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INVESTIGATION OF MULTIPHOTON RECORDING OF FLUORESCENT MARKS IN LHC-480: PMMA FILMS BY 750-800 NM LASER

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Introduction. Among the various photosensitive compounds, chromone-based organic molecules and compounds have great potential in the development of optical memory systems with luminescent readout. Chromone derivatives contain a chromone ring structure, which is a fused ring system consisting of a benzene ring and a furan ring. From several chromone derivatives the 2-(furan-2-yl)-3-(thiophene-2-carbonyl)-chromen-4-one (LHC-480) were chosen to study due to its unique properties, such as high luminescence quantum yield, long-term chemical stability, and large two-photon absorption cross-section [1]. These molecules can be imbeded into polymer films to create write-once read-many (WORM) archive memory media. Under the influence of ultraviolet radiation, the bond linking the carbon and oxygen atoms within the furan ring of a molecule can be broken, which initiates an irreversible process that transforms the molecule from a non-luminescent form into a final luminescent form. The luminescence excitation band of the final form is shifted from the absorption spectrum of the initial non-luminescent form, which enables nondestructive readout [2]. Two-photon recording is a nonlinear process where recording occurs only when a certain threshold value of laser radiation intensity is exceeded. This mechanism allows for high-precision localization of the recording radiation and provides high-resolution information recording [3]. The spectral-luminescent properties of Chromones can be different for single-photon recording and multiphoton recording. For example, in single-photon recording with radiation from the 355 - 365 nm range, an isomer is formed that luminesces in the 480 - 580 nm wavelength range. In contrast, multiphoton recording with laser radiation in the spectral range of 532-600 nm leads to the appearance of an additional stable shorter-wavelength band (440-470 nm) of luminescence [4]. These differences indicate the existence of at least two different fluorescent forms of the studied compounds [5]. Further investigation of the mechanisms and dynamics of phototransformation of chromone derivatives under different recording parameters will help in selecting optimal parameters of the recording laser source and improving the understanding of the light-sensitive compounds and their properties, which is crucial for the development and optimization of data recording devices for optical memory systems.

Main part. The main part of the study involved preparing LHC-480: PMMA polymer films on glass substrates using two methods: spin coating and solution casting. Single photon recording of luminescent marks was achieved using an Ultraviolet laser diode with a wavelength of 365 nm. The luminescence spectrum of the recorded marks was measured. Multiphoton recording of fluorescent centers in the films was carried out in a rectangular grid pattern using the second harmonic generation of a fiber femtosecond laser with a central wavelength of 770 nm and a pulse duration of about 700 fs. The luminescence spectrum of the recorded marks was also measured and analyzed.

Conclusion. In this study we analyzed the luminescence spectra obtained under various excitation conditions and recording parameters. The presence of a shorter-wavelength band (440-470 nm) of luminescence under different recording parameters was examined. Thus, the possibility of obtaining multiple fluorescent forms of the compound under the experiments conditions was checked.

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