The Optoelectronic Device for the Control Availability of Vapor of Harmful Substances

Z. Mykytyuk, A. Fechan, O. Sushynsky, O. Yasynovska

Abstract – **This work is devoted to designing of precision construction of vapor sensor of harmful substances.**

\Keywords – **cholesteric liquid crystal, spiral pitch, lasing**

I. INTRODUCTION

The liquid crystals are wider used in devices of displayed and transferred of information. The cholesteric liquid crystals are the one-dimensional chiral photonic crystals with photonic forbidden zone for the light with circular polarization, which are coincided with sign of medium chirality.

The nature of spiral structure of cholesteric liquid crystal permits, owing to their orientation in layer and activation of dye, to create the distributed feedback lasers [1]. In distributed feedback lasers the selectors are the periodical reflective structure. The period such structure is equal of half of length of light wave. To achieve the generation, at the time of excitation by pulse solid-state laser in absorption band of dopand dye, the fluorescence spectrum of dye must to overlap with spectral region of Bragg's diffraction of cholesteric liquid crystal.

The interest way to use such hiral materials is as the gas sensitive element of designing of harmful substance sensors. These sensors are used in monitoring of surroundings. And this is aim to design the portable devices of control of atmospheric state. So far as the pitch of cholesteric spiral and wave length of laser generation of distributed feedback lasers are depend from properties of chiral materials. The chiral material properties are depends from internal influence (temperature, aggressive medium, ultraviolet radiation, pH of chemical medium). Such system is used as initial transducer for the sensor, in which the wave length of laser radiation provides the information about the internal influence [2].

II. EXPERIMENTAL PART

The thin film liquid crystals have a good the gas and the vapor absorption for the internal medium. When the gas and vapor are absorbed in surface, it is changing the optical properties of cholesteric films, first of all the selective reflection. The influences of harmful substance on the spectral characteristics of cholesteric liquid crystals are investigated. The time range of harmful substance influence is equal 20-40 s. In all investigation cases the linear shift of wave length of selective reflection, if the vapor concentration is in range 0-200 g/m^3, is determinate. Besides that shift are appears in to the long or short wave range. The high material sensitivity are observe to the ammonia vapor S=1.14, than to the acetone and ethanol vapors are equal S=0.31 and S=0.16 correspondingly.

Z. Mykytyuk, A. Fechan, O. Sushynsky, O. Yasynovska – Electronic Devices Department, Lviv Polytechnic National University, 12, S. Bandery Str., Lviv, 79013, UKRAINE, E-mail: zmykytyuk@polynet.lviv.ua

The obtained results give the possibilities to propose the new construction of optoelectronic devices for the control of availability of harmful substances (Fig.1).

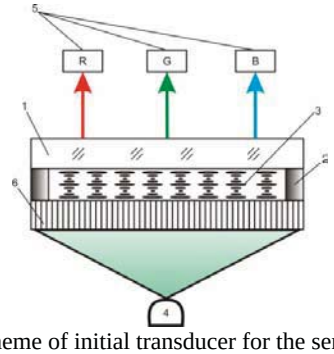

Fig. 1. The scheme of initial transducer for the sensor of harmful substances based on cholestric liquid crystal: 1 – glass plates; 2-spacers; 3 – the mixture of cholesteric liquid crystal with dye; 4-lasing source; 5-photodetectors; 6- porous substrate

The liquid crystal cell is filled by liquid crystal mixtures with the dye, and excite by lasing source. The wave length of lasing source is matched with absorption range of dye. The fluorescent wave of dye is proportioned to pitch of cholesteric spiral. That is why in such structure the generation of optical radiation is appears. The wave length of generation is matched with edge of photonic spiral. Direct in to the photosensitive elements the radiation is propagated. The wave length such radiation are correspond to pitch of cholesteric spiral. The value of spiral pitch directly is depends from the concentration of vapor of harmful substance, which are passed through the selective membrane. The maximum of spectral sensitivity of registered photo detectors correspondingly in blue, green and red range of spectrum are placed. Therefore, the values of photo detectors response give the possibilities to determinate the wave length of falling radiation. The changing of such radiation is informed about the availability of harmful substances.

II. CONCLUSION

The concentration changing of vapor of harmful substances leads to changing the spiral pitch, and caused to shift of photonic forbidden zone and as the result of such process the changing of wave length of generation is occurred.

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