Quality assurance tests of silicon microstrip sensors for the Silicon Tracking System in the CBM experiment at FAIR

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The Compressed Baryonic Matter (CBM) experiment aims to explore the QCD phase diagram in the region of high net baryonic densities and moderate temperatures. The core of the CBM experimental setup — the Silicon Tracking System — will consist of 8 stations based on double-sided silicon strip sensors and self-triggered read-out. It will have to cope with large track densities and event rates up to 10^7 s^{-1}, will have to enable high momentum resolution and detection efficiency as well as stand radiation doses up to $1{\times}10^{14}$ n_{eq}/cm^2.

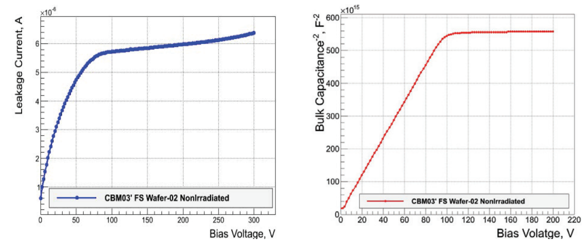
A large amount of sensors (about 1400) will be required to construct the STS. For the proper operation of the system, each sensor requires a number of procedures to ensure proper production and to verify the full accordance to the technical specifications. Local laboratory tests are as important as verification of the technical specifications provided by the manufacturer. These tests will ensure that the sensors will be suitable for the STS detector and will satisfy its requirements. Both these two procedures define Quality Assurance for the Silicon Tracking System, which includes visual inspection, bulk and interstrip parameters measurements, sensor efficiency and total signal to noise ratio tests, measurements of irradiated sensors, low temperature performance and current stability tests. In the following, we report on QA tests of STS prototype sensors with 256 strips per side, 300 μm thickness and 58 μm strip pitch [1].

Bulk measurements — current-voltage (I-V) and capacitance-voltage (C-V) characteristics (see Figure 1) — can serve as basic acceptance criteria. These measurements are a good instrument to assess the quality of the sensor, to verify the manufacturer data and to make sure there has been no damage during sensor manufacturing or handling.

Also, some passive electrical characteristics were measured for different strips of the sensor. These measurements aim to investigate the charge collection and the equivalent noise charge of the sensor. The value of coupling capacitance (Figure 2) allows to judge about the transmission of the signal. The ratio of coupling and interstrip capacitances affects the value of the signal transmitted to the read-out electronics. For these measurements the wafer prober Süss-PA300 was adapted in the clean room with temperature and humidity control.

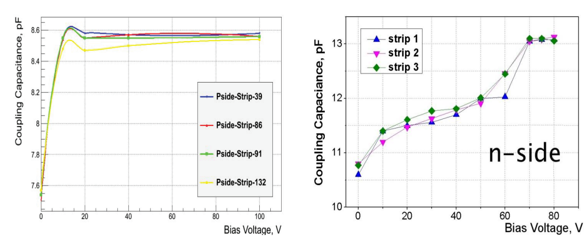
Figure 3 indicates the variation of current-voltage curves for sensors that were irradiated with different fluences. As a part of QA, these measurements were carried out to investigate the sensor's behavior and perfomance after irradiation.

Future QA activities for STS include long-term stability tests, low temperature performance measurements and optimization of the measurement procedures via LabView software.



(a) (b)

Figure 1: Bulk measurements: a) current-voltage; b) capacitance-voltage.



(a) (b)

Figure 2: Coupling capacitance measurements: a) p-side of the sensor; b) n-side of the sensor.

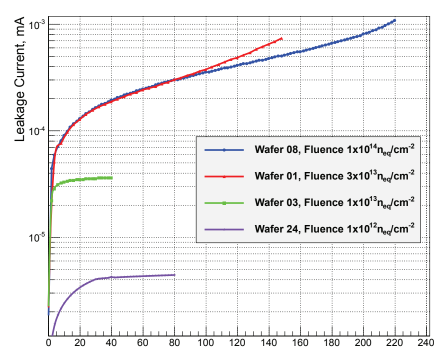


Figure 3: Current-Voltage curves for irradiated sensors.

References

[1] J. M. Heuser *et al.*, CBM Progress Report 2011, Darmstadt 2012, p.17