

## Annealing of radiation defects in 8" silicon sensors for CMS HGCAL

To withstand the much higher radiation levels resulting from a tenfold rise in integrated luminosity at the High-Luminosity LHC, the CMS experiment will upgrade its existing endcap calorimeters (CE) with the new High Granularity Calorimeter (HGCAL). This detector will enable particle-flow calorimetry through its exceptionally fine transverse and longitudinal segmentation for both readout and triggering, providing over six million readout channels. The electromagnetic compartment and the high-radiation zones of the hadronic section will employ silicon pad sensors, collectively covering a surface area of 620 square meters. The system is designed to endure particle fluences up to  $1.5 \times 10^{16}$  neq/cm<sup>2</sup> and radiation doses reaching 1.5 MGy.

The sensors are fabricated on 8-inch p-type silicon wafers with active thicknesses of 300  $\mu\text{m}$ , 200  $\mu\text{m}$  (both float zone), and 120  $\mu\text{m}$  (epitaxial). They are diced into hexagonal geometries to optimize wafer area utilization and facilitate efficient tiling. To study radiation-induced bulk damage as well as inter-cell effects on the wafer-scale sensors, full sensors –from prototypes to production rounds –were irradiated with neutrons at the Rhode Island Nuclear Science Center (RINSC) up to fluence levels of  $1.4 \times 10^{16}$  neq/cm<sup>2</sup>.

This talk focusses on the electrical characterization (IV+CV) of production sensors of all three thicknesses exposed to  $2 \times 10^{15}$  neq/cm<sup>2</sup>. The study investigates for the first time the isothermal annealing behaviour at 60°C after annealing durations ranging from 10 to 5000 minutes. Hamburg model parameters extracted from the full-sensor data will be compared to single-diode results. The post-irradiation behaviour of sensors with hot regions in the pre-irradiation IV measurements as well as epitaxial sensors with stacking faults in individual cells are investigated.

### Type of presentation (in-person/online)

in-person presentation

### Type of presentation (I. scientific results or II. project proposal)

I. Presentation on scientific results

**Author:** DINCER, Gizem Gul (KIT - Karlsruhe Institute of Technology (DE))

**Co-authors:** SICKING, Eva (CERN); DIEHL, Leena (University of Zurich (CH))

**Presenter:** DINCER, Gizem Gul (KIT - Karlsruhe Institute of Technology (DE))

**Session Classification:** WG3/WP3 - Extreme fluence and radiation damage characterization