

## Design, electrical properties and fabrication method study of a novel 3D-Compound-Shell-Electrode silicon detector

*Saturday, 14 December 2019 14:20 (1 minute)*

In this work, a novel three-dimensional (3D) structure of silicon detector: 3D-Compound-Shell-Electrode detector (3DCSED), based on the 3D-Trench-Electrode detector and 3D-Open-Shell-Electrode detector (3DOSED), is proposed. In a 3DCSED, an open trench electrode will be etched about 10% of the detector thickness from the bottom side of the detector to meet the close trench electrode etched about 90% of the detector thickness from the top side. This ensure not only the unit structure be stable in the fabrication process, but also the detection efficiency can be guaranteed through the optimization of the electrode structure comparing to the conventional 3D-Trench-Electrode detector. In order to optimize the 3DCSED structure, it is important to study 3DCSED's electrical properties to determine the detector's working performance by full 3D technology computer-aided design (TCAD) simulations. From the electric field distribution results, detector charge collection efficiency has been improved by optimization of the detector trench electrode, and the trapping problem in the detector bulk has been solved. Due to the highly doped trenches, each pixel cell is isolated to ensure a uniform electric field distribution, but electrically and physically connected with each other through the remaining silicon bulk between broken electrodes. Furthermore, the current-voltage (I-V) characteristics, capacitance-voltage (C-V) characteristics, charge collection property, and full depletion voltage have been analyzed to study the detector's properties under heavy radiation environment for high energy application. Last but not least, in this work, we propose a method to fabricate the 3DCSED. In this method, the deep etching is processed by Deep Reacting Ion Etching (DRIE) or laser wit respective processing procedures.

### Submission declaration

Original and unpublished

**Primary authors:** Dr LIU, Manwen; Prof. LI, Zheng

**Presenter:** Dr LIU, Manwen

**Session Classification:** POSTER

**Track Classification:** Pixel sensors for tracking