New approaches to high energy physics sensors by CiS

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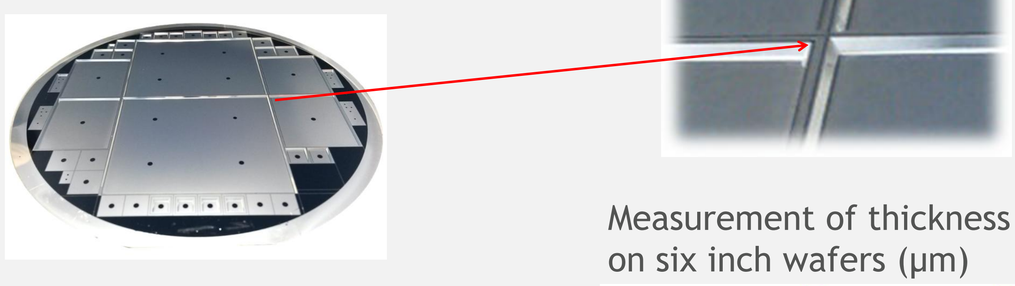
Motivation

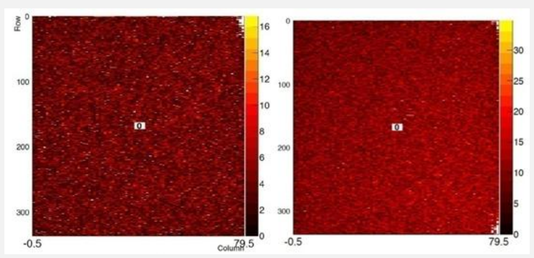
- Sensors for HEP have to be improved to meet the following requirements: better radiation hardness, lower material budget, better local resolution.
- The CiS Forschungsinstitut is contributing by researching in the fields of large area thinned sensors, active edge sensors, trenched and 3D sensors as well as overcoming the punch-through bias grid.

Large area thinned pixel sensors via KOH etching

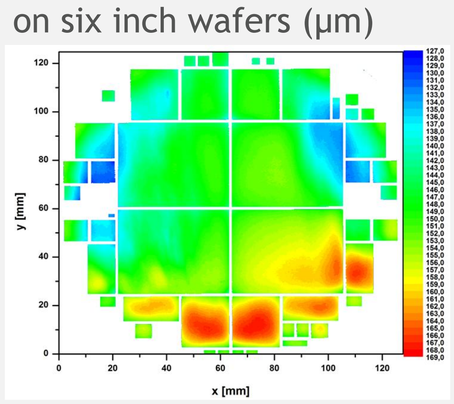


Bump tests

(flip chip done at IZM Berlin data by A.Macchiolo, MPP)

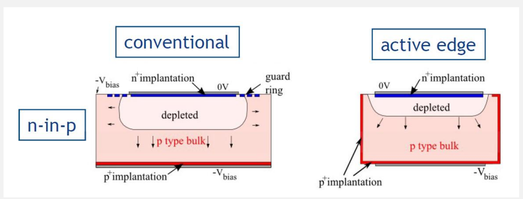


Measurement of thickness on six inch wafers (µm)

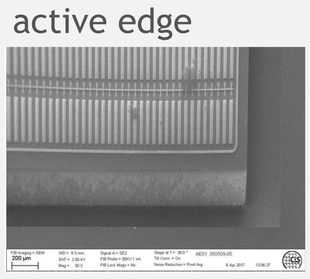


- By thinning the HEP sensors, the material budget of HEP detectors is lowered.
- Thinning of 4“ and 6“ wafers was done from 525 µm down to 100 µm (on 6“ wafers less homogeneous).
- Sensor wafer runs on 4“ wafers successful: With a total yield of 76 % for quad sensors and 94 % for the single chip sensors, this prototype run led to excellent results.

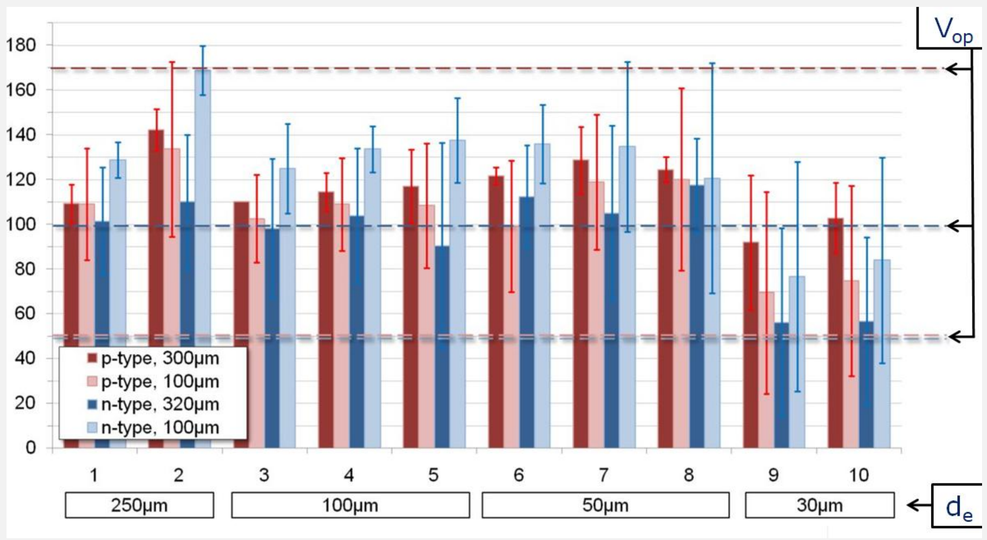
Active Edges



Pixel sensor near the active edge



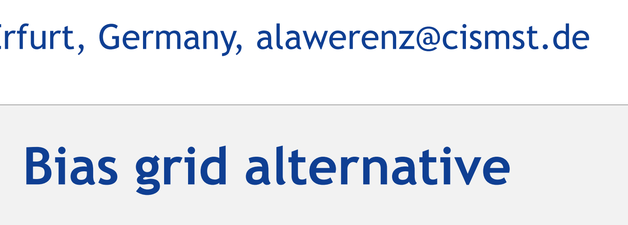
Breakthrough voltage (V)



- Three different doping techniques (ion implantation, plasma implantation, diffusion) for the edge doping succeeded.

Bias grid alternative

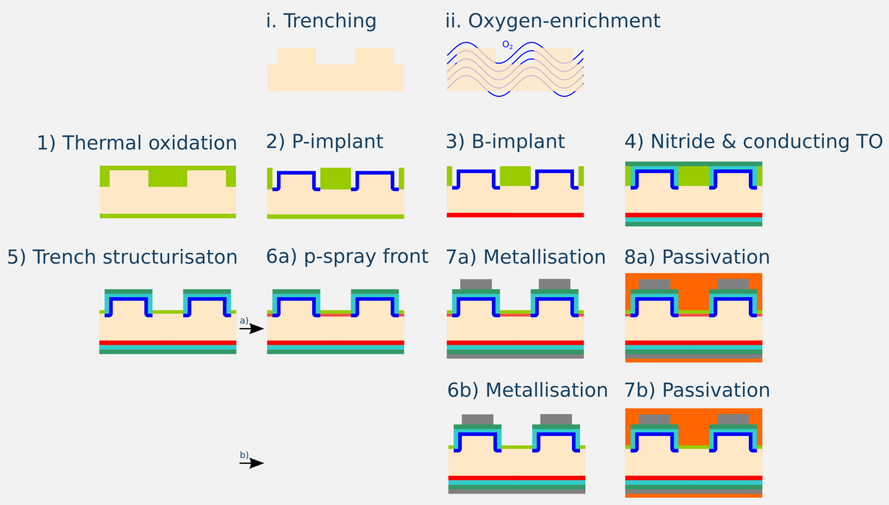
- When in operation, conventional bias grids of sensors (with punch through) lower efficiency and local resolution, esp. after irradiation.
- The solution is a temporary grid with fuses instead of punch-throughs, which are removed via etching after leakage current characterisation.
- The main production is finished, IV-characterisation shows excellent results.
- Bump-bonding with front end chips and analysis with an X-ray source are on the way.



Single chip card with wire-bonded assembly

Trenched planar sensors

- Trenches are serving as 3D-structured isolations between pixels.
- No guard rings are necessary.
- Fast prototyping, variable sizes and geometries are possible.
- A qualification against conventional 3D-sensor technology is planned.



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