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Slim-edge planar silicon sensors for large-area radiation imaging

We are proposing the development of an improved technology for the fabrication of pixelated silicon planar sensors with slim edge, to minimize the dead area when tiling several sensors to build a large area detector. Slim edges will be obtained through segmented trenches, fabricated with Deep Reactive Ion Etching technique and doped to be electrically active. On the one side, this approach ensures mechanical stability to the wafers, avoiding the need of a support wafer. The process is thus simplified and the fabrication costs are reduced. On the other side, the absence of a support wafer enables flexibility in the backside surface processing (e.g., the possibility of tuning the doping profile), thus offering an enhanced efficiency for low-energy x-rays.
At the same time, optimized guard ring structures will be designed to enable the application of a high voltage bias, necessary for fast and efficient charge collection. The sensors will be designed so that the required operating conditions are met also after accumulating a large dose of ionizing radiation, as high as 1 GGy.
Several photon and particle imaging applications will benefit from this technology, in particular synchrotron and X-ray Free Electron Laser spectroscopy and particle tracking in high-energy physics experiments.
Preliminary experimental results on p-on-n sensors, obtained from a pilot fabrication run developed in the framework of INFN project PixFEL, will be discussed.

Summary

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