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Design and image-quality performance of high resolution CMOS-based X-ray imaging detectors for digital mammography

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A variety of digital mammography detectors are currently used in the early diagnosis of a breast tumor and cancer. Direct conversion method with amorphous selenium and indirect detection type such as amorphous silicon (a-Si) flat panel arrays (TFT), CCDs with scintillation materials have been widely employed as an X-ray image sensor in clinical use for several years. More recently, CMOS (complementary metal-oxide semiconductor) imaging detectors in conjunction with a scintillation screen have been appeared as an attractive candidate due to relatively low fabrication cost, low power consumption, compactness and high frame rate in many scientific and medical applications. Therefore, we tried to investigate the potential use of a scintillator-based CMOS APS (active pixel sensor) for high resolution digital mammography.
In this work, two type scintillation materials such as Gd2O2S:Tb and CsI:Tl with a columnar structure were used as a conversion material of an incident X-ray into visible lights. The 100μm-thick screen with Gd2O2S:Tb particle in acrylic binder was fabricated through screen printing method and 150μm-thick CsI:Tl screen with a needle structure was fabricated by thermal evaporation process. The X-ray converter screens were fabricated onto a white TiO2 reflective layer coated glass substrate for low-dose X-ray mammographic imaging. And also, the CMOS flat panel imager with 25x50mm2 active area and 48μm pixel pitch was used for high resolution imaging acquisition. The imaging characterization of the used X-ray detector was measured and analyzed in terms of linearity about incident X-ray dose, modulation transfer function(MTF), noise-power spectrum(NPS) and detective quantum efficiency(DQE) using a W/Al mammographic X-ray source with various energies of 25-50kVp.

Primary author: Dr CHA, Bo Kyung (KERI(Korea Electrotechnology Research Institute))

Co-authors: Dr SEO, Chang-Woo (KERI); Prof. CHO, Gyuseong (KAIST); Prof. KIM, Ho Kyung (PNU); Mr KIM, Jong Yul (KAIST); Mr YUN, Seungman (PNU); Dr JEON, Sungchae (KERI); Dr HUH, Young (KERI); Mr KIM, Young Joo (KAIST)

Presenter: Dr CHA, Bo Kyung (KERI(Korea Electrotechnology Research Institute))

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