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Reflectance, Transmittance and Color Gamut of Superimposed Layers of Cholesteric Liquid Crystals†

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The spectral reflectance curves of superimposed layers of cholesteric liquid crystals (CLC) having the same handedness add as there is little absorption. The peak reflectance of the sum cannot exceed 0.5 and the transmittance cannot be less than 0.5, which is the theoretical limit. The shape of the reflection and transmission band resembles rectangles and thus can be compared with the spectral curves of optimum colors. The chromaticity loci of CLC colors and its luminous reflectance equals 0.5 of the value of the luminous reflectance attached to the optimum colors. The color gamut thus produced can be shown to be greater than that which has been obtained with pigments.

A significant improvement can be obtained using superimposed layers of CLC having opposite handedness. Their spectral curves add and the peak reflectance is not limited by the value of 0.5 but approaches 1.0. Use of CLC's of opposite handedness is not always practical as they have different chemical and physical properties. A similar result can be obtained using two CLC layers of the same handedness and a half-wave retardation plate interposed between them. This plate converts the transmitted through the upper layer right-handed (left-handed) component into a left-handed (right-handed) one, which is then reflected from the lower layer and contributes to the reflected left-handed (right-handed) component from the upper layer. The chromaticity loci and color gamut of such superimposed CLC pairs of coatings now approaches that of optimum colors of the same luminous reflectance.

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