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Development of novel KEK/HPK n(+)-in-p silicon sensors and evaluation of performance after irradiation

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We have been developing highly radiation-tolerant n(+)-in-p silicon planar pixel and microsrip sensors for use in the high-luminosity LHC. Novel n(+)-in-p pixel sensors were made using a combinations of the bias structure of punch-through or polysilicon resistor, the isolation structure of p-stop or p-spray, and the thickness of 320 μm or 150 μm.
The strip sensors and associated test structures were made of the polysilicon resistor and the p-stop isolation structures.
The strip sensors and test structures were irradiated using 70 MeV protons to particle fluences of 5x10ˆ12 to 1x10ˆ15 , and the pixel sensors using 23 MeV protons to 2x10ˆ15 1-MeV neq/cmˆ2.
In evaluating the performance of the irradiated sensors, we have observed a number of effect that we would like to understand: (1) decreased efficiency under the bias rail, (2) increased onset voltage in the punch-through protection structures, (3) decreased potential of the p-stop implant between the n(+) strips,(4) decreased active area in the strip end, etc.
We discuss the common source that may have caused the above observations.

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