Color-Tunable Mirrors Based on Electrically Regulated Bandwidth Broadening in Polymer-Stabilized Cholesteric Liquid Crystals

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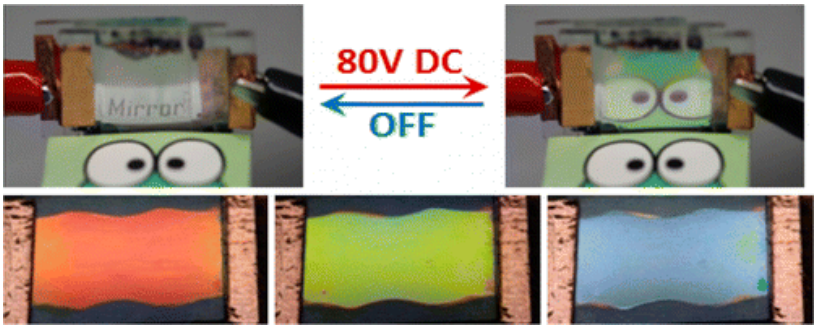
SUBJECTS
Chirality,

Abstract



We report on the preparation of color-tunable mirrors based on electrically regulated bandwidth broadening of the circularly polarized reflection of polymer-stabilized cholesteric liquid crystals (PSCLCs). A number of improvements relating to the practical implementation of these materials are detailed including color and bandwidth stability, baseline optical properties, and response times. Experimentation reported herein focuses on the contribution of structural chirality, viscoelastic properties of the polymer network architecture, and electro-optic drive schemes. Through the examination of samples prepared in different conditions and compositions, we further elucidate the dominant role of structural chirality as well as the impact of cross-linking of the polymer stabilizing network on the threshold voltage and relative change in bandwidth per voltage ($\Delta(\Delta\lambda)/V$). Furthermore, the appearance of nonideal optical properties (scatter and haze) in some samples is shown to be correlated with the polymer/LC compatibility and effectiveness of structural templating. Due to the employment of an electromechanical displacement mechanism, the switching times of the PSCLCs are slower than mechanisms based on liquid crystal reorientation. However, a potential approach is identified to reduce the on and off switching times to approximately 1 s.

KEYWORDS: liquid crystals, optical materials, polymer stabilization, color, photonic band gap

Supporting Information

monomers with various alkyl chain lengths, Figure S3, temporal stability of electrically induced bandwidth broadening in four PSCLC samples; Figure S4, electric field induced bandwidth broadening of PSCLCs with various cell thicknesses. Supplementary video: Video 1, high-contrast, color-tunable mirror from an assembled LH/RH PSCLC depicted in Figure 2. This material is available free of charge via the Internet at http://pubs.acs.org.

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