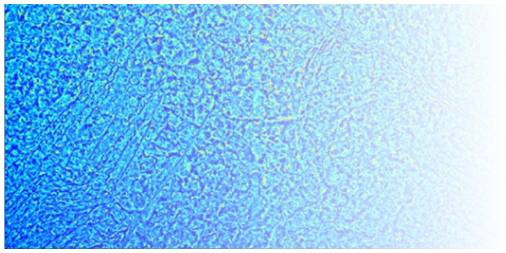

Science & Technology Facilities Council | UK Research and Innovation

Rutherford Appleton Laboratory
21st – 22nd March 2019

Contribution ID: **13** Type: **not specified**

High-Z Detector Development @ STFC. Past, Present & Future

Thursday, 21 March 2019 13:00 (1 hour)

The STFC have been working with high density compound semiconductor materials for over a decade. Our HEXITEC spectroscopic X-ray imaging detector [1] was developed to take advantage of the properties of detector materials like cadmium telluride (CdTe). Since it's conception and thanks to exceptional energy resolution, HEXITEC has gone on to be used in wide variety of applications from materials science at synchrotrons [2] to industrial applications in the fields of security [3] and medical [4] imaging. In the first part of this talk I will review our experience with CdTe, GaAs:Cr and CdZnTe detectors when used with the HEXITEC technology. Key parameters such as energy resolution, charge sharing rates and uniformity will be discussed.

As the HEXITEC technology approaches its 10th birthday, we have recently begun work on a new generation of detector technology. Due for delivery in early 2020, MERCURY builds upon our experience with HEXITEC and compound semiconductor materials and will deliver a spectroscopic imaging system operating at a continuous 1 MHz frame rate. This high frame rate is required to deal with the ×100 increase in flux that is expected at Diffraction Limited Storage Ring (DLSR) synchrotrons which will become commonplace in the next 10 years. The second part of this talk will provide an update on this development and discuss the requirements for the technology. For example, these extreme frame rates necessitate a move away from the CR-RC shaping currently implemented in HEXITEC and a move towards the inclusion of ADCs in-pixel. The MERCURY design also capitalises on our recent work on charge induction in small pixel detectors and the inclusion of a dual-polarity front end will allow correction of charge loss due to depth-of-interaction effects at higher energies [5].

The final part of this talk will look towards our plans for a successor to the Large Pixel Detector (LPD) technology [6] which was delivered to the XFEL.EU in 2017. DynamiX is a proposed small pixel integrating detector for use at XFELs and DLSR Synchrotrons. The technology will have small pixels of < 100 m, operate at a continuous frame rate of 1 MHz and deliver a large dynamic range of the order 105 × 12 keV X-rays. The high frame rate of this camera system has been chosen to match the aspiration to deliver continuous high repetition rate pulses at upgraded FEL light sources like XFEL.EU and LCLS-II. The higher average intensity at these upgraded facilities will mean that sensors will have to endure much higher absorbed radiation doses. This increased radiation hardness requirement and the arrival of high energy instruments (> 12 keV) will drive the need for High-Z systems. The results of recent characterisation of CdZnTe and GaAs:Cr-based LPD sensors at the LCLS FEL that are supporting this development will be discussed [7].

References

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