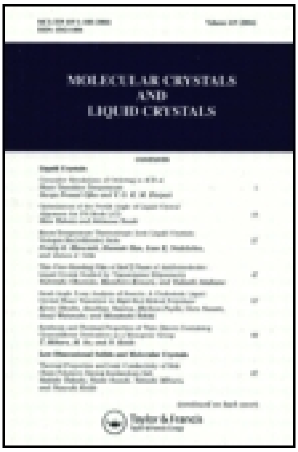

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Light Modulator Based on Optically Active Nematic-Chiral Liquid Crystal Structure

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LIGHT MODULATOR BASED ON OPTICALLY ACTIVE NEMATIC-CHIRAL LIQUID CRYSTAL STRUCTURE

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At the present time liquid crystals have extensive practical applications. The reason for this has been both the appearance of a wide assortment of new liquid crystal materials with the requisite properties and the discovery of new physical effects which depend to a considerable extent on the symmetry and configurational features of liquid crystals. Particularly noteworthy in this respect are liquid crystals with spiral structure [1]. The helical twist of the supermolecular structure ensures the unique properties of such liquid crystals.

Twisted and supertwisted nematic liquid crystal displays available today are based on the twist effect, in which the twisted helical structure of nematic liquid crystal is reoriented to homeotropic structure [2]. In twisted nematic (TN) cells the nematic molecules align parallel to the substrate with the twist angle of director Φ_m 90° and very small tilt angle θ_o of the director. Recently a number of results on new type of twist effects in liquid crystals have been published where the values of

Φ_m and θ_o are ohanged: supertwisted nematio effeot (STN) [3,4], supertwisted birefringenoe effeot (SBE) [5], optioal mode interferenoe effeot (OMI) [6].

In this paper we proposed a new type of eleotro-optioal effeot based on "optioally aotive nematio-ohiral (OANC) liquid orystal struoture". We obtained this struoture in the layers of nematio-ohiral mixtures with the thiokness less than 5 μm at the surfaoes, oovered with polyamide ZLI-2650. OANC struoture rotates the plane of polarization of transmissing light. The struoture has no linear birefringenoe: the rotation of the plane of polarization does not depend on relative plaoe of liquid orystal oell between the polarizer and analyzer, the value of the angle of rotation is not ohanged with rotation of liquid orystal oell and with inolined oell that is for oblique inoidenoe of light.

The struoture where the rotation of the plane of polarization does not depend on initial polarization direotion of inoident light was known for a long time [7] and experimentally this type of struotures was studied in [8,9]. This oase oan be observed, when the wavelength of inoident light $\lambda \gg \gamma P$, where $\gamma=(\varepsilon_1-\varepsilon_2)/(\varepsilon_1+\varepsilon_2)$, ε_1, ε_2 are dieleotrio oonstants, P is the spiral pitoh. In this oase De Vries formula is used for the value of the angle of rotation [10].

We used several liquid orystals to obtain OANC struoture. In the present paper the data are given for the nematic ZLI-2293 (Merck) which has been doped with optically active nonmesomorphic tigogenin caprate (TC). Helical pitch is 2,5 μm and thickness of the samples is about 4 μm. Two methods were used to determine the undisturbed spiral pitch: Cano wedge shape method [11] and laser diffraction on the focal conic structure [12]. Representative spectrum of optical activity for this OANC structure is shown in fig.1. Measurements were made at room temperature.

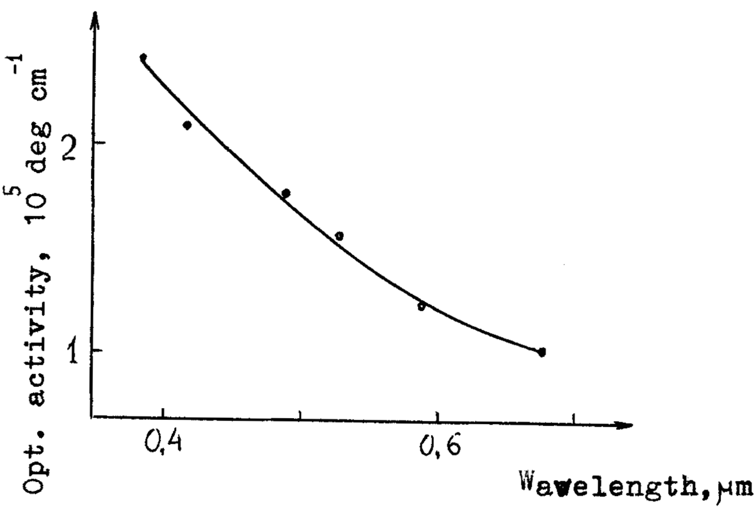

fig.1

The used nematic-chiral mixtures have positive dielectric anisotropy and in electric field optically active structure is transmitted into homeotropic. At switching off the field the structure goes back to the initial state.

A typical form of optical response to pulse voltage at crossed polarizers is shown in fig.2. The amplitude of electric pulse is 30V and width is 100μsec. The rise time is less than 100μsec and the decay time is less than 5 msec.

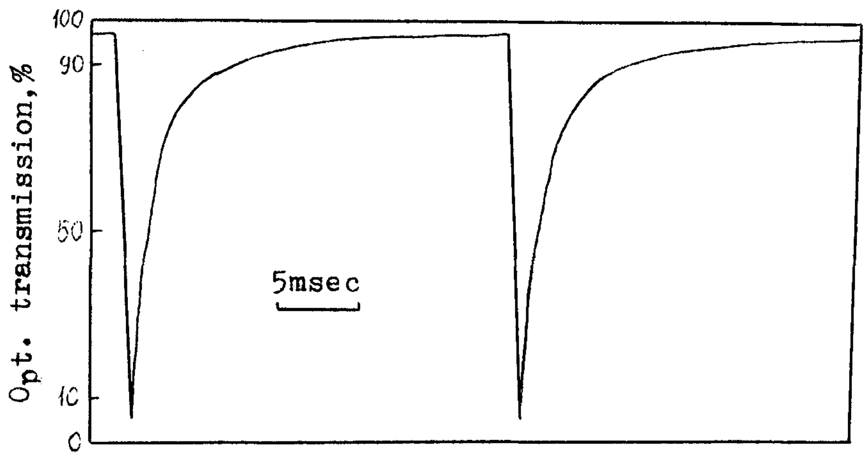

Fig.2

The transmission as a function of the applied voltage is shown in fig.3.

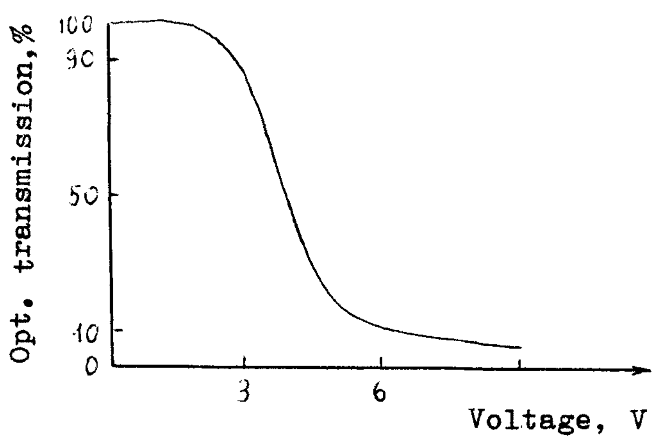

Fig.3

Characteristic features of the OANC structure are high degree of homogeneity at comparative simplicity of orienting surface treatment and independence of optical properties of the sample position between the polarizer and analyzer. High electrooptic characteristics allow to use this structure in some optical processing systems.

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