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Optical Blocking Performance of CCDs Developed for the X-ray Astronomy Satellite XRISM

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We have been developing P-channel Charge-Coupled Devices (CCDs) for the upcoming X-ray Astronomy Satellite XRISM, planned to be launched in 2022. While the basic design of the CCD camera (Soft X-ray Imager; SXI) is almost the same as that of the lost Hitomi (ASTRO-H) observatory, we are planning to improve several critical points on the basis of Hitomi's in-orbit data. One of the largest problems recognized in the Hitomi data is so-called light-leak events, which were only found in the data taken during time when the backside of the spacecraft is toward the day earth. The main light paths are originating from holes opened for other instruments on the back plane of Hitomi. Although XRISM is designed to close these holes to block the outside light, we further improved the optical blocking performance of the CCDs as a kind of fail-safe design. There are two origins that cause light-leak events: One is "pinholes" found on the aluminum optical blocking layer (OBL) deposited on the surface of the CCDs. The other is an end-surface leakage that happens near the physical boundaries of the imaging areas. To suppress the generation of pinholes, which is considered to be a deterioration of the aluminum layer, we adopted a double-layer OBL with an 100+100-nm thickness. We also added an extra aluminum layer on the backside of the CCDs to block light from a transparent die bonding sheet, which is the main path of the end-surface leakage. We developed test sample CCDs and irradiated optical/infrared LED light on them to evaluate their optical blocking performance. As a result, the light leak was effectively reduced compared with that of Hitomi's CCDs. We thus conclude that the light leak found in Hitomi will be addressed by these two new designs. We here report on the details of the optical blocking performance of flight-model CCDs for XRISM.

Submission declaration

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