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Low-Resistance Strip Sensors for Beam-Loss Event Protection

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AC-coupled silicon strip sensors can get damaged in case of a beam loss due to the possibility of a large charge accumulation in the bulk, developing very high voltages across the coupling capacitors which can destroy them [1]. Punch-through protection (PTP) structures are currently used to avoid this problem helping to evacuate the accumulated charge as large voltages are developing [2]. Nevertheless, previous experiments, performed with laser pulses, have shown that these structures can become ineffective in relatively long strips. The large value of the implant resistance can effectively isolate the "far"end of the strip from the PT structure leading to large voltages [3, 4].

In order to overcome this problem we propose to reduce the strip resistance so that the PTP structures can be effective even when the big amount of charge is deposited far from the PTP side of the strip. We have fabricated one batch of "low-resistance strip sensors" by means of the deposition of an Aluminium layer in contact with the strip implants, reducing drastically the strip resistance. One of the technological challenges of this proposal is the creation of the coupling capacitor after the deposition of this aluminium layer, as thermal processes would destroy the Aluminium over about 400 ºC. Several experiments have been performed to optimize the low temperature deposition of the isolation, resulting in a tri-layer made of a sandwich of two Plasma-Enhanced CVD (PECVD) silicon oxide layers with a silicon nitride layer in between [5].

In the conference, results will be presented on these experiments and optimization of the MIM coupling capacitors. Also general performance results from the first Low-R sensors fabricated at the clean room of CNM-Barcelona will be shown (technological parameters, IV, CV). First tests on the PTP structures behaviour will be shown, which indicate that some technological issues should still be solved in order to have a full PTP performance [6]. Results on the tests on other important sensor parameters for this experiment will be presented, like strip resistance, inter-strip isolation, and pulse shape. Initial laser tests emulating the event of a beam loss will also be presented. Finally, the optimization and solutions proposed for the second batch, already in production, will be detailed, together with some new technological proposals to be implemented.

References:
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