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

Twisted and supertwisted nematic liquid orystal displays available today are based on the twist effect, in which the twisted liquid structure οľ nematio orystal homeotropic struoture reoriented to twisted nematic (TN) cells the nematic molecules align parallel to the substrate with the angle of director $\Phi_{\mathbf{m}}$ 90° and very small angle θ_0 of the director. Recently a number results on new type of twist effects in liquid crystals have been published where the values of

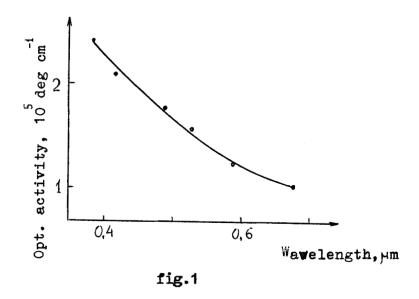
 $\theta_{\rm m}$ and $\theta_{\rm O}$ are changed: supertwisted nematic effect (STN) [3,4], supertwisted birefringence effect (SBE) [5], optical mode interference effect (OMI) [6].

In this paper we proposed a new type electro-optical effect "optically based on liquid active nematic-chiral (OANC) structure". We obtained this structure in layers of nematic-chiral mixtures with the thickness less than 5 μ m at the covered with polyamide ZLI-2650. OANC structure rotates the plane of polarization transmissing light. The structure has no linear birefringence: the rotation of the plane polarization does not depend on relative place of liquid crystal cell between the polarizer and analyzer, the value of the angle of rotation is not changed with rotation of liquid crystal cell inclined cell that is for oblique incidence of light.

The structure where the rotation plane of polarization does not depend on initial polarization direction incident ΟÍ light and experimentally [7] known for a long time this type of structures was studied in This case can be observed, when the wavelength of incident light $\lambda > \gamma P$, where $\gamma = (\varepsilon_1 - \varepsilon_2)/(\varepsilon_1 + \varepsilon_2)$, ϵ_1 , ϵ_2 are dielectric constants, P is the spiral pitch. In this case De Vries formula is used for the value of the angle of rotation [10].

We used several liquid orystals to obtain OANC structure. In the present paper the data

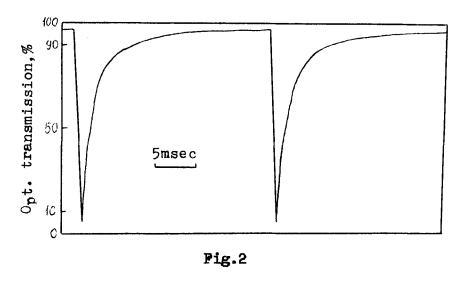
are given for the nematic ZLI-2293 (Merck) which with has been doped optically active nonmesomorphic tigogenin caprate (TC). Helical pitch is 2.5 μ m and thickness of the samples is Two methods were used to determine about 4 µm. the undisturbed spiral pitch: Cano wedge method [11] and laser diffraction on the focal conic structure [12]. Representative spectrum of optical activity for this OANC structure shown in fig.1. Measurements were made at room temperature.



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 $100\mu\text{sec}$. The rise time is less than $100\mu\text{sec}$ and the decay time is less than 5 msec.



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

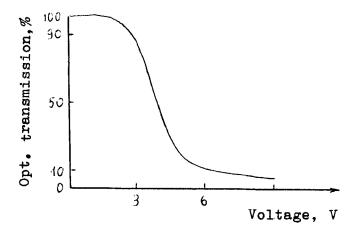


Fig.3

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

REFERENCE

- 1. Chilaya G.S. and Chigrinov V.G., Sov. Phys. Crystallogr., 33, 154, 1988 (Kristallografiya, 33, 260, 1988)
- 2.Schadt M. and Helfrich W., Appl.Phys.lett., <u>18</u>, 217, 1971
- C.M. 3.Waters and Raynes B.P.. U.K.Pat.
- GB212316 B2, 1982 Kando Y., Nakagomi T. 4.Kando and Hasagewa Germ.Pat. DE-3503259 A1, 1985
- 5.Scheffer T.J. and Nehring J., Appl. Phys. Lett., 45, 1021, 1984
- M. Leenthouts F., 6.Schadt and Appl. Phys. Lett., <u>50</u>, 1987
- 7. Chandrasekhar S., Liquid orystals, Cambridge University Press., Cambridge 1977
- 8. Robinson C., Tetrahedron, 13, 219, 1961 9. Cano R., Chatelain P., Compt. Rend. 259, 1964
- 10.De Vries H., Acta Crystallogr 4, 219, 1951
- 11.Cano R., Bull.Soc.Miner.Cryst., 91,20,1968
- 12.Kahn F.J., Phys. Rev. Lett., 24, 209, 1970