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BRAGG REFLECTION OF LINEARLY POLARIZED LIGHT IN A CHIRAL SMECTIC C LIQUID CRYSTAL FOR OBLIQUE INCIDENCE

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Abstracts Reflection spectra were measured with oblique incident σ and π polarized light in a chiral smectic C liquid crystal. For the first-order diffraction, with σ-polarized incident light, the reflection light is π-polarized and vice versa.

It is experimentally shown that in chiral smectic C liquid crystals for the light propagating along helical axis the first-order Bragg diffraction is absent, only the second order being observable.[2-5] For oblique incident light first and second order appear.

Transmission spectra were measured in our previous studies. In the present experiment we used a device for measuring the reflectance of oblique rays. The investigations were performed on 4-p-hexyloxyphenyl ester of 4'-(2"-methylbutyl)biphenyl-4-carboxylic acid[6] produced by BEH Chemicals Ltd with a chiral smectic C phase with selective reflection in the visible light range. The reflection of light linearly

polarized in the plane of incidence (π-polarization) and perpendicular to it (σ-polarization), was measured. All measurements were carried out for single domain plane structure samples (the helical axis was perpendicular to the film surface). Samples of about 20μm thick were sandwiched between the faces of flat and hemispherical glasses.

The reflectance spectra for four combination σ and π polarizations for the first and second order are shown in Fig. 1. λ_o is the wavelength of the maximum of reflection for perpendicular incidence (λ_o Pn, where P is the spiral pitch and n, the refractive index along the spiral axis[2,3]), R, the reflective coefficient, λ , the wavelength of light, the incidence angle is 44°. According to the experimental results the first order σ polarized light is scattered to π polarized and vice versa. The polarization properties of second order reflected light are similar to the selective reflection which occurs in cholesterics. Quantitative polarization characteristics give an azimuthal dependence of reflectance. The polarization characteristics for the first and second order reflections in the division analyzer were measured.

The dependence of the reflective coefficient (R) on the analyzer position for the first order reflected light is shown in Fig.2. The incidence angle was 44°, the polarizer being in

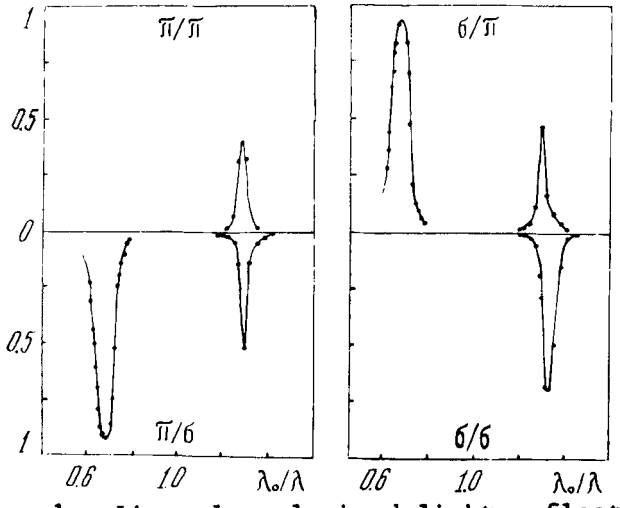

Fig. 1. Linearly polarized light reflection spectra for four combinations of polarizer and analyzer. R, the reflective coefficient; λ_0, the wavelength of the maximum of reflection for perpendicular incidence of light; λ, the wavelength of light.

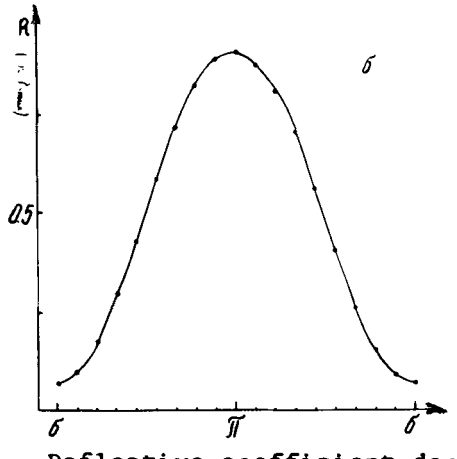

Fig. 2. Reflective coefficient depending on the analyzer position for the first order reflection. Incidence angle - 44°, polarizer being in б position.

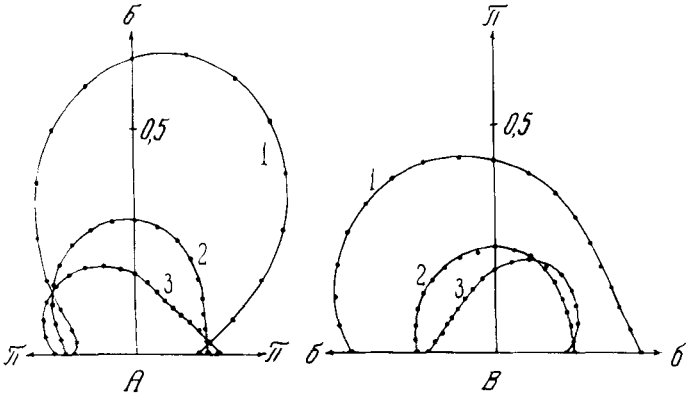

Fig. 3. Azimuthal dependence of the reflective coefficient for second order diffraction. A - б position of the polarizer; B - π position of the polarizer.

The angles indicate the directions of the analyzer and the radius, the reflective coefficient.

The analyzer rotations correspond the $\pi \to б \to \pi$ directions in case A, and $б \to \pi \to б$ directions in case B. The angles of incidence: 1 - 44°, 2 - 25°, 3 - 1.5°.

σ position. The analyzer position changed between the σ - π - σ planes in the range 10°. Analogous curve was obtained for the polarizer in π position.

Fig. 3 shows the polarization characteristics of selective reflection for the second order σ and π polarizations of incident light for the angles of incidence: 1-44°, 2-25°, 3-1.5°. The polarizer was in σ position in case A and π position in case B. The analyzer was rotated from π position (angles 0° and 180° in Fig.2A) to σ position (angles 90° in Fig. 2A) and from σ position (angles 0° and 180° in Fig. 2B) to π position (angle 90° in Fig. 2B). The reflective coefficient is plotted in polar coordinates, the angles indicating the directions of the analyzer and the radius, the reflective coefficient.

The wavelength of the maximum of selective reflection in the π/π and σ/σ positions was set for each case.

The observed characteristics are in good agreement with the previous experimental results [2-5] and theoretical calculations [7-8].

A detailed comparative analysis of the theoretical and experimental results will be performed.

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