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Study of bulk damage of high gamma irradiated n+-in-p silicon diodes

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The bulk damage of p-type silicon detectors caused by high doses of gamma irradiation has been studied. The study was carried out on different types of n+-in-p silicon diodes with various silicon bulk resistivities. The diodes were irradiated by Cobalt-60 gamma source to total ionizing doses ranging from 0.50 up to 8.28 MGy, and annealed for 80 minutes at 60℃. The main goal of the study was to characterize the gamma-radiation induced displacement damage by measuring current-voltage characteristics (IV), and the evolution of the full depletion voltage (VFD) with total ionizing dose by measuring capacitance-voltage characteristics (CV). It has been observed that the bulk leakage current increases linearly with total ionizing dose, and the damage coefficient depends on the initial resistivity of the silicon diode. The effective doping concentration, and therefore also VFD, significantly decreases with increasing total ionizing dose. We assume that the decrease of effective doping concentration is caused by the effect of acceptor removal. The Transient Current Technique (TCT) was used to verify the full depletion voltage and to extract the electric field distribution and the sign of the space charge of the silicon diodes irradiated to the lowest and the highest delivered total ionizing doses. Another noteworthy observation from this study is that the IV and CV measurements of the gamma irradiated diodes did not reveal any annealing effect.

Collaboration

Role of Submitter

I am the presenter

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