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Performance Evaluation of Stitched Passive CMOS Strip Sensors

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The vast majority of foreseen upgrades to existing particle physics detectors, as well as future Linear Collider experiments will continue to be based on silicon sensors as main tracking device. This means sensors will become even more of a cost driver than they already are today. In addition, sensors in the Float-Zone technology currently used in the LHC experiments are available from only a very small number of manufacturers in the large quantities required. Therefore, alternative detector technologies and designs that are cost-effective and that can be realised through widely established commercial industrial production processes are becoming more and more relevant.
One important group of candidates are sensors realised in CMOS technology. Typically, industrial CMOS foundries are equipped for high volume production but fabricating chips that are much smaller in area than in particular the full size strip sensors in production for e.g. LHC Phase-II experiment upgrades today.
In order to obtain sensors in the large dimensions required, several neighbouring reticles have to be connected in a process known as stitching.
The passive strip sensors presented in this contribution were designed and developed in a p-CMOS technology and produced by a European manufacturer. Stitching of up to five different reticles was used on the strip sensors to obtain detectors with strip lengths of up to 4 cm. Sensors in our study comprise three different flavours of strip sensors fabricated on a 150 μm thick wafer made with the passive p-CMOS 150 nm process. Following initial electrical characterisation on a probe station, the sensors were tested in the laboratory with Sr-90 sources and IR-lasers. Results from two batches of sensors are presented in this study, with an improved backside processing on the second batch of sensors to enhance the HV performance of the initial batch. Our results include position-resolved signal and signal-to-noise measurements to understand the behaviour of the sensors. In this context, we also evaluate the impact of stitching on the sensor functionality. Based on our results, we are able to demonstrate that stitching does not show any negative effect on the sensor performance, and, hence, the stitching of CMOS strip sensors can be considered successful.

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