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Development of a full depleted back illumination sensor based on SOI CMOS technology for future X-ray astronomy satellites

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We have been developing monolithic active pixel sensors based on the Silicon-On-Insulator (SOI) CMOS technology, called XRPIX, for next-generation X-ray astronomy satellites. Compared to CCDs, which are currently used as standard sensors for X-ray astronomy, our devices have much better time resolution of ~ microsecond since they can issue triggers to determine X-ray arriving time. Therefore, we can employ active shields to reduce non-X-ray background (NXB), and can extend the energy range coverage beyond 10 keV, where NXB becomes dominant. We successfully demonstrated the trigger function with our previous prototypes.

We aim to cover the energy range of 0.5–40 keV with XRPIX. For higher energy range, a key is to have thick depletion layers. By using float zone wafer with a resistivity of ~ 7 kOhm cm, we developed a prototype called XRPIX1b-FZ which has a 500-micron thick sensor layer. We found the device is fully depleted with a bias voltage of 120 V and demonstrated its high detection efficiency by irradiating it with various line X-rays. A back illumination (BI) configuration is essential to make the devices sensitive to soft X-rays below 1 keV. We are now fabricating BI sensors based on XRPIX1b-FZ and will test them soon. In this talk, we will present details of our development and will show our recent results.

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