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Parametric process optimization for Indium, Gallium and Boron dopants using TCAD simulation modeling

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Radiation tolerance for fluences exceeding 2-3 × 10^{15} n_{eq}/cm^2 in current Low Gain Avalanche Diodes (LGAD) and other intrinsic gain silicon devices, is highly compromised due to gain layer de-activation. Previous studies using Carbon co-implantation or Gallium at the gain layer, have already demonstrated a 20 % improvement and a 20 % degradation respectively. Use of Indium, an implant demonstrated to increase tolerance at solar cell applications, can be considered as an alternative to the above. In this study, a process optimization is performed to evaluate the feasibility of a production yielding same doping characteristics for Indium, Gallium and Boron dopants. The reference profile, against which optimization is performed, is extracted though SiMS measurements on Gallium implanted LGAD gain layer. Using preliminary SRIM calculations, generic parameters are extracted and subsequently translated into multiple process scenarios, simulated thought TCAD Synopsys. With a multi-dimensional fit approach, doping profiles characteristics are evaluated (dose integral, depth, profile shape) and the appropriate process parameters, allowing a uniform profile across all implants, are extracted.

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