SOME ELECTRO - OPTICAL CHARACTERISTICS OF SEMICONDUCTOR - LIQUID CRYSTAL INTERFACE

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1. Introduction

In modern photonics and optoelectronics there is big kind of elements (spatial light modulators, optical valves, etc.) based on semiconductor – liquid crystal structure [1]. In such devices it is used the semiconductors' photoconductivity and liquid crystals' orientation phenomena. Here, it should be noted that deep investigations of optical and electro-physical characteristics, which take place on such interface, can lead to noticeable improvements of physical parameters of these devices [2, 3].

In this work, the study of some electrooptical characteristics of semiconductor – liquid crystal interface is presented.

2. Experiment

The investigated semiconductor – liquid crystal system is a thin layer of nematic liquid crystal located between ITO glass and semiconductor. The presence of semiconductor substrate allows applying constant electric field (DC) along the semiconductor surface.

By applying DC electric field to semiconductor substrate the orientation effects appear. To investigate their dynamic characteristics, the method of recording of laser beam reflected from the semiconductor substrate has been used. The scheme of experiment is shown in Fig. 1.

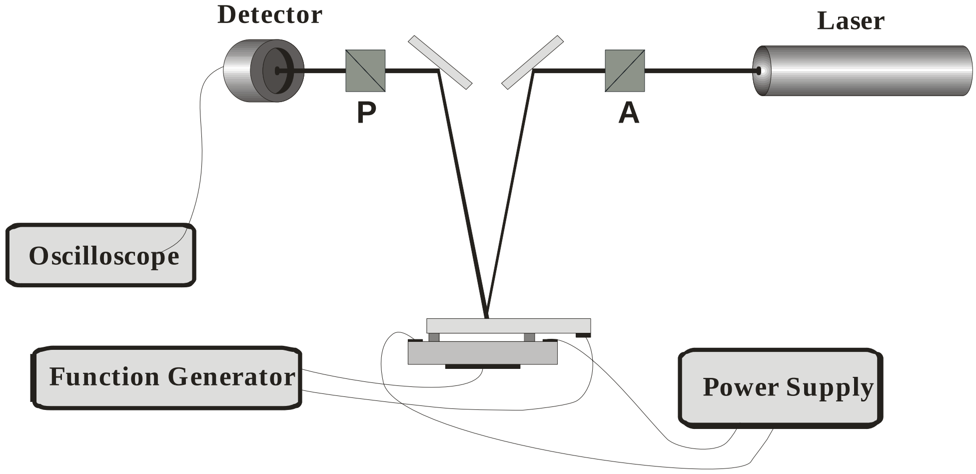

Fig.1. The scheme of experiment.

The sample is placed between two crossed polarizers (PL, AL) and a reflected from the sample laser beam is recorded by a photodetector connected to an oscilloscope. Two types of lasers with 632.8 nm and 532 nm wavelengths were used.

Three samples with different thicknesses (23, 36 and 50 μm) have been investigated. Substrates of n-Si (ρ = 4.5 Ohm·cm) and 5-CB liquid crystal were used for all three samples. DC electric field applied to the semiconductor substrate causes intensity oscillations of the laser beam. The shape of these oscillations is presented in Fig.2.

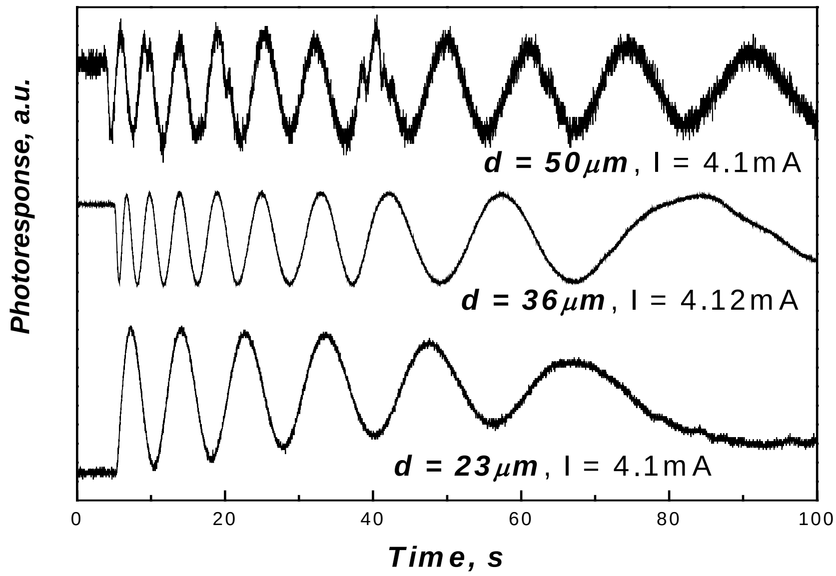

Fig. 2. Oscillations caused by DC field for different LC thicknesses.

Laser wavelength - 532 nm.

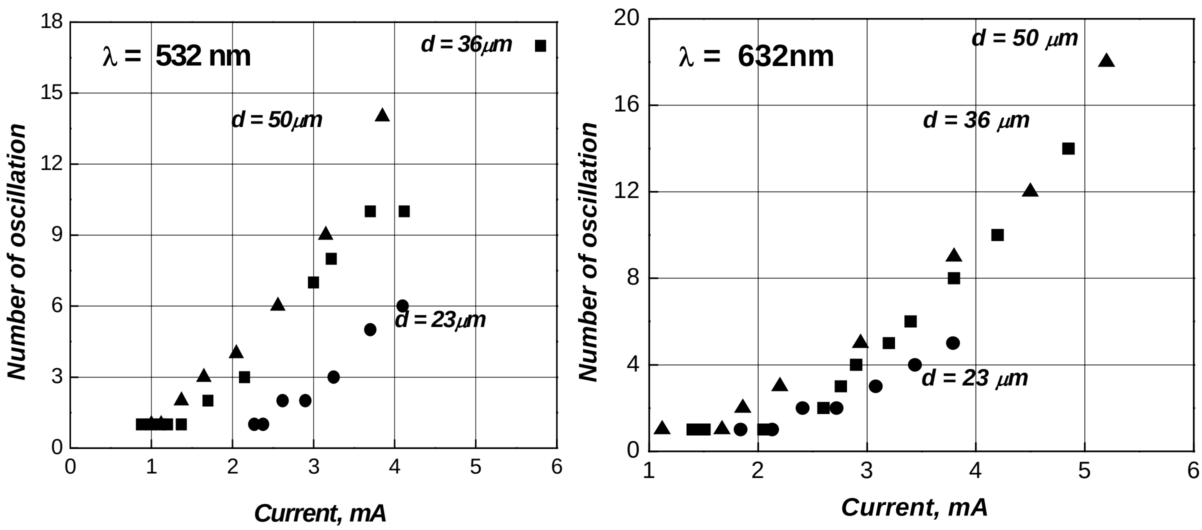

Fig. 3. Number of oscillations vs. DC current for different liquid crystal layer thicknesses.

As is seen in Fig. 2, the number of oscillations increases with thickness of LC layer.

The dependence of number of oscillations vs. DC current through the semiconductor substrate has been investigated too (see Fig. 3).

As is seen in Fig. 3, the number of oscillations also increases with the current and the influence of latter almost is the same both for different thicknesses of LC layer and wavelengths of laser beam.

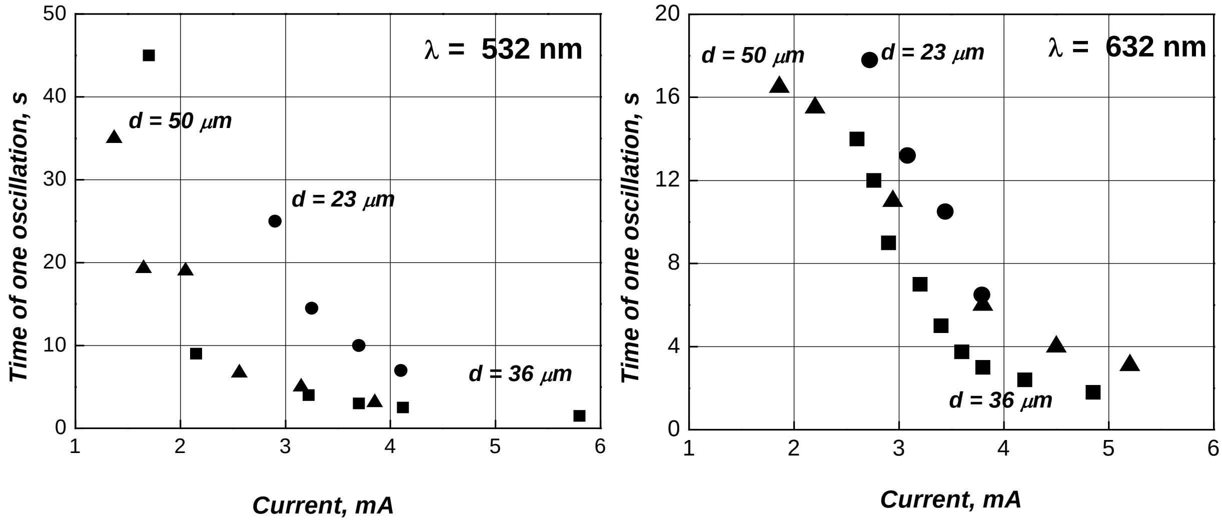

Fig.4. Oscillation time-period vs. DC current for different laser beam wavelength.

From the shape of oscillations (Fig. 3) it can be concluded that the time-period of oscillation changes depending on the thickness of liquid crystal layer. The observed regularity is clearly seen in Fig. 4, where the dependence of one oscillation time-period vs. DC current through a semiconductor is presented for different thicknesses. It is obvious that one oscillation time-period decreases with the growth of current.

3. Conclusions

From our investigations it is seen that the application of longitudinal DC field to the semiconductor substrate of LC cell leads to a generation of orientation oscillations. At that, the shape of these oscillations differs from the well-known for LC [4] oscillations caused with the Freedericksz transition. The number of such oscillations increases with the increase in the LC layer thickness and the value of current through the semiconductor. Thus, it is obvious that the application of DC field along the semiconductor substrate of LC cell creates additional possibilities to control its electrooptical characteristics.

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