

Possibilities for Thick, Simple-Structure Silicon X-Ray Detectors Operated by Peltier Cooling

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Abstract: We have proposed two types of simple-structure silicon (Si) X-ray detectors with 1.5-mm-thick high-resistivity Si substrates, which are able to be operated at reasonably low negative bias and cooled by Peltier cooling. Since the device structures are simple and the detectors require only one high voltage, the cost of the X-ray detection system can be reduced very much. Moreover, the absorption of cadmium X-ray fluorescence (energy: 23.1 keV) in 1.5-mm-thick Si is approximately 65%, whereas in commercial silicon drift detectors (Si thickness: approximately 0.3 mm), it is approximately 19%. We have simulated the electric potential distribution within the proposed detectors and carried out fundamental experiments towards the realization of the detectors.

Keywords: silicon X-ray detector, simple-structure X-ray detector, thick Si substrate, high resistivity Si substrate, high sensitivity to high-energy X-rays, gated silicon drift detector.