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## Going beyond the reflectance limit of cholesteric liquid crystals: experimental and theoretical investigations

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The reflectance of cholesteric liquid crystals (CLC) is limited to 50% of ambient (unpolarized) light at normal incidence because circularly polarized light of the same handedness than the helix is reflected.

We report the elaboration procedure and the structural properties of Polymer-Stabilized CLCs which reflect more than 50% in the infrared spectrum. Photopolymerizable mesogens are blended with a CLC exhibiting a thermally induced helicity inversion and the mixture is cured with UV-light when the helix is right-handed. The reflectance exceeds 50% when measured at the temperature assigned at a helicoidal structure with the same pitch but a lefthanded sense before curing. From SEM investigations, it is shown that the organization of the mesophase is transferred onto the structure of the polymer network and arced patterns are revealed in relation with the twisted plywood model given by Bouligand to describe the cholesteric arrangement of chitin molecules in the cuticle of arthropods. The gel structure is discussed as containing two populations of low molar mass LC molecules (free and polymer bound fractions). Each of them was characterized by a band of circularly polarized light which is selectively reflected.

The optical properties of the structure are investigated numerically by means of a one-dimensional finite-difference time-domain algorithm. Taking into consideration that the distribution of the domains occupied by the two populations cannot be described by a deterministic model, the overall optical behaviour of the structure is assessed by averaging the contribution of stochastically generated one-dimensional samples. Each sample is subdivided into a number of randomly interlaced polymer bound and free fractions with inverse helicoidal structures. The overall distribution of these regions is controlled by adjusting the percentage of the polymer to values that can be directly correlated with experimental data. The reflectance of each sample is calculated independently and the total reflection spectrum is derived by averaging over a sufficient number of samples. Results demonstrate that structures with randomly distributed areas of alternating senses of helicity are indeed capable of providing enhanced reflectance that exceeds the 50% limit.

Novel opportunities to modulate the reflection over the whole light flux range are offered. Potential applications are related to the light management for smart windows or hyperreflective polarizer-free displays with a larger scale of reflectivity levels.

*References*

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