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First tests of a novel radiation hard CMOS sensor process for Depleted Monolithic Active Pixel Sensors

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The upgrade of the ATLAS tracking detector for the High-Luminosity Large Hadron Collider at CERN requires the development of novel radiation hard silicon sensor technologies. Latest developments in CMOS sensor processing offer the possibility of combining high-resitivity substrates with on-chip high-voltage biasing to achieve large depleted active sensor volume. We characterized depleted monolithic active pixel sensors (DMAPS), which were produced in a novel modified imaging process implemented in the TowerJazz 180nm CMOS process (manufactured by Tower Semiconductor Ltd, Israel) in the framework of the monolithic sensor development for the ALICE experiment. The novel process modification implemented in this technology allows full depletion of the epi layer even after substantial irradiation. The designed sensor aims to minimise the capacitive load on the amplifier and enable fast signal collection, in time for the LHC 25ns bunch spacing. Separating the collection well from digital area allows to decouple analog and digital electronics to further minimize capacitance and prevent cross-talk. The radiation hardness of the charge collection to Non Ionizing Energy Loss (NIEL) has been characterized for the different pixel sensor cell designs. The talk focuses on the charge collection properties measured in the laboratory using radioactive sources, focused X-ray beam tests and in test beams. The talk summarises results on charge collection efficiency and charge collection time measured in the lab and beam tests, local efficiency distribution in the pixel as determined in beam tests with comparisons before and after irradiation. Finally an outlook the design of a full-reticle size CMOS sensors towards ATLAS specifications will be given.

TRACK

CMOS Sensors

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