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Analysis of Edge and Surface TCTs for Irradiated 3D Silicon Strip Detectors.

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We performed edge and surface TCT measurements of a double sided 3D silicon strip detector at the Jozef Stefan Institute. Double sided 3D devices are a useful counterpart to traditional planar devices. The TCT techniques allow the electric fields in 3D devices to be probed in a way not possible before.

The strip detectors had a substrate thickness of 300 micrometers and a strip pitch of 80 micrometers. The columns, that formed the electrodes, had a diameter of 10 micrometers, and were 250 micrometers deep. The junction electrodes were connected together to form the strips with 20 micrometer wide Aluminium metalisation. The Ohmic electrodes were all connected together on the backside of the device with a uniform contact. The detectors were tested both prior to irradiation and after irradiating to 5 x 10ˆ15 N/cmˆ2. Studies were performed into the effect of varying bias voltage and also the effect of annealing on the irradiated sample. An IR laser (1020 nm for surface, 1060 nm for edge) was used to scan the devices with a FWHM of 8 micrometers. This allowed scans with a resolution of 2.5 micrometers to be performed. The irradiation and edge polishing were completed at the Jozef Stefan Institute in Ljubljana.

The TCT experiment was undertaken in an atmosphere of dry air, with the irradiated samples held at a temperature of -20C. Annealing was achieved insitue by warming to 60C for intervals of 20, 40, 100, 300 and 600 minutes.

The collected charge as a function of position and electric field was obtained for both per and post irradiated devices and after annealing. The rise and fall times of the signal waveforms are compared for different bias voltages and positions. This gives information on the origin of the induced signal, that is the portion from electron or hole motion. The results are compared to simulation.

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