Reconfigurable Reflective Colors in Holographically Patterned Liquid Crystal Gels

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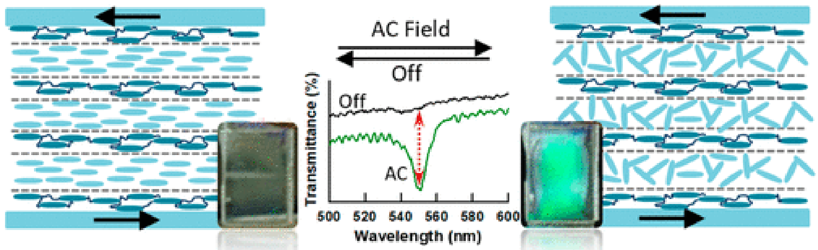
Abstract



Thin film holographic gratings have attracted significant attention due the tailorability of their photonic properties. The ability of holography to create materials with unique photonic properties is particularly promising when combined with stimuli-responsive liquid crystals. Holographic polymer-dispersed liquid crystals (H-PDLCs) are an example of such a system where nonuniform irradiation is used to template alternating polymer-rich and polymer-poor regions with a periodicity related to the illumination wavelength. These systems typically use nonmesogenic monomers at a concentration range where a significant volume fraction of the final system is polymer. Here, we present a reconfigurable material that was generated by holographically polymer stabilizing liquid crystals (H-PSLCs) using liquid crystalline monomers, thereby enabling both alternating regions to be liquid crystalline. The "stabilizing effect" of the liquid crystalline polymer leads to a material with regions of periodic transition temperatures. As written, the polymer-rich regions have a higher isotropic transition temperature than the polymer-poor regions. Upon heating these samples beyond the isotropic temperature of the polymer-poor regions, a vivid wavelength specific reflection appears due to the refractive index mismatch between the ordered liquid crystalline polymer-rich regions and the disordered isotropic polymer-poor regions. When these materials are further heated to the isotropic temperature of the polymer-rich regions, the samples again return to a transparent state because the refractive index modulation between the alternating isotropic regions is negligible. By tailoring the liquid crystalline isotropic transition temperature to be near-room temperature, modest AC-fields can be used as an Ohmic heat source to drive the thermal color change.

KEYWORDS: liquid crystals, optical filters, polymer stabilization, electrochromism

Supporting Information

temperature and polarization direction of the reading beam maximum, H-PSLCs prepared with various laser exposure intensities, reversible switching response of H-PSLCs with various polymer concentrations, and various alkyl chain lengths (PDF)

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Supporting Information

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Patterned Liquid Crystal Gels

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