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Characterization of thin irradiated epitaxial silicon sensors for the CMS phase II pixel upgrade

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The high luminosity upgrade of the Large Hadron Collider (HL-LHC) foreseen for 2022 will allow the experiments at the collider to collect data at a luminosity of 5×10^{34} cm^{-2}s^{-1}, enhancing the discovery potential for new physics.
The precise determination of vertices in the high radiation environment close to the HL-LHC interaction points demands the development of solid state detectors that can withstand unprecedented fluences.

The CMS experiment strategy to overcome this challenge consists in the replacement of the whole tracking system, the so-called phase II tracker upgrade.
The innermost layers of the upgraded pixel detector will experience fluences in the order of $\phi_{eq} \approx 10^{16}$ cm^{-2} after an integrated luminosity of 3000 fb^{-1}.
Several options are under investigation to provide a material and a design still operational after such fluences.
Thin planar silicon sensors are candidates to achieve this goal since they show a less severe degradation of the charge collection efficiency with irradiation than thicker devices.

The University of Hamburg and DESY are carrying on the characterization of highly irradiated epitaxial silicon sensors with an active thickness of 100 μm.
The investigation includes diodes and strip detectors irradiated up to a fluence of $\phi_{eq} = 1.3 \times 10^{16}$ cm^{-2}.
The properties of the diodes are determined through their current- and capacitance-voltage characteristics, while their charge collection efficiency is measured using laser and radioactive sources.
A test beam campaign has been carried out at the DESY II test beam facility to characterize the strip detectors.
A beam telescope has been used to determine precisely the impact position of beam particles on the sensor.
This allows an unbiased measurement of the charge deposit in the strip sensor and reduces the effects of the noise.

In this talk the results of the diode characterization and of the strip sensor test beam are presented.

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