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Radiation tolerance and annealing studies using test-structure diodes from 8-inch silicon sensors for CMS HGCAL

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To face the higher levels of radiation due to the 10-fold increase in integrated luminosity during the H-L LHC, the CMS detector will replace the current endcap calorimeters with the new High-Granularity Calorimeter (HGCAL). The electromagnetic section as well as the high-radiation regions of the hadronic section of the HGCAL (fluences above 1.0e14 neq/cm2) will be equipped with silicon pad sensors, covering a total area of 620 m2. Fluences up to 1.0e16 neq/cm2 and doses up to 1.5 MGy are expected. The whole HGCAL will operate at -35℃ in order to mitigate the effects of radiation damage. The sensors are processed on novel 8-inch p-type wafers with an active thickness of 300 µm, 200 µm and 120 µm and cut into hexagonal shapes for optimal use of the wafer area and tiling. With each main sensor several small sized test structures (e.g pad diodes) are hosted on the wafers, used for quality assurance and radiation hardness tests. In order to investigate the radiation-induced bulk damage, these diodes have been irradiated with neutrons at JSI (Jožef Stefan Institute, Ljubljana) to fluences between 2.0e15 and 1.5e16 neq/cm2. In this talk electrical characterisation and charge collection measurements of the irradiated silicon diodes will be presented. The study focuses on the isothermal annealing behaviour of the bulk material at temperatures of 6.5℃, 20℃, 40℃ and 60℃.

Primary experiment

CMS collaboration

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