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Characterization of Novel Trench-Isolated LGADs for 4D tracking

Silicon detectors are crucial for charged particle trajectory measurements with high precision. They provide high spatial granularity using pixels, strips and are ubiquitous in High Energy Physics (HEP) experiments. In recent years, Low Gain Avalanche Detectors (LGADs) have shown the capability of timing measurements in the tens of ps range, giving a possibility to make ultra-fast silicon detectors (UFSD). The low gain is sufficient to perform precise particle time measurement. However, the segmentation still provides hindrance in achieving 100% fill factor (FF) for many applications and to use LGADs as 4-dimensional (4D) tracking devices. The new LGAD design based on trench isolation technique (TI-LGAD) is very promising in reducing the inter-pixel distance and hence increased FF which in turn makes them capable of 4D tracking. This contribution describes the features of a new TI-LGAD sensors production by FBK, in which the no gain region is reduced significantly by replacing Junction Termination Extension (JTE) and p-stop implant with slender trenches. A new R&D batch was produced in FBK within the RD50 collaboration, in which several structures and process splits are implemented. This batch enables a systematic study to select the best process and layout. In this work, we will present the isolation between pixels, and the dead area between pixels for various structures. We characterized the structures using pulsed IR/Red laser and measured the Inter-Pixel Distance (IPD) for different border geometry. We achieved an IPD of about 3 microns which is significantly lower than any previous LGAD technology. The main aim of this contribution will be laser characterization to look for enhanced FF for 4D tracking.

Primary author: BISHT, Ashish (University of Trento, Fondazione Bruno Kessler)

Co-authors: BORGHI, Giacomo (Fondazione Bruno Kessler); BOSCARDIN, Maurizio (Fondazione Bruno Kessler); CENTIS VIGNALI, Matteo (Fondazione Bruno Kessler); FICORELLA, Francesco (Fondazione Bruno Kessler); HAMMAD ALI, Omar (Fondazione Bruno Kessler); PATERNOSTER, Giovanni (Fondazione Bruno Kessler)

Presenter: BISHT, Ashish (University of Trento, Fondazione Bruno Kessler)