurring and the polarization switching from unpolarized to circularly polarized. Modeling of the light propagation through ULH CLCs is used to confirm the change in position and polarization characteristic of the reflection band with incidence angle observed experimentally. This study provides a new perspective on ULH CLCs and reveals a unique reconfigurable angular chromaticity.

KEYWORDS: cholesteric liquid crystals, uniform lying helix, total reflection, oblique incidence angle

Supporting Information

relative to the incidence plane; calculated transmission spectra for a planar CLC and ULH CLC for various incidence angles and comparison with experimental results; and estimate of the axis tilt due to the flexoelectric effect (PDF)

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