Infrared Illuminated CdZnTe detectors with improved performance
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It was found that illumination by IR light with a properly chosen wavelength close to the CdZnTe absorption edge can significantly improve spectrometric characteristics of CdZnTe quasi-hemispherical detectors [1]. IR radiation was noted to influence the detector’s sensitivity, changing the equilibrium between free and trapped carriers and improving charge collection. The positive effect can be achieved at low levels of illumination depending on the wavelength used and detector’s operation temperature. Infrared illumination can be performed using conventional low-power IR SMD LEDs. Different detection probes with CdZnTe quasi-hemispherical detectors from the smallest volumes of a few cubic millimetres to the larger with volumes of 1.5 cm³ and 4.0 cm³ were fabricated and tested.

Quasi-hemispherical CdZnTe detectors [2] have a rather simple design and good spectrometric and operating performances. The quasi-hemispherical detectors are rectangular with a length-width-height ratio of $A \times A \times (A/2)$, have large negative electrode on five sides and a positive dot electrode in the centre of one of the large sides. CdZnTe crystals from Rīdlen Technologies were used to fabricate the detectors. Commercially available CdZnTe miniature detection probes [3] were modified and new detection probes for the large volume detectors were designed and fabricated. The detection probe consists of the CdZnTe quasi-hemispherical detector, the IR LEDs placed near the detector and the charge sensitive preamplifier mounted inside of a sealed housing with permanent attached cable. The LEDs and probe’s preamplifier were powered from the same power source of ± 12 V. Required illumination intensity was set by adjusting the LED direct current. Commercially available IR LEDs with wavelength of 940 nm or 1050 nm were used as IR light sources. During the measurements LEDs direct currents did not exceed 0.6–0.7 mA for the LEDs of 940 nm and 5–12 mA for the LED of 1050 nm depending on the CdZnTe detector used.

The results of measurement obtained with the modified probe SDP500S. Quasi-hemispherical detector volume 500 mm³.

![Graphs and diagrams related to the measurement results.]

MAIN RESULTS

- Modified commercially available CdZnTe probes types SDP110 with detectors up to 60 mm³ and SDP500 with detectors of 500 mm³ and new probes SDP1500 with detectors of 1500 mm³ and SDP4000 with detectors of 4000 mm³ were fabricated and tested.
- Significant improvements of spectrometric characteristics in a wide gamma-energy range under influence of the correct chosen illuminating wavelength and correct adjusted illumination intensity were obtained.
- The degree of improvements was different for different detectors due to the different source materials used in the detectors and their dimensions.
- The low intensity illumination by wavelength of 940 nm was used at room and at the near room temperatures.
- IR illumination by a wavelength of 1050 nm improves energy resolution and stability of the detector at low temperatures.

REFERENCES