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PREPARATION AND TESTING OF LIQUID CRYSTAL DISPLAY DEVICES

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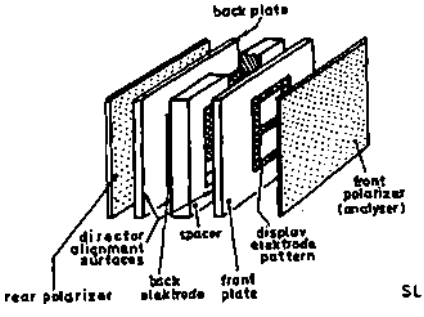
ABSTRACT. The article deals with preparation of nematic display devices by using ready mode mixture as active substance. The aim of experiments was to obtain stable and simply procedures. Special attention was paid to the aging effects, as well as to other processes heaving the influence on the life time of LCD device.

INTRODUCTION. Liquid crystal mixture, commercialy known as RO-TN-101, as an active substance in liquid crystal display device has been used.

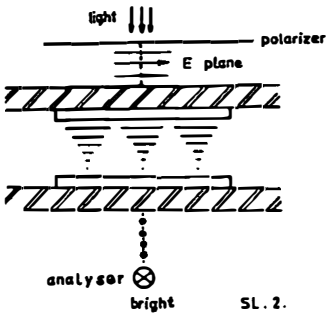
From the structural point of view mixture RO-TN-101 is nematic, i.e. such type of structure whose orientation arangement of rod molecules follows the rotation about some axis. Molecular orientation changes by this rotatien from one to another wall of the cell for 90°. Cells of the thickness of 10-20 μm are filled with such active substance and put between two semitransparent electrodes. Two crossed polarisers are attached on both sides of the cell, and the whole device is known as liquid crystal desplay (LCD) device, Fig. 1.



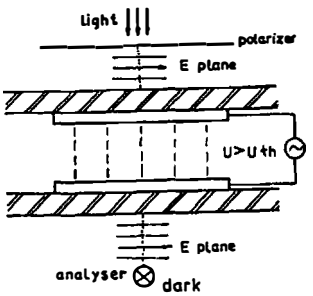
SL.1

The principle of LCD is the following: The plain of polarisation, i.e. E vector of the incident light follows the rotation of the structural arangement of the molecules, and one has light at the exit of the cell, Fig. 2. However, when the voltage is applied on the electrodes, the molecules of liquid crystal take the orientation parallel to the applied field, and result is that one has dark at the exit of the cell, as is shown on Fig. 3. The effect foolows

the shape of the electrodes, and very simple display can be constructed. However, many internal as well as external influences can significantly reduce stability and life time of the device.



SL.2.



SL.3.

EXPERIMENTAL RESULTS. On the glass plates of 4 cm^2 (2x2 cm^2), with flatnes better than 5 μ, a semitransparent electrodes of Al and NiCr, thicknes of 250 Å and 300 Å, film resistance 8 Ω/□ and 12 Ω/□ respectively and transparence of 80% for 6328 Å line He-Ne laser, by evaporation in vacuum were deposited. Evaporator was VARIAN NRC and thickness of the electrodes has been controlled by automatic control system ADS 200. We used plastic foil and epoxy as the spacers.

Thickness of the spacers varied between 10-30 μ. After finishing preparation of the cell, the mixture of nematic esters RO-IN-101 of Hoffman La Roche Co. has been put inside, as an active substance in display. Finaly, the polarisation foils of 0,25 mm thicknes of light transmitivity (ZIRALO B-45) of Baum Chemical Co., were added on both sides of the cell. Because of the reason of simplicity, the electrodes in the first experiments were taken to be round in shape, and the complete device has to give "display effect" in the area where electrodes have been crossed. In latter experiments we started with 7-segment numerical display construction. The first experiments after difficultes with fixing of the spacers, finding appropriate spacer thicknes as well as filling the cell in vacuum - were successful.

One of the aims in the experiments on display device was to find it's real life-time as well as the influences of more flexible and simply procedures of preparation on LCD devices properties, stability and duration age. We found that after three mounths of very successful operation the LCD effect suddenly desappeared.

Theoreticaly, there is a number of reasons which can be responsible for the foillure.

Trivial reasons like breaking of electrical contact on one or both electrodes can be excluded: electrical integrity of the circuit was experimentaly confirmed. The voltage we used was less than 2V, and the experiments were actualy very short about a few minutes every time. Under these conditions hydrolisis of LC because of DC component on the electrodes s seems not to be very probable.

The reason like contamination of LC during the filling of the cell is theoreticaly possible. As we used a special thin hollow needle for this operation, LC was not actualy in contact with air or other chemical agens: we do not believe that contamination was the reason for the foillure.

There is a real possibility that the end of life-time of these mixtures, was the reason for the sudden change, because the mentioned age (2,5 years) is comparable with the age duration (3-3,5 years) of the similar kind of nematics in display devices, according to the results from Philips laboratories.[2]

In the next period we shell tray in contact with Hoffman la Roche labs., to find out the reason of the mentioned behaviour, as well as to finish the construction of stable numerical display.

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