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Signal simulation under the bias rail in n^+-in-p pixel sensors before and after irradiation

We have developed n^+-in-p pixel sensors with biasing network to provide the reverse bias voltage to individual pixels without bumpbonding a readout ASIC. This is a part of quality control of the pixel sensors in the sensor fabrication process to eliminate those having defective pixels, e.g. inducing the microdischarge. The pixel sensor that has a design with a conductive trace, called the bias rail, running at the boundary between the pixels has shown a loss of track-finding efficiency at the boundary under the bias rail when the device is irradiated with protons. The device has shown little efficiency loss initially. It was shown qualitatively and visually that the loss of efficiency is due to the interplay of electric field in the silicon bulk and the induction of charge to the electrode of constant voltage. In this signal simulation, we have imported the electric fields and the weighting potentials from TCAD calculations. We have evaluated the charges lost to the bias rail from the distribution and drifting of the charge carriers in the silicon. A comparison of the results with or without radiation damage has confirmed quantitatively the loss or little loss of efficiency, respectively.

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