



Contribution ID: 47

Type: Oral

Investigation on observed charge multiplication in no-gain multipled LGAD region within plasma formation and under low and high intensity injection using femtosecond laser at ELI

Tuesday 28 February 2023 17:35 (20 minutes)

We report an experimental investigation on charge multiplication in a no-gain (inter-pad) region in a multipad Ultra Fast Silicon Detector (UFSD). The UFSD sample we measured is not a standard segmented UFSD that is now accepted as CMS LGAD. It is a sample that has been produced in the Ti-LGAD RD50 production batch. Furthermore, this UFSD is not a trench LGAD (Ti-LGAD). This tested UFSD has 49 microns of inter-pad distance, and as isolation structures, it uses a guard (bias) ring with 2 p-stops. The JTE is employed as a termination structure. The non-irradiated, investigated sample has been subjected to a femtosecond laser at the ELI ERIC, Eli Beamlines, in Prague. Charge multiplication is observed as strong enhancements in the charge collection distribution. Very strong dependence on bias and charge intensity injection (deposited energy) has been observed. It was found that the observed enhancements in charge collection in the inter-pad region where no gain layer is present, significantly increases with increased bias and with increased laser power. Those enhancements, are understood as a charge multiplication in inter-pad region and explained as the results of the impact of a strong electric field near the p-stops, that is further enhanced by the design of an isolation structure and consequently, by the processing parameters chosen in IP design: the distance between JTE and p-stop, and the distance between two p-stops where a grid (bias) ring is inserted.

Intensity of laser pulses and the rate of charge injection allow the plasma formation in inter-pad region, therefore, the observed charge multiplication must follow the additional underlining mechanism that differs from the one that usually leads to the reduced impact ionization (due to charge density induced electric field screening). Contrary to expectations, for the case we observed, the impact ionization is enhanced with increased plasma density.

An extensive and systematic study that will cover different UFSD prototypes is currently a work in progress, and through covering a large pool of measured samples, we will be able to give a more conclusive answer.

Beside the observed charge multiplication under plasma regime in no-gain region in non-irradiated LGAD (without defects inside that would facilitate the impact ionization), we also emphasize here the accuracy of our methodology and precision on measured inter-pad distance that is achieved with TCT set up developed at the ELI Beamlines, Extreme Light Infrastructure ERIC.

In general, this work contributes to R&D on segmented n-on-p sensors and the acquired knowledge is also transferable to future development of any picosecond avalanche detectors required for FCC.

Primary authors: Prof. LASTOVICKA MEDIN, Gordana (University of Montenegro (ME)); Dr MATEUSZ, Rebarz (ELI Beamlines, Extreme Light Infrastructure ERIC); Dr KRAMBERGER, Gregor (Jozef Stefan Institute in Ljubljana)

Co-authors: DOKNIC, Jovana (University of Montenegro); Dr ANDREASSON, Jakob (ELI Beamlines, Extreme Light Infrastructure ERIC); Dr LASTOVICKA, Tomas (ELI Beamlines, Extreme Light Infrastructure ERIC); BOZOVIC, Ivona (University of Montenegro)

Presenters: Prof. LASTOVICKA MEDIN, Gordana (University of Montenegro (ME)); LASTOVICKA MEDIN, Gordana (University of Montenegro (ME))

Session Classification: LGAD

Track Classification: LGAD