[1] A. V. Timofeev and V. I. Pistunovich, in: Voprosy teorii plazmy (Problems in Plasma Theory), No. 5, p. 351, Gosatomizdat, 1967.
[2] L. I. Artemenkov et al. Plasma Physics and Controlled Nuclear Fusion Research (Proc. of II Intern. Conf. on Plasma Physics, Culham, 1965), v. II, p. 45, IAEA, Vienna, 1966.

REGISTRATION OF A GAMMA-RAY PULSE WITH A SEMICONDUCTING DETECTOR BASED ON CADMIUM TELLURIDE

P. S. Kireev and L. I. Kalugina
Moscow Steel and Alloys Institute
Submitted 27 May 1968
ZhETF Pis. Red. 8, No. 2, 73 - 75 (20 July 1968)

Cadmium telluride is presently regarded as the most promising material for the construction of semiconductor detectors of gamma radiation; this explains the intensive research performed on this material by many investigators. The work performed in this direction at the Moscow Steel and Alloys Institute has led to the development of p-n junctions prepared by various methods (diffusion, alloying, ion bombardment).

The junctions have low inverse currents, to 10^{-9} A at inverse voltages to 160 V, and the junction areas are on the order of 0.5 cm^2. When it was found that these junctions are sensitive to gamma radiation, we undertook an investigation of their possible use for registration of rapid processes accompanied by gamma radiation. We chose for the registration the gamma radiation produced upon deceleration, by means of a tungsten target, of electrons accelerated to 30 MeV in the linear accelerator of the Kurchatov Atomic Energy Institute; the p-n junctions were located in the gamma-ray beam. The signal induced in the junction by the incident gamma radiation was fed to a recording system that ensured high-speed sweep of the investigated signal with a two-beam oscilloscope operating in the slaved-sweep mode. One beam was used to record the signal from the investigated detector, and the other to record the comparison signal. The apparatus made it possible to superimpose sinusoidal time markers of frequency 10^8 Hz on the investigated process.

The comparison signal was obtained from a silicon gamma detector with p-i-n structure, capable of obtaining an undistorted plot of a gamma pulse with a time resolution 1 - 3 nsec. Figure 1a shows an oscillogram of the signal recorded with a CdTe detector (lower trace) and the silicon detector. Figure 1b shows similar oscillograms with time markers superimposed.

The signal was picked off a 75-ohm load resistance, with an inverse bias of 600 V applied to the silicon detector and approximately 80 volts on the CdTe detector. It can be concluded from an examination of the oscillograms that the sensitivity of the CdTe detector exceeds that of the silicon detector, and that its temporal characteristics are not worse than those of the latter. This is evidenced by the steeper leading front of the signal. The presence of a plateau on the signal from the CdTe detector is due to the fact that, owing to the relatively small inverse bias applied to the detectors, the conditions for linearity between the voltage picked off the load resistance and the gamma-ray intensity were violated, causing saturation to set in. In the case of the silicon detector, on which the bias was 600 V, the saturation occured at much higher beam intensities.

To check on this assumption, an inverse bias of 160 V was applied to the CdTe detector. As seen from Fig. 2, the form of the signal is similar to that from the silicon detector

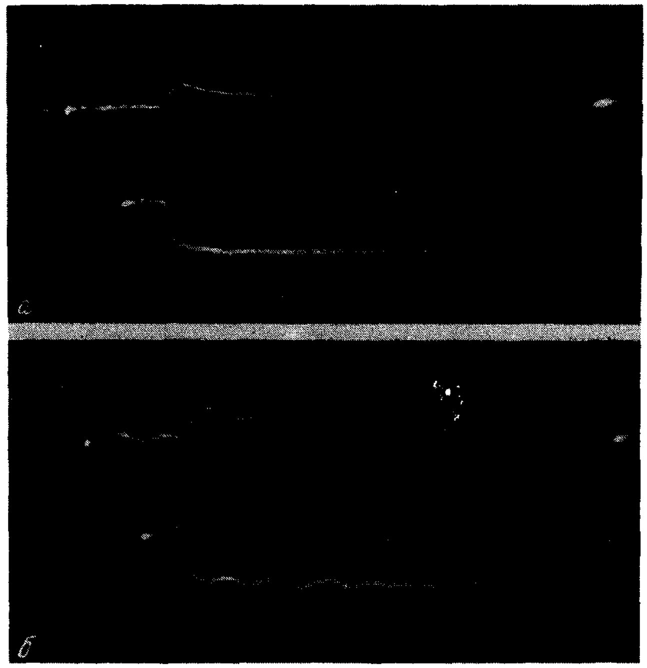

Fig. 1. a) Oscillogram of signals obtained with the aid of semiconductor detectors: upper - with silicon detector, lower - with CdTe detector; b) the same signals with time markers.

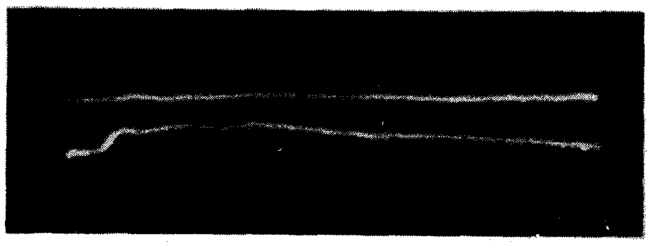

Fig. 2. Lower - signal from CdTe detector with inverse bias ∿ 160 V; upper - beam without detector

(Figs. 1a, b).

Thus, the preliminary results of the investigations confirm the proposed advantages of the CdTe detectors, with respect to sensitivity, over the silicon detectors. They show simultaneously that CdTe detectors can be used to study the temporal characteristics of processes accompanied by gamma radiation. It can be assumed that CdTe detectors will find use for the study of the characteristics of neutron fluxes, especially those of thermal neutrons, including their temporal characteristics. In fact, the isotope Cd^{113}, whose content in natural cadmium is approximately 12%, has a capture cross section not smaller than 3×10^{-21} cm^2 at neutron energies 0.01 - 0.3 eV. This leads to an effective conversion of the neutron radiation into gamma radiation within the volume of the detector. The gamma radiation is registered, in turn, by the detector itself. Such a detector, with controlled sensitivity, may be indispensable in a number of cases.

It should be noted in conclusion that the possibility of investigating the temporal characteristics of detectors was afforded us by I. A. Arkhangel'skii and Yu. A. Brusov, and Yu. D. Bespyatov and M. N. Medvedev helped with the experiment. The detectors were made of material obtained by a staff headed by A. V. Vanyukov. The authors express their gratitude to all, and thank V. S. Vavilov, B. M. Vul, and A. P. Landsman for interest in the work.