Contribution ID: **12** Type: **Oral**

Radiation tolerance study using test-structure diodes from 8-inch silicon sensors for CMS HGCAL

Tuesday, 28 February 2023 14:05 (20 minutes)

The CMS detector will be upgraded to face a nearly 10-fold increase in integrated luminosity for the High-Luminosity LHC era compared to that of the current LHC Runs 1-3 combined. It will be adapted to the higher levels of radiation and larger amounts of data collected. The endcap calorimeters of the CMS detector will be replaced by the High-Granularity Calorimeter (HGCAL). The HGCAL will facilitate the use of particle-flow calorimetry with its unprecedented transverse and longitudinal readout/trigger segmentation, with more than 6M readout channels. Silicon pad sensors will be used for the electromagnetic section as well as for the high-radiation regions of the hadronic section of the HGCAL (with fluences above $10^{14} n_{eq}/cm^2$), covering a total area of 620 m^2. In the highest radiation regions, fluences up to $10^{16} n_{eq}/cm^2$ and doses up to 1.5 MGy are expected. The silicon sensors are processed on novel 8-inch p-type wafers with three different thicknesses (300 μm, 200 μm, 120 μm), cut into hexagonal shape for tiling and for optimal use of the wafer area. Each sensor is segmented into several hundred cells of hexagonal shape of 0.5 to 1.1 cm^2 in size, each of which is read out individually. In addition to the main sensors, the full wafer hosts small sized test structures used for quality assurance and radiation-hardness tests. In order to study the radiation-induced bulk damage, the test structures were irradiated with neutrons at two institutes: JSI (Jožef Stefan Institute, Ljubljana), with a well-known neutron spectrum and fluence calibration and RINSC (Rhode Island Nuclear Science Center), a novel neutron irradiation facility that can host full 8-inch wafers. We present the results of a radiation-tolerance testing program of the bulk material of HGCAL prototype silicon sensors performed with irradiated test structure diodes. The talk will focus on the electrical characterisation and charge collection measurements, isothermal annealing behaviour of the bulk material and the comparison of the results between diodes irradiated at the different irradiation facilities. The measured results are compatible with previous studies and in line with expectations. We observe expected behaviour of the electrical properties and the charge collection efficiency is in agreement with the HGCAL specifications. The results can also be used in simulation studies for establishing an operating and annealing scenario for HGCAL.

Primary author: KALUZINSKA, Oliwia Agnieszka (KIT - Karlsruhe Institute of Technology (DE))

Co-author: KIESELER, Jan (CERN)

Presenter: KALUZINSKA, Oliwia Agnieszka (KIT - Karlsruhe Institute of Technology (DE))

Session Classification: Planar sensors

Track Classification: Planar sensors