11th International "Hiroshima" Symposium on the Development and Application of Semiconductor Tracking Detectors (HSTD11) in conjunction with 2nd Workshop on SOI Pixel Detectors (SOIPIX2017) at OIST, Okinawa, Japan

Contribution ID: **85** Type: **POSTER**

Comparison of transient response characteristics in the CIS detector irradiated by gamma rays and X rays

Sunday, 10 December 2017 20:40 (1 minute)

CMOS image sensors (CISs) have many advantages for the applications such as particle detection, nuclear industry, and space imaging sensors and have been widely used as the detectors for particle detection and space applications. However, the CIS detectors are sensitive to the radiation damage for applications in the harsh radiation environments such as space and nuclear environments. The transient responses of the CISs during radiation are one of the most important key issues to the detector design, reliability and applicability. Though many papers have reported the stable accumulated dose (such as the total ionizing dose and displacement damage dose) radiation effects in CISs, fewer papers have focused on the transient response in PPD CISs induced by radiation, especially for the comparison of transient response characteristics in the CIS detector irradiated by gamma rays and X rays.

The paper reported herein examines of the transient response characteristics in the CIS detector irradiated by gamma rays and X rays. The CISs have 4 Megapixels and pinned photodiode (PPD) pixel architecture with a standard 0.18 μm CMOS technology. The transient radiation experiments of the PPD CISs are carried out by a 60ˆCo gamma ray source and X ray source (at the Northwest Institute of Nuclear Technology, Xi'an, CHN). The dark signal distributions of the dark images induced by gamma rays and X rays during radiation are analyzed to compare the difference of transient response characteristics. The mechanisms of the transient effects in the CIS detectors are demonstrated by combining the experimental results and theoretical analysis.

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Session Classification: POSTER

Track Classification: Radiation damage and radiation tolerant materials