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Characterization of silicon n+-p-p+ detectors with Al2O3 passivating layers grown by Atomic Layer Deposition method

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The study focuses on evaluating the characteristics of n+-p-p+ silicon detectors with Al2O3 isolation films processed by Atomic Layer Deposition (ALD) method with a goal of determining the value of the charge density in the alumina layer providing detector stable operation at high voltage. For this, distribution of potentials over the multiple n+ rings implemented in the detector as Voltage Termination Structure (VTS) was studied experimentally. Simulation of the potentials and electric field was applied as a tool to extract the charge density Qf in Al2O3 providing appropriate detector performance.
The results showed: a) applicability of the punch-through model to VTS operation in n-on-p Si detectors; b) impact of the Al2O3 charge on the maximum electric field initiating carrier avalanche multiplication. Simulations allowed to define Qf of -(4-7)×1011 cm-2 as a value critical for VTS operation in the detector under study.

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