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Investigation of the crystallographic and detection properties of the CdTe at the ANKA synchrotron light source

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CdTe is widely used as room temperature detector for ⊠- and X-ray detection due to its high atomic number Z (48 and 52 for Cd and Te, respectively) and high density (5.86 g/cm3) which determine high absorption efficiency up to 100 keV for thicknesses above 1 mm [1]. The improvement of the material quality over the last years showed the good performance of CdTe pixel detectors. However, there are still some material issues to be investigated such as the presence of Te inclusions and small inhomogeneities. In addition, when CdTe detectors are illuminated with very high X-ray photon fluxes they experience a degradation effect [2].
In this work we have investigated semiconducting CdTe as pixelated sensor by using some of the available methods at the ANKA synchrotron facility (KIT, Karlsruhe). By combining white beam topography with X-ray diffraction and X-ray fluorescence methods we have characterised the crystallographic properties of the material. The topography results demonstrated the presence of several orientation contrast features that could be assigned to small angle grain boundaries. Those structures are disseminated in whole area of the investigated crystal and they form a network of dislocations inside the CdTe crystal. By means of the X-ray diffraction measurements we have estimated a grain boundary tilting angle around 0.01°.
In view of the possible applications of CdTe at synchrotron facilities, the detector was illuminated with a varying X-ray flux between 1.2 x 106 ph/mm2s and 1.5 x 1010 ph/mm2s than can be expected at synchrotron facilities. The investigated CdTe sensors were processed at the Freiburg Material Research Centre (FMF) starting from a 3 inch CdTe wafer that was delivered from the Acrorad Japanese Company. One is a CdTe detector with M-p-n diode structure. The M layer is the Platinum contact; p is the slightly p-doped CdTe crystal and n is the electrode layer that connects the metallised area of the crystal to the readout electronic. The other detector is a quasi-ohmic CdTe sensor with Platinum electrodes on both sides.

References

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