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Characterisation of the Charge Transport Properties of High-Flux Capable CdZnTe

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The STFC‘s Rutherford Appleton Laboratory (RAL) has been characterising high-flux capable CdZnTe [1]. This detector material has potential use in a number of high-flux industrial applications such as medical and security imaging. The next generation of free electron laser light sources, like the European XFEL or SLAC LCS, also require detectors able to image at high x-ray fluxes and high energies (> 10 keV).

Small CZT detectors were fabricated by Redlen Technologies and flip-chip bonded by STFC to PIXIE ASICs. [2] This ASIC consists of four arrays of 3x3 pixels on pitches of 250um and 500um. Each pixel consists of a charge sensitive pre-amplifier, whose analog output is buffered straight off the chip. An XIA DGF PIXIE-16 system was used to digitise each of the nine analog signals at a rate of 100 MHz, giving a timing resolution of 10ns. The results of digitial pulse shape processing have been used to carry out characterisation of the performance of this CZT material, including the charge transport properties of electrons and holes.

In this paper, the results of rise time and charge collection efficiency measurements as a function of applied bias voltage will be reported. Early measurements suggest that in this material the hole mobility-lifetime is of the order ˜ 10-4 cm2 V-1 and has a hole mobility of ˜ 100 cm2 V-1 s-1; giving a lifetime value that is approximately an order of magntiude greater than previously reported values for spectroscopic grade CdZnTe. The improved charge transport properties of holes suggests that this material will be less suseptable to polarisation effects that have previously been reported to occur at high-fluxes due to hole trapping.

References

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[2] M. C. Veale et al., “An ASIC for the Study of Charge Sharing Effects in Small Pixel CdZnTe X-Ray Detectors,” IEEE Transactions on Nuclear Science, vol. 58, no. 5, pp. 2357-2362, Oct. 2011 https://doi.org/10.1109/TNS.2011.2162746

Primary authors: THOMAS, Brett (Science and Technology Facilities Council); VEALE, Matthew (STFC Rutherford Appleton Laboratory); SELLER, Paul (RAL); WILSON, Matthew (STFC); SCHNEIDER, Andreas (STFC-RAL)

Presenter: THOMAS, Brett (Science and Technology Facilities Council)

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