Investigation of the performance of metal halide scintillator films on CMOS flat panel detector for X-ray imaging application

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Digital X-ray imaging detectors with indirect method typically uses amorphous silicon TFT (thin film transistor) or silicon CMOS (complementary metal oxide semiconductor) backplane and different scintillator films for many medical diagnosis, security and nondestructive test applications. Scintillator material is an essential component in indirect X-ray imging detector, which converts high-energy ionizing radiation (X-rays) into visible light. Over recent decades, significant research efforts have focused on identifying and developing efficient scintillators for radiation detection, resulting in the commercialization of numerous scintillator technologies. However, there remains a strong need to develop novel scintillator materials that combine low cost with high light yield and fast decay times to meet the demands of high-speed radiation detection technologies.

Recently, metal halide perovskite nanocrystals (NCs) have attracted considerable attention as potential scintillators for X-ray detection and imaging. In this study, granular Cs3Cu2I5 scintillating films with thicknesses ranging from 50 to 200µm were fabricated to realize high luminescence efficiency and enhanced spatial resolution in digital X-ray imaging systems. High-resolution dynamic CMOS flat-panel detectors were used as the light-sensing backplane. These large area optical detectors comprise silicon photodiode arrays with pixel pitches of 50µm (full-resolution) and dual sensitivity function (high sensitivity and dynamic range mode).

The microstructure and scintillation characteristics, such as X-ray–excited emission spectra and light output obtained by X-ray luminescence (XL), were analyzed. The imaging performance of CMOS flat-panel detectors integrated with metal halide perovskite scintillation films was assessed through measurements of relative light response, modulation transfer function (MTF), noise power spectrum, and phantom-based X-ray imaging (Figure 1). The results indicate strong potential for high-speed and high-resolution digital X-ray imaging in both medical and industrial fields. The detailed results will be presented in the conference.

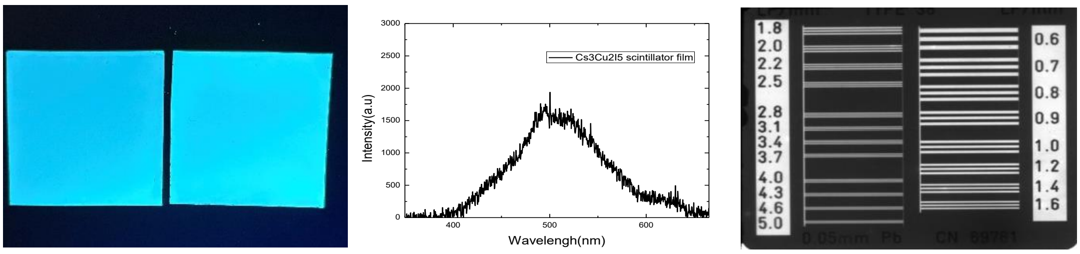

Figure 1. Photograph of metal halide scintillator films under X-ray exposure (left), X-ray luminescence spectrum (center) and X-ray image with a line-pair phantom (right).

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