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ARCADIA MAPS process qualification through the electrical characterization of passive pixel arrays

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In the last two decades several collaborations have been involved with the development of novel Monolithic Active Pixel Sensors (MAPS) technologies [1-2]. The ARCADIA project aims at the design of fully depleted MAPS for HEP, medical, space and X-ray detection applications, that can be produced with a commercial 110nm CMOS production process. Passive pixel arrays have been included in the test structures of the first two engineering runs of the project to evaluate the feasibility and the characteristics of pixels with different pixel pitch and layout. Electrical measurements, namely IV and CV curves, have been used to evaluate the main characteristics of the produced devices in terms of dark current, depletion voltage, punch through current and pixel capacitance, which were rated against the results of TCAD simulations. In particular, we took the dips in the pixels and pwell currents as a reference for the extraction of the full depletion and punch-through voltages, that represent the limits of the operating voltage range. We extracted groups of four samples from specific positions within each wafer and we characterized them from the electrical point of view to obtain information on the variability in the operating voltage range and in the pixel capacitance, reflecting variations in the production process. At the workshop, we will present the results of the characterization of samples extracted from wafers produced in both engineering runs with an active, fully depleted thickness of 48, 100 and 200 µm. The sensors functionality has been confirmed for all the wafers, and the observed intra-wafer and inter-wafer non-uniformities are in line with the expected variability of process parameters. CV curves confirm that, once the full depletion is reached, the main contribution to the pixel capacitance is due to the sensor perimeter, and thus devices with different thicknesses show similar capacitance.

[1] Mager M. ALPIDE, the Monolithic Active Pixel Sensor for the ALICE ITS upgrade. NIM-A 824 (2016) 434–438.
[2] Pernegger H., et al. First tests of a novel radiation hard CMOS sensor process for Depleted Monolithic Active Pixel Sensors. JINST 12 (2017) P06008.

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