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CdZnTe (CZT) as a Material for Detecting Hard X-rays at Synchrotrons and FELs

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The first electrons have circled the newly upgraded Swiss Light Source (SLS) 2.0, a fourth generation synchrotron. Photons with energies > 20 keV will be available at an increased flux compared to the third-generation synchrotron which has been replaced. Specifically, the brilliance will increase by two orders of magnitude. In these energy ranges, Silicon is no longer efficient as a detection material. High-Z (atomic number) semiconductors are required, with GaAs:Cr, CdTe, and CdZnTe (CZT) being suitable candidates. CZT sensors, supplied by Redlen Technologies, have shown the most promising properties with a low leakage current and minimal afterglow transients.

Single sensors ((2×2) cm2) made up of 256×256 pixels with a 75 μm pitch have been bump-bonded to the JUNGFRAU readout ASIC. Developed at PSI, JUNGFRAU is a charge-integrating readout chip with three gain levels and dynamic gain switching. In this talk, we will present and overview of the basic characterisation of Redlen CZT sensors using JUNGFRAU. We will discuss leakage current maps, $\mu\times\tau$ measurements and noise as well as the spectral resolution at 60 keV. A comparison to GaAs:Cr and CdTe will help to provide insight into the advantages of CZT. Finally, we will discuss the future of CZT, including full modules ((8 × 4) cm2) with JUNGFRAU. We will also discuss integration with the new Matterhorn photon-counting readout ASIC (also developed at PSI), which is optimised for electron and hole collection at a high count rate (20 MHz/Pixel).

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Workshop topics

Sensor materials, device processing & technologies

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