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A high energy-resolution pixelated ASIC chip designed for electron and X-ray microscopy

The development of advanced Application-Specific Integrated Circuits (ASICs) for Scanning Transmission Electron Microscopy and X-ray Micro-CT has emerged as a crucial driver for achieving high-precision material characterization. In particular, acquiring 2D distribution of the electrons or X-ray photons along with measuring their energy is desired for imaging the chemical elements at microscale, however cannot be achieved with pixelated detectors currently available. This work presents a monolithic pixel sensor test chip designed for electron microscopy applications, fabricated using 180 nm CMOS technology with a pixel size of 85 μm × 85 μm. Each pixel incorporates a low-noise amplifier, a feedback circuit, and a high-speed analog-to-digital converter (ADC) to ensure optimal performance. The ASIC achieves an energy resolution of 205.2 eV, measured using a Fe-K X-ray at 5.9 keV, and a time resolution of approximately 1.2 ns, enabling precise measurements in key applications such as electron energy loss spectroscopy (EELS), time-resolved imaging and diffraction. This publication introduces several innovative design features of the ASIC, along with its characterization and measurement results, demonstrating its potential to advance the field of electron and X-ray microscopy.

Workshop topics

Applications

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