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Application of 3D MESA Silicon Strip Detector for use in MRT Dosimetry at the Australian Synchrotron.

Microbeam Radiation Therapy (MRT) is a promising preclinical radiotherapy modality that uses micron-sized, spatially fractionated radiation fields to treat radioresistant and otherwise untreatable tumours. A typical MRT configuration consists of arrays of 25-75 μm wide high-dose 'peaks' separated by 100-400 μm wide low-dose 'valleys' that are produced by an x-ray spectrum from a synchrotron light source. A synchrotron light source is essential as the concept of MRT dose delivery requires very low divergence and a high dose rate (>20kGy/s) to deliver treatment doses quickly enough to minimize dose blurring due to motion of the target. The high dose rate, high dose gradients and small field sizes present a challenge for Quality Assurance and dosimetry.

To address these issues CMRP have produced a novel n-type SOI silicon single strip detector (SSD) - the 3D MESA SSD – that aims to improve spatial resolution via construction of an isolated sensitive volume (SV). This is accomplished by using ion plasma etching techniques to remove the silicon surrounding the SV until it protrudes 10 μm above a SiO2 insulating layer. Two options of the 3D MESA SSD have been produced– named 'one sided' (22.5 μm wide) and 'two sided' (36 μm wide). Each option was fabricated with three different lengths of the SV: 50, 100, or 250 μm.

Detector Topology was examined using a scanning electron microscope at the Australian Institute of Innovative Materials (AIIM). Electrical characterisation of samples mounted on Dual-In-Line (DIL) package was performed at CMRP using a Keithley 237 high voltage source measure unit and a Boonton 7200 capacitance bridge to produce IV and CV curves to determine optimal bias and leakage current. Charge collection studies on those samples using Ion Beam Induced Charge Collection (IBICC) with 5.5 MeV 2He4 ions were carried out at the ANSTO ANTARES 10MV tandem accelerator in conjunction with TCAD modelling.

Radiation damage studies, detector bias studies, and acquisition of microbeam dose profiles were performed at the Australian Synchrotron's Imaging and Medical Beamline (IMBL) hutch 2B using CMRP's X-Tream dosimetry system. The impact of charge collection from under the bridge that connects the SV to the readout pad has been studied. Investigation into methods of mitigating and eliminating excess charge collection are presented and discussed.

Electrical and charge collection characteristics, topology, and microbeam dose profiles will be presented in this poster.

Keywords or phrases (comma separated)

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No

Are you an ECR? (<5 yrs</br>since PhD/Masters)

No

What is your gender?

Male

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