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A Novel Energy-resolving High-speed X-ray Camera as a Powerful Tool in the Full-Field X-ray Analysis of Materials and Biological Samples

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A new energy-resolving X-ray camera capable of time-, energy-, and space-resolved measurements has been developed. This new device is built around a high-speed pnCCD detector. A poly-capillary optics can be attached in front of a beryllium entrance window to conduct X-ray photons from the probe to distinct pixels onto the detector. For the detection of light elements, a thinner Be-window can be chosen.

The pnCCD has an active area of 12.7 x 12.7 mm2, 264 x 264 pixels with 48 μm square pixel size. The column-parallel and spilt-frame readout enable frame rates exceeding 400 Hz (equivalent to 28 Mpixel/s) and a maximum count rate of 620 kcps. The spectroscopic performance at this speed is around 150 eV (FWHM) for Mn-Kα. The full depletion of detector volume enables quantum efficiencies approaching 100 % in the 1 keV-10 keV energy range and is still amounting to 22 % for 24 keV photons.
The camera is capable of fast acquisition of spatially and energy resolved fluorescence images. A dedicated software enables the acquisition and the online processing of the spectral data for all 69696 pixels, leading to a real-time visualization of the elements distribution in a sample. We present measurements with synchrotron radiation and laboratory sources showing the camera capability of performing full-field X-ray Fluorescence (FF-XRF), full-field total-reflection XRF (TXRF), X-ray Diffraction (XRD) and X-ray fluorescence Tomography. Examples from applications in biological sciences are also given.

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