temperature efficiency decreases proportionally with the increase in the band gap of the main semiconductor material.

Table. Experimentally obtained coefficients of reduction in the efficiency of film PhECs and the width of the band gap of their basic semiconductor layers

Based material	Temperature coefficient of efficiency, rel., %/°C	Band gap width of a semiconductor, eV
CdTe	-0,14	1,44
Amorphous Si	-0,21	1,2-1,3
$CuInSe_2$	-0,36	1,04-1,07

Keywords: photoelectric converters, temperature efficiency, semiconductor material, cadmium telluride.

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EFFECT OF FAST SWITCHING IN THIN FILMS OF CADMIUM TELLURIDE

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To ensure the protection of electric circuits, protection elements of radio electronic equipment (REA) against impulse overvoltages are used. The most important property of protection elements: gas dischargers, semiconductor zener diodes, varistors and limiting diodes is their ability to reduce their resistance Re from $5 \cdot 10^4$ - 10^{10} Ohm to a value significantly lower than the input resistance of the element in a short time τ_{sw} (switching time or tripping time) REA, when the voltage U_i in the circuit exceeds the value of the threshold voltage U_t, which is called the switching threshold or activation threshold [1]. If such protection elements are connected in parallel to the protected device, then when $U_i > U_t$, during τ_s, the amplitude value of the voltage on the device decreases to the value U_t (stabilizers, varistors, limiting diodes) or to a value significantly lower than U_t (gas dischargers). Limiting silicon diodes have become the most widespread, as they have a high speed (τ_s at the level of 1 ns) [2]. However, they can shunt a limited amount of energy and have an interelectrode capacitance of 20 pF, which limits their use for the protection of microwave REA.

Therefore, in order to create protective elements for microwave REA, in this work, the amplitude-time characteristics of switching in thin films of cadmium telluride were studied.

Amplitude-time characteristics of the switching process in the obtained thin films of cadmium telluride were studied according to experimental oscillograms. A qualitative view of a typical oscillogram of an experimental plot of voltage on film samples is shown in Figure 1 (curve 1). This figure also shows a qualitative view of a typical oscillogram of voltage pulses acting on the sample [3].

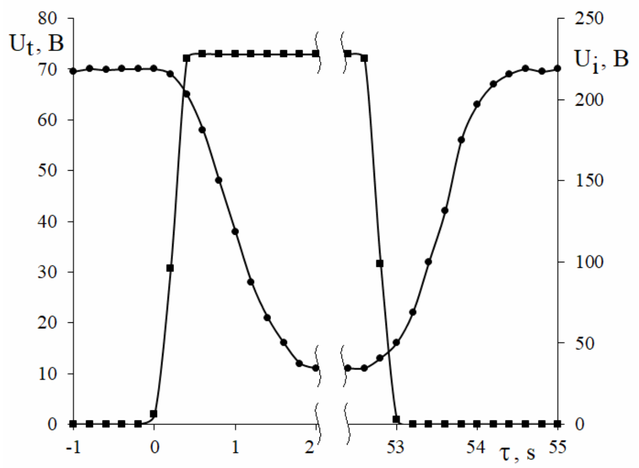

Fig. 1. Typical oscillogram of experimental voltage plot on film samples of cadmium telluride

The determination of the characteristics of the switching process was preceded by the determination of the trigger threshold, which was carried out by applying a rectangular pulse to the samples. This pulse had the minimum amplitude necessary for the first trigger. Then, several measuring pulses with the minimum necessary amplitude for successive activations, which was identified with the value of the threshold voltage U_t, were applied. The results of the research are shown in Table.

The table shows the voltages of the trigger thresholds U_t, the maximum voltages on the samples U_s, the maximum residual voltage on the samples U_{max}, the minimum residual voltage on the samples U_{min}, the switching time to the low-resistance state τ_s. Table 1 also shows the values of the electrical resistance of the samples to direct current R_e after 20-fold impulse exposure with the amplitude U_i. It was established that the magnitudes of the amplitude-time characteristics do not depend on the polarity of the action of the current pulses on the film samples.

Table. Results of studies of amplitude-time characteristics of switching of thin-film samples of cadmium telluride and electrical resistance of these samples to direct current after a series of pulse impacts

d, μm	U_t, V	U_s/U_i, V	$(U_{max}-U_{min})/U_i$, V	τ_s, ns	R_e, Ohm
3	75	42/285	(20-10)/285	<2	$1.7 \cdot 10^5$
3	75	38/71	(20-10)/271	<2	$2.0 \cdot 10^5$
4	70	40/214	(13-5)/214	<2	$1.3 \cdot 10^6$
4	70	50/211	(12-5)/211	2	$7.7 \cdot 10^6$
6	70	52/216	(15-7)/216	2	$5.6 \cdot 10^6$
6	75	51/225	(15-7)/225	2	$5.6 \cdot 10^6$
7	80	55/240	(20-10)/240	<2	$1.5 \cdot 10^6$
7	70	53/219	(20-10)/219	2	$1.7 \cdot 10^6$
8	105	120/316	(40-20)/316	2	$2.3 \cdot 10^6$

It was experimentally established that cadmium telluride layers with a thickness of 3 to 7 μm can be used to create protection elements for ultra-high-frequency radio electronic equipment, since samples representing film layers of cadmium telluride placed in the housing of microwave diodes, when electric pulses of 1 μs duration were applied to them, had switching time at the level of 2 ns and had a capacity of no more than 2 pF. At the same time, the value of the residual voltage could be reduced to 5 V, and the value of the activation voltage could be adjusted by the thickness of the base layer.

Keywords: switching process in thin films, cadmium telluride layer, protective element.

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