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CMOS pixel sensors on high resistive substrate for high-rate, high-radiation environments

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The design of fast, rad-hard pixel detectors for future HEP experiments requires drift-based sensor concepts. To achieve this, high resistive bulk material and/or the possibility to apply high voltage to bias the sensor are needed. Commercial CMOS technologies on high resistive substrate are becoming an interesting option for this kind of development. In addition to the possibility of having a depleted volume for charge collection, they provide a comparatively cheap process with high throughput suitable for future large area detectors. Production on 8"wafers allows for wafer scale hybridization processes, without the need of laborious and expensive bump bonding. Both passive and active sensors can be designed.
We will present results on prototype pixel matrices in the LFoundry 150nm CMOS process on a 2kOhm-cm p-type bulk material. Two flavors of active CMOS pixels have been designed, as well as a passive sensor and test structures. Characterization is ongoing both in the lab and in test beams. The sensors show leakage current lower than a few nA per unit volume and breakdown voltage around 120V, before irradiation. Depletion depth is measured to be approximately 120um for bias voltages of 110V. Spectra of radioactive sources have been recorded with the active pixel matrices using 55Fe and 3.2GeV electrons. The results are in agreement with the simulated gain and noise of the readout chain. Samples have been shipped for neutron and x-ray irradiations. Results of the characterization will be shown with particular emphasis on timing performance and radiation tolerance.

Authors: GONELLA, Laura (Universitaet Bonn (DE)); HIRONO, Toko (University of Bonn)

Co-authors: ROZANOV, Alexandre (CPPM, Aix-Marseille Université, CNRS/IN2P3 (FR)); WANG, Anqing (Centre National de la Recherche Scientifique (FR)); HUEGGING, Fabian (Universitaet Bonn (DE)); KRUEGER, Hans (University of Bonn); PERIC, Ivan (KIT - Karlsruhe Institute of Technology (DE)); Mr LIU, Jian (Centre National de la Recherche Scientifique (FR)); BARBERO, Marlon B. (CPPM - CNRS/IN2P3 / Aix-Marseille Université (FR)); WERMES, Norbert (Universitaet Bonn (DE)); BREUGNON, Patrick (Centre National de la Recherche Scientifique (FR)); PANGAUD, Patrick (Centre National de la Recherche Scientifique (FR)); RYMASZEWSKI, Piotr (Universitaet Bonn (DE)); GODIOT, Stephanie (Centre National de la Recherche Scientifique (FR)); HEMPEREK, Tomasz (Universitaet Bonn (DE))

Presenter: HIRONO, Toko (University of Bonn)

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