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The study of the lifetime of ZnS-based luminescent films by using the devices of LMS series

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Abstract. The development of the device to measure the lifetime of ZnS luminescent films with different dopants has been presented. The devices have been designed to operate under semi-automatic (LMS 01) and program mode (LMS 02) of measuring the parameters of films with setting the input ones. The data are transmitted to a computer and processed by a specialized program that, in its turn, controls the operation of the device, on the whole.

Keywords: thin film, device, luminescence, ZnS, intensity of light.

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Recently the devices based on thin luminescent films have acquired a wide development and spreading. First of all, these are multi-colored flat luninescent panels. The basic material for films is ZnS [1–3] that is doped by various impurities of ions, for example Mn^{+2}, Cu^{+2}, which causes the change in the colour of the films luminescence. One of the most important characteristics of luminescent films is the lifetime of illumination, or aging of films [3]. When performing these studies, the problem of arranging the studies themselves, that is the problem of using such a device that would give a possibility to observe changes in the luminous intensity of films in a real time scale is of great importance. The application of various devices unadapted to carry out these studies directly, for example candelometers, is rather complicated at large time intervals and with a great number of the fims under investigation. The investigator feels a particular inconvenience when he wants to elucidate the character of luminescent films aging followed by recording the data and conducting a statistical processing of the results of studies.

In this work the device to perform researches connected with the lifetime of luminescent films is proposed.

The result of joint work of the authors' team was the development of a series of devices under the title of LMS in two versions. The outward appearance of the devices LMS S12-01 and LMSS12-02 is depicted in Figs 1 and 2, respectively. The given devices measure the luminous intensity of films after the preset time interval. The first version measures in a semi-automatic way (the investigator takes off the data himself), the second one is fully automated. The device consists of two units. The elements of controlling the device are located in the first unit, and the films under investigation - in the other one.

The measuring unit realizes the interaction of all functional units of the model. The basic part of the measuring unit is a special cassette for 12 films. It provides a reliable electrical contact of the films under study with the power supply and protects films from external radiation, mechanical deformations and damages during their testing. Under the cassette, the board of the photoamplifier comprising 12 light receivers is located. The structural block diagram of the device LMS 01 is showm in Fig. 3.

Its main difference from LMS 02 lies in the fact that in the latter the control of the device using a microcont-

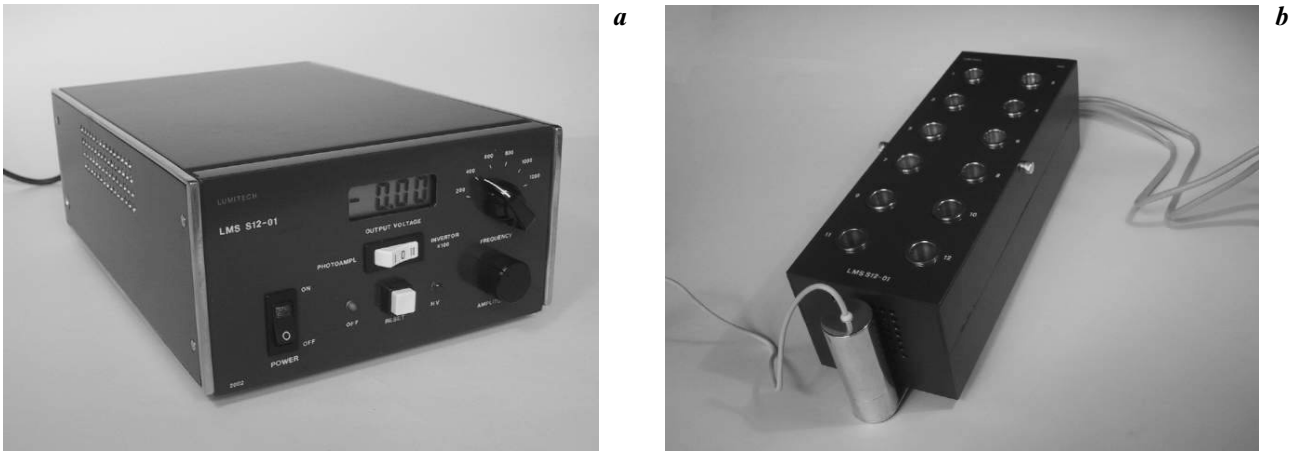

Fig. 1. LMS- 01 device : a) Control unit; b) measuring unit.

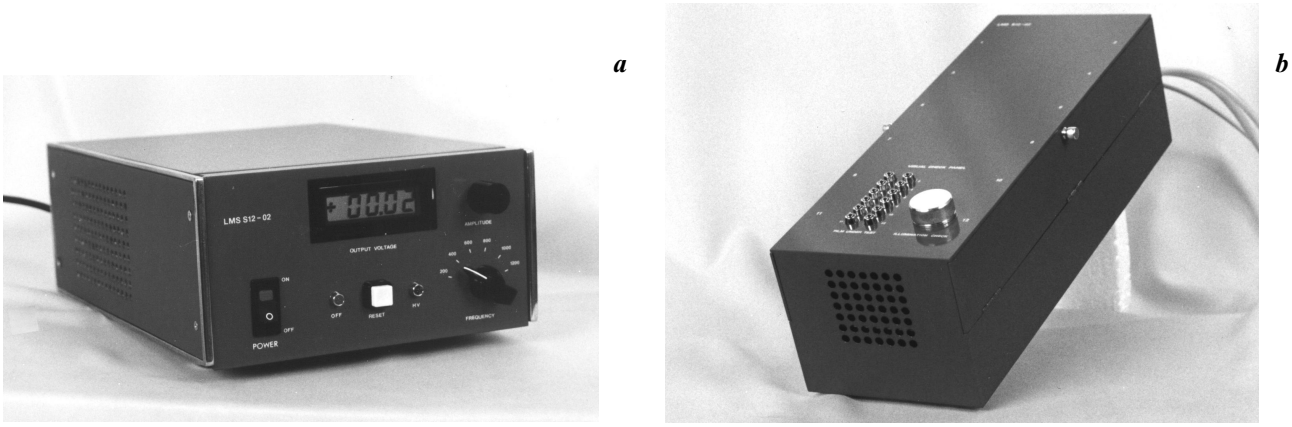

Fig. 2. LMS- 02 device : a) Control unit; b) measuring unit.

roller is realized. This allows one to fully automate the measuring process. Via a built-in port RS232, a microcontroller gets the instructions and sends the measured data to a computer. A specially developed computer program that runs under the operational system Windows 98–2000 controls the measurement process and constructs the plot of dependence of illumination as a function of time.

In the device of series 01, the choice of the film to be investigated is performed by the operator transferring a measuring probe to a special cell with the film. The data obtained via a special input-output card are transmitted to a computer and processed by the program. Besides, in the series LMS-02 the computer program itself optimizes the gain of the photoamplifier that gives a possibility to obtain a larger dynamic range of the gain. The device of series 02 also allows one to set a constant time interval after which a fixed point on the plot of dependence of the luminous intensity as a function of time will be derived.

Before the beginning of measurements, the investigator specifies the following parameters – voltage magnitude and its frequency. These parameters will be stored in the files of a computer alongside with the measurement data later on.

The manufacturing method for luminescent films was based on the serigraphy one. The packet structure for studies is described in [4] and it is routine for such investigations.

Using the proposed device, a lot of films at different parameters of measurements were tested. By analyzing the experimental data, one can make a conclusion about a gradual decrease in the luminous intensity of the most of electroluminescent films prepared for all the films having a different composition with the time of operation which makes up some ten thousands of hours [1]. The typical curves of the change in the luminous intensity of films depending on time are shown in Fig. 4. The approximation of the glowing curve by a mathematical dependence gives dependences, shown in Fig. 4. This gives a possibility to construct models and project output parameters of luminescent films beforehand by varying their operating modes and manufacturing methods.

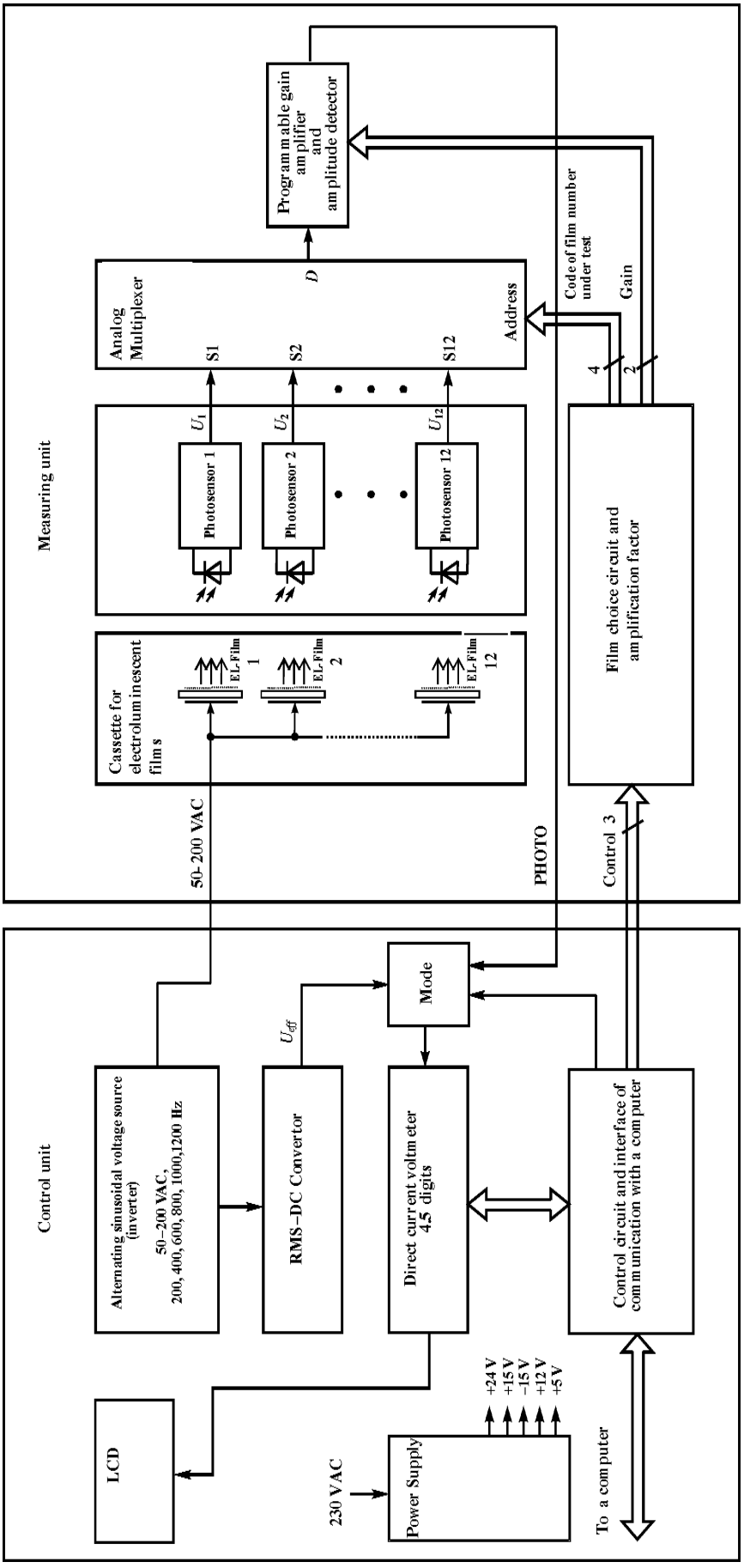

Fig. 3. Block-diagram of LMS-02 .

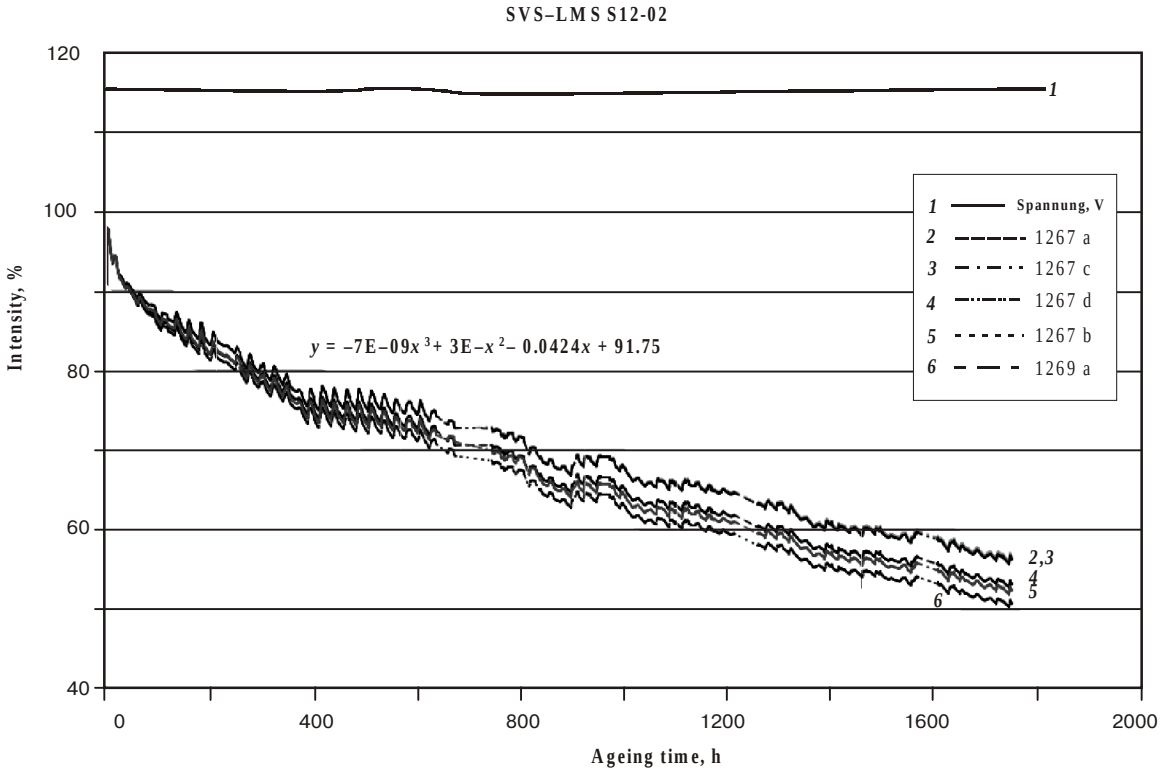

Fig. 4. Typical lifetime curve of ZnS film and approximation functional. A result was obtained with LMS series device.

Conclusions

Thus, the proposed devices that control parameters of luminescent films under the computer-based mode allow one to observe the change in the luminous intensity during a certain time, which gives a possibility to make an analysis and conclusions on their likely use in different electronic and optoelectronic devices in future.

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