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High-Z sensors for synchrotron sources and FELs

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High-Z compound semiconductors aim to replace silicon as sensor material for X-ray energies above 15 keV thanks to their superior absorption efficiency. However, compared to silicon, high-Z sensors still lack in several aspects such as homogeneity, charge transport properties, charge trapping (leading to polarization and afterglow effects), long ranged fluorescence photons, and others.
The aim of this study is to identify sensor materials that can widen the usable energy range of our detector systems at synchrotron sources and free electron lasers (FELs) towards higher photon energies. Promising results have been obtained using the 75 μm pitch JUNGFRAU charge integrating detector in combination with various high-Z sensors (GaAs:Cr, Ohmic/Schottky type CdTe and CdZnTe). As charge integrating detectors allow the direct measurement of the collected charge of every single photon with a high spatial resolution, these detectors offer interesting insights into temporal as well as spatial sensor effects which affect the charge collection.
As one of the major challenges of the upcoming 4th generation of synchrotrons or FELs are very intense and potentially pulsed photon beams, the sensor material of choice needs to be able to reliably measure highly intense signals and to have no afterglow phenomena after illumination. We performed a measurement campaign at the Material Science (MS) beamline of the SLS using photon fluxes up to 5×10¹⁰ ph/(mm²·s), specifically focusing on the dynamic behavior (like signal stability, polarization and afterglow effects) of various high-Z sensor materials like GaAs:Cr, Ohmic/Schottky type CdTe and CdZnTe. The presentation will give an overview of the results obtained.

Primary author: GREIFFENBERG, Dominic (Paul-Scherrer-Institute)

Presenter: GREIFFENBERG, Dominic (Paul-Scherrer-Institute)

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