Contribution ID: **97** Type: **Oral Communication**

Optimising hybrid pixel detectors sensor layout with 25 µm pitch for the radiation levels of 4th generation synchrotron light sources

Wednesday 3 July 2024 09:30 (20 minutes)

With the evolution of synchrotron light sources to 4th generation (diffraction limited storage-rings), the brilliance is increased by up to two orders of magnitude compared to 3rd generation facilities. For instance, the Swiss Light Source (SLS) is presently undergoing an upgrade to SLS2.0, promising a performance enhancement by a factor of 40.

One of the main challenges arising from the increased flux is the heightened accumulated dose in silicon sensors leading to radiation damage. This translates into an increase of both noise and dark current, as well as a reduction of dynamic range for long exposure times, thus affecting the performance of the detector, in particular for charge integrating architectures. This effect is notably critical for small pixel pitches, such as the 25 µm MÖNCH detector. An optimised design of the pixel implant and metal layers can improve the post-irradiation behaviour. We have designed sensors with a 4x4 mm² pixel array featuring 16 design variations of 25 µm pitch pixels with different implant and metal sizes and tested them bump-bonded to MÖNCH0.3 - a charge integrating hybrid pixel detector readout ASIC.

Following a preliminary assessment of the functionality and performance of the different pixel designs, the assembly has been irradiated with X-rays in our laboratories. The variation of the tested parameters was characterised at different accumulated doses up to 100 Mrad. The annealing dynamics at room temperature have also been tested. The results will inform the pixel design for future full-scale sensors with long-term stability.

Authors: BERGAMASCHI, Anna; ZHANG, Jiaguo (Paul Scherrer Institut); Dr HEYMES, Julian (Paul Scherrer Institut); DINAPOLI, Roberto (Paul Scherrer Institut)

Co-authors: MOZZANICA, Aldo; BRAHAM, Bechir (Paul Scherrer Institut); SCHMITT, Bernd; LOPEZ CUENCA, Carlos (PSI - Paul Scherrer Institut); RUDER, Christian (Paul Scherrer Institut); Dr MEZZA, Davide (Paul Scherrer Institut); THATTIL, Dhanya (Paul Scherrer Institut); GREIFFENBERG, Dominic; FRÖJDH, Erik (Paul Scherrer Institut); BARUFFALDI, Filippo (Paul Scherrer Insitut (Switzerland)); FERJAOUI, Khalil (Paul Scherrer Institut); PATON, Kirsty (Paul Scherrer Institut); MOUSTAKAS, Konstantinos; CARULLA ARESTE, Maria del Mar; BRÜCKNER, Martin (PSI - Paul Scherrer Institut); Dr SIEBERER, Patrick (Paul Scherrer Institut); KOZLOWSKI, Pawel; BARTEN, Rebecca (Paul Scherrer Institut); HASANAJ, Shqipe (Paul Scherrer Institut); EBNER, Simon (Paul Scherrer Institut); KING, Thomas (Paul Scherrer Institut); Dr HINGER, Viktoria (Paul Scherrer Institut); Dr XIE, Xiangyu (Paul Scherrer Institut)

Presenter: Dr HEYMES, Julian (Paul Scherrer Institut)

Session Classification: Sensor Materials & Front-End Electronics