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Electron detection with CdTe and GaAs sensors using the charge integrating hybrid pixel detector JUNGFRAU

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JUNGFRAU is a charge integrating hybrid pixel detector developed for use at X-ray free electron lasers. With in pixel gain switching it provides single photon sensitivity down to 2 keV while maintaining a dynamic range of 120 MeV. The pixel size is $75 \times 75 \mu\text{m}^2$ and the largest detector currently in use has 16M pixels. The characteristics of Jungfrau makes it an interesting detector for electron detection, capable of both providing information about the energy deposition of single electrons, in the low flux regime as well as measuring very high fluxes, for example in diffraction experiments, due to the charge integrating architecture. Exploiting the possibility to acquire per pixel information on energy deposition and leakage current it also is a useful tool for sensor characterization.

While Silicon sensors coupled to hybrid pixel detectors show good results up to ~ 100 keV [1, 2], at higher electron energies multiple scattering in the sensor layer reduces the spatial resolution. One strategy to mitigate this is to use a high Z sensor material which gives a shorter track of the primary electron. In this work we compare Si, GaAs and CdTe sensors bump bonded to JUNGFRAU and present results on energy resolution, cluster size and modular transfer function. The measurements were carried out using a 300 keV FEI Tecnai G2 Polara microscope at 100, 200 and 300 keV. We also compare the results to simulations done in Geant4.

[1] J. Mir, R. Clough, R. MacInnes, C. Gough, R. Plackett, I. Shipsey, H. Sawada, I. MacLaren, R. Ballabriga, D. Maneuski, V. O'Shea, D. McGrouther, A. Kirkland, Characterisation of the Medipix3 detector for 60 and 80 keV electrons, *Ultramicroscopy* 182 (2017) 44–53.

[2] G. Tinti, E. Fröjd, E. van Genderen, T. Gruene, B. Schmitt, D. A. M. de Winter, B. M. Weckhuysen, J. P. Abrahams, Electron crystallography with the EIGER detector, *IUCr* 5 (2) (2018) 190–199.

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