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Development of an Event-driven SOI Pixel Detector for X-ray Astronomy - Improvement of an Intra-chip Readout Circuit for Low Noise Performance -

We have been developing monolithic active pixel detectors, named "XRPIX"based on the silicon-on-insulator (SOI) pixel technology, for future X-ray astronomy satellite missions. Our objective is to replace X-ray Charge Coupled Devices (CCD), which are now standard detectors in the field. The XRPIX series offers good time resolution (˜1 μs), fast readout time (˜10 μs), and a wide energy range (0.5–40 keV) in addition to having imaging and spectroscopic capability comparable to CCDs. XRPIX contains a comparator circuit in each pixel for hit trigger (timing) and two-dimensional hit-pattern (position) outputs. Therefore, signals are read out only from selected pixels.

In our previous studies, we successfully demonstrated X-ray detection by the event-driven readout. We recently improved the X-ray spectral performance by introducing in-pixel charge-sensitive amplifier circuits and achieved an energy resolution of 320 eV (FWHM) for 5.9 keV X-rays with which Mn-Kα and -Kβ lines are resolved for the first time in the XRPIX series. We found that most of the readout noise can be attributed not to the sense-node but to the readout circuit. Thus, we designed a new prototype in which we modified the intra-chip readout circuits. In this presentation, we report on the recent development and evaluation results of the new device.

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