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INFLUENCE OF THE TRANSMISSION PROCESSES UPON THE BACKGROUND BRIGHTNESS AND RELATION BETWEEN THE DARK AND BACKGROUND SCINTILLATIONS OF ELECTRO – OPTIC TRANSFORMER

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Abstract: *The background brightness is a parameter which is defined by the thermo-electronic system of the photo cathode and the level of the external influences – auto electronic and auto ionic emission, ionizations and stimulation of atoms from remaining gases, optic reverse relation screen – photo cathode, etc. Evaluation of the influence of the above mentioned processes is defined when examining the amplitudes and temporary spectres of the scintillations on the electro – optic transformer screen. The relation between the multi – electronic scintillations and the process of ionization exchange and ionization of the atoms, absorbed by the electrostatic lens under the influence of the electronic field shows a sudden increase of one or two times of the background brightness which is defined on account of the auto electronic emission.*

Key words: *electro – optic transformer*

Methods are proposed about measurement and evaluation of the emission processes influence upon the background brightness of the electro-optic transformer (EOT).

The background brightness is conveniently presented by the values of the photo cathode illumination and the density of the photo cathode dark electricity which corresponds to this illumination is calculated when the photo cathode integral sensitivity is known. To increase the accuracy of the dark electricity evaluation when measuring the illumination of the photo cathode, it is necessary to decrease the effects of the external influences upon the work of the electro-optic transformer as an optic reverse relation, which is provoked by reflection of assembly pieces through the photo cathode, reflections and ionic reverse relation. For this reason the illuminated area of the photo cathode is limited to 10% of the work site.

The electricity density from the thermo – electronic emission at the photo cathode of the electro-optic transformer can be calculated in two ways: by the method of counting the scintillations, provoked by the thermo – electronic emission and the method of density evaluation of the background at decreased accelerating pressure.

When measuring the thermo electronic emission by the method of counting single electrons from the photo cathode, it is necessary to give an account of the proportion between the constant screen illuminations and the constant integrated charge scintillations at the registering apparatus.

To value the influence upon the brightness of the background from the processes of ionic – electronic emission of the photo cathode, it is necessary to analyze the amplitude spectre of the multi – electronic scintillation from the work site.

One of the main parameters of the EOT is background brightness which is defined by the photo cathode thermo-electronic emission and the level of external influences – autoelectronic and autoionic emission, ionizations and atom stimulation from remainder gases, optical reverse connection screen – photocathode, etc. The evaluation of the above mentioned processes is defined by research of the amplitudes and temporal spectres of the EOTs screen scintillations. A research of the EOT parameters is carried out in [4, 7, 8]. The connection between the multielectronic scintillations and the process ionization and ionization of the atoms, which are absorbed by the electrostatic lens by the influence of caused by the thermoelectric emission and by the method of density evaluation of the background brightness at reduced accelerating voltage of EOT.

the electric field, is presented in [2, 6]. Research of electric emission influence is carried out in [3]. The abrupt raise of the background brightness by one or two units is defined at the expense of the autoelectronic emission.

Methods are proposed for measurement and evaluation of the emission processes upon the background brightness of the EOT.

The background brightness of the EOT is conveniently expresses by the values of the photocathode illumination [5] and the density of the photocathode background electricity which corresponds to this illumination, is calculated when we know the integral sensitivity of the photocathode.

To increase the accuracy of the electricity evaluation when measuring the photocathode illumination, it is necessary to decrease the external influences upon the work of the EOT as an optic reverse connection, which is induced by reflection of parts when mounting them, by illuminations that go through the photocathode or ionic reverse connection. For this particular aim, the illuminated area by the photocathode is decreased by 10 % from the work site [1].

The electricity density of the thermoelectric emission from the EOT photocathode is measured by two methods: by the method of counting the scintillations which are

When measuring the thermoelectronic emission value by the method of counting the single electrons from the EOT photocathode, it is necessary to count the correlation between the constant illuminations of the screen and the constant integrated charge scintillations of the registering appliance. For registration of the scintillations, appliance [1] is used.

The amplitude spectre of multielectronic scintillations from the work site is analyzed to evaluate the influence of the background brightness from the processes of the ion-electronic emission of the photocathode which evoke multielectronic scintillations. The photocathode background electricity density of the multielectronic scintillations is evaluated by their integral number, calculated by the average scintillations amplitude.

When the electricity values from the thermoelectric emission and the electricity from the multielectronic scintillations are defined, the influence of these processes upon the level of the photocathode background torrent is defined and the appearance of an additional emission in the EOT is specified. To specify the illumination level, which arises in the EOT and goes to the photocathode, the EOT photocathode is stuck with the registering EOT photocathode. The screen brightness of the registering EOT is measured by means of a photo electronic multiplier. To define the spectre of the waves which appear in the examined EOT, changeable interference filters are put between the photocathodes. To define the background brightness of the registering EOT and the existence of diffused light, the screen brightness of the registering EOT is measured when the power supply of the examined EOT is turned on and off.

The background brightness of the examined EOT is evaluated by means of the measuring the radiant flux by the registering EOT. The comparison between the background brightness of the examined EOT with the measured background brightness of the registering EOT gives the possibility to evaluate the influence of radiations, which come along with emission processes upon the background brightness and to compare it with the influence of the additional photocathode emission.

The density values of the background torrent, thermoelectrical current and the current from the multielectronic scintillations, which correspond to currents 10, 12,5 and 15 kV of EOT are represented in Table 1 for four examined EOTs. The thermoelectricity density is within the limits of $2.10^{-16} \ldots 7.10^{-6}$ A/cm.

The background brightness of the photocathode, which is stimulated by the multilectronic scintillations, is multiplied about 10 times with an increase of the accelerating voltage from 10 kV to 15 kV and it is within the boundaries from

Table 1

EOT Number	Accelerating voltage kV	Electricity density, A/cm^2			
		From scintillations x10^{-16}	Background current x10^{-16}	Thermoel. Current x10^{-16}	Additional emissions x10^{-16}
1	10	0,12	5,9	5,9	-
	12,5	0,16	6,3	5,9	-
	15	0,18	7,5	5,9	1,1
2	10	0,29	2,5	2,3	-
	12,5	0,64	3,7	2,3	7
	15	1,3	12	2,3	62
3	10	0,14	4,7	4,2	-
	12,5	0,78	7,2	4,2	1,8
	15	2,2	13	4,2	5,6
4	10	0,79	8,1	7,1	-
	12,5	1,8	13	7,1	6,2
	15	7,8	33	7,1	17

$1,2.10^{-16}$ to 33.10^{-16} A/cm., i.e. it is commensurable with the density of the thermoelectricity.

The measurement of the amplitude spectres of the multielectronic scintillations when the photocathode is darkened, shows that the average amplitude of the multielectronic scintillations correspond to 8 … 12 electronic group at acceleration voltage 10 kV and it is increased till 12 … 16 electronic group at voltage 15 kV.

As is can be seen from the table, the thermoelectronic emission and the processes which induce multielectronic scintillations and an additional emission in the EOT, they also induce single electron scintillations on the screen. By increasing the accelerating voltage from 12,5 to 15 kV, the electricity density of the additional emission increases, and at 15 kV it reaches 50 % form the background electricity density.

The electronic character of the additional emission gives grounds to suggest that the reason for its origin is the photoelectronic emission of the photocathode, which is induced by the great transparency of the screen surface, by the illumination processes which accompany ionization and atom stimulation from the remaining gas in the EOT, as well as from cathode luminescent surface under the influence of the electronic bombing.

On the basis of emission processes analysis, it is necessary to examine if there exists a correlation between the dark scintillations of the EOT at background brightness 10^{-7} cd/m^2 and the background scintillations at background brightness $2,6.10^{-3}$ cd/m^2.

The experiment [1] is used for this reason, and the data from the experiment are represented in Table 2. The data refer to the dark and background scintillations by means of an analogue – digital transformer with a digital indicator and printing output.

Table 2

EOT type "П"			EOT type "В"		
Number	Dark scintillations Q	Background scintillations θ	Number	Dark scintillations Q	Background scintillations θ
1	6	37	1	10	61
2	7	46	2	9	57
3	6	40	3	11	65
4	8	49	4	10	60
5	9	57	5	9	57
6	12	68	6	8	59
7	10	63	7	8	54
8	9	56	8	7	51
9	9	58	9	9	53
10	8	50	10	8	52

On the basis of experimental data, it is necessary to define if there exists a correlation between the number of the dark and background scintillations when examining different types of EOTs. The types "П' and "В" are object of the research. The data about the dark scintillations number are marked by "Q" and the background scintillations are marked by θ in the table. 10 experiments are carried out at corresponding brightness.

The dark and background scintillations values form a system of random values with two-dimensional normal distribution. Their correlation is researched by checking the hypothesis about independence of the correlation coefficient between them $\rho_{Q\theta}$. In the common case the null hypothesis is $H_o : \rho_{Q\theta} = 0$ and the alternative is $H'_o : \rho_{Q\theta} \neq 0$ when using bilateral criteria. To define the correlation coefficient $r_{Q\theta}$, the following formula is used:

(1)
$$r_{Q\theta} = \frac{\sum_{i=1}^{n}(Q_i - \bar{Q})(\theta_i - \bar{\theta})}{\sqrt{[\sum_{i=1}^{n}(Q_i - \bar{Q})^2][\sum_{i=1}^{n}(\theta_i - \bar{\theta})^2]}}$$
,

where $\bar{Q} = \frac{1}{n}\sum_{i=1}^{n} Qi$ и $\bar{\theta} = \frac{1}{n}\sum_{i=1}^{n}\theta_i$, and the result is $\bar{Q} = 8{,}65$ and for $\bar{\theta} = 54{,}65$.

The correlation coefficient is $r_{Q\theta} = 0{,}93$

The statistical authenticity is defined by the formula:

(2)
$$t = \frac{r_{Q\theta} - \sqrt{n-2}}{\sqrt{1 - r_{Q\theta}^2}} = 10{,}64 ,$$

It is proved that t has a Stewdent distribution with number of degrees of freedom

$r = n - 2$, i.e. $r = 18$.

At significance level α and number of degrees of freedom r $t = \left(\frac{\alpha}{2}, r\right)$ is defined. If $t \leq t\left(\frac{\alpha}{2}, r\right)$, the null hypothesis is accepted and it is considered that the values Q and θ are independent, otherwise the null hypothesis is rejected, i.e. the values Q and θ are interrelated.

At significance level $\alpha = 0{,}05$ and number of degrees of freedom r = 18, it is admitted that $t = \left(\frac{\alpha}{2}, r\right) = 2{,}101$.

Because $t > t(0,025; 18)$, the correlation coefficient is significant, i.e. there is a “strong” linear correlation between the dark and background scintillations.

The following conclusions can be drawn:

1. The background brightness is defined by the thermoelectronic, ionelectronic emission, as well as by the additional emissions, which are induced from the EOT’s presence in the autoelectronic processes, accompanied by atom stimulation from remaining gases and cathode-luminescence surfaces. In this connection, the lack of correlation between the background brightness and the multielectronic scintillations quantity is explained.
2. When choosing EOT as an element of an electro-optical appliance for objects observation with dim outline, it is necessary the background illumination level to be very low, i.e. the background scintillations to be reduced to minimum.

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