Electric field studies on Cadmium Zinc Telluride
(CdZnTe) Materials

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Abstract

Cadmium Zinc Telluride (CdZnTe) has been the focus of intense research in recent years and is regarded as the material of choice for the production of the next generation of X-ray and -ray detectors.

The internal electric field distribution in cadmium zinc telluride (CdZnTe) x-ray and γ –ray detectors strongly affects their performance in terms of charge transport and charge collection properties. In CdZnTe detectors the electric field distribution is sensitively dependent on not only the nature of the metal contacts but also on the working conditions of the devices such as the temperature and the rate of external irradiation.

This work focuses on the direct measurements of the electric field profiles in CdZnTe detectors obtained using the Pockels electo-optic effect at room temperature, at low temperature conditions and under *in situ* X-ray irradiation. These data is also compared with alpha particle induced current pulses obtained by the transient current technique, and the influence of both low temperature and x-ray irradiation on the electric field evolution and charge transport is discussed extensively.

Results from these studies reveal strong distortion of the electric field consistent with the build-up of space charge at temperatures below 250K. Below this temperature the electric field has a severely non-uniform depth distribution, with a high field region occupying ~10% of the depth of the device under the cathode electrode and a low field in the remainder of the device, even in the absence of external irradiation. This distortion is explained in terms of temperature induced band bending at the metal-semiconductor interface, causing the formation of positive space charge in the bulk.

Also, in the presence of X-ray irradiation levels a significant distortion in the electric field is observed even at room temperature, caused mainly by a high rate of photo-induced charge injection. The observed electric field profiles match well the predicted theoretical model.