

Novel guard ring system design and implementation for detector dicing edge protection and reduced dead area

A new guard system has been proposed based on the experience of the development of Si Mini-Pad detectors. The new GR system is a multi-guard-ring system with segmented n+ implants between them to prevent the punch-through of electric field through the GR's to reach the detector dicing edge. 2D processing and device simulations have shown that with this new GR system, one achieve 1) punch-through protection, 2) reduction of detector dead space, 3) it is detector manufacture/foundry independent regarding the SiO₂ property, and 4) it can increase the detector radiation tolerance to a few times of Mrads. Simulations have shown that in the new GR system, the maximum electric field near the GR edges can be reduced by more than a factor of two, and the dead area can be reduced in the order. Further simulations will be performed to obtain optimum design in terms of n+ segmentation geometry, n+ dose, GR widths and numbers. The next engineering run of the Mini-pad detectors with the improved GR system is underway in the detector foundry, and test results will also presented.

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