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A summary of the radiation resistance of carbonated gain implants

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A new Ultra Fast Silicon Detectors production (UFSD3.2) has been produced by Fondazione Bruno Kessler (FBK) in Trento, in collaboration with University of Trento and National Institute of Nuclear Physics in Turin (INFN); this production aims to improve the radiation resistance of the multiplication layer (gain layer).

Previous FBK-UFSD productions (UFSD2 and UFSD3) demonstrated that the co-implantation of carbon into the gain layer mitigates the acceptor removal mechanism. In UFSD2 and UFSD3, the gain implant has been enriched with carbon in a range of dose 1C-10C [a.u.]. The carbon enrichment showed unexpected effects: the active fraction of boron into the gain implant decreases with increasing carbon dose (carbon-boron capture); the intrinsic radiation resistance of carbonated gain layers is better for carbon dose 1C than higher doses.

In UFSD3.2, a carbon dose in a range 0.4C-1C has been implanted, in the order to identify the optimal carbon dose that maximizes the radiation resistance and minimizes the carbon-boron capture.

In this contribution: we will report a mapping of carbon-boron capture in a range of carbon dose 0.4C-10C; we will show the acceptor removal coefficients measured on gain implants enriched with carbon doses 0.4C, 0.6C, 0.8C and 1C, irradiated with neutrons up to fluence of 2.5E15n_eq/cmˆ2. Our studies show a link between the dose where carbon-boron capture starts and that that makes the most radiation resistant gain implant

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