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Edge-on technique using a high energy electron beam for characterisation of irradiated pad diodes

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The charge collection of three 150 μm thick n^+pp^+ pad diodes has been scanned along the diode thickness using a 4.2 GeV electron beam at the DESY II beam test facility. The electron beam enters from the sensor edge and its position along the edge was reconstructed by three planes of a EUDET-type telescope. Compared to the conventional edge-TCT with laser light, the main advantages of using electron beam are: I. The method can be used for pad diodes, II. The results of the measurements can be normalised to an absolute value.

The diodes have an area of 25 mm^2 and a p-doping concentration of 4×10^{12} cm^{-3}. The measurements were performed at -20 °C for bias voltages up to $V_{bias} = 800$ V. One diode was not irradiated while the other two were irradiated with 23 MeV protons to a 1 MeV neutron equivalent fluence of $\Phi_{eq} = 2 \times 10^{15}$ cm^{-2} and 4×10^{15} cm^{-2}, respectively. The result of these measurements is the charge profile as a function of depth for each diode. For the non-irradiated diode, the charge profile is uniform as a function of the depth and independent of the applied bias voltage. For the irradiated diodes, the charge profiles are non-uniform and it changes with the applied bias voltage. The Charge Collection Efficiency (CCE) of irradiated diodes at 800 V was estimated using these measurements to be 0.88 and 0.78 for the lower and higher irradiation fluence, respectively.

In this work, the online alignment and the measurement procedures, as well as charge profiles of three diodes are presented. The results are used for tuning simulation models of charge collection in irradiated diodes and segmented silicon sensors.

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