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Impact of Low-Dose Electron Irradiation on the Charge Collection of n+p Silicon Strip Sensors

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The response of p+n strip sensors to electrons from a 90Sr source was measured using the ALiBaVa readout system. Sensors before hadron irradiation and after a mixed irradiation with 15 1014 1 MeV neq/cm2 23 GeV protons plus 6 1014 1 MeV neq/cm2 reactor neutrons have been investigated. The measurements were performed over a period of several weeks, during which a number of operating conditions were varied. The sensors were fabricated by Hamamatsu on 200 µm thick float-zone silicon. Their pitch is 80 µm, and both p-stop and p-spray isolation of the p+n strips were studied. The electrons from the 90Sr source were collimated to a spot with a full-width-at-half maximum of 2 mm at the sensor and the dose rate at the maximum in the SiO2 was about 0.6 mGy/s. The estimated dose at the end of the measurements was about 1 kGy in SiO2. As function of 90Sr irradiation dose significant changes in charge collection and charge sharing are observed. The effects are significantly larger for the sensors without hadron irradiation. Annealing studies with temperatures up to 80℃ have shown that the observed changes are only partially reversed. The observations are qualitatively explained with the help of TCAD simulations. The relevance of the measurements for the design and the use of p+n strip sensors in different radiation environments are discussed.

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