

Development of a Flexible 64-Channel X-ray Imaging System based on CsPbBr₃-Polymer Nanocomposite Scintillators

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In this work, we developed a flexible multichannel X-ray detection platform designed for conformal imaging on curved surfaces. The system integrates a 64-channel silicon PIN photodiode array on a polyimide-based flexible PCB (F-PCB) coupled with a CsPbBr₃ nanocrystal-PVDF nanocomposite scintillator film fabricated via electrospinning. To optimize both mechanical flexibility and detection efficiency, various polymer matrices, including PVDF and PDMS, were evaluated. The synthesized CsPbBr₃ nanocrystals exhibited a strong radioluminescence peak at approximately 530 nm under X-ray irradiation, ensuring efficient light-to-signal conversion with the silicon-based photodetector.



Fig.1. Images of CsPbBr₃ nanocrystal-PVDF nanocomposite scintillator film coupled F-PCB

The 8x8 photodiode array exhibited a low dark current (<10 nA at 10 V) and maintained stable performance after 1,000 bending cycles with less than 5% variation. The integrated system successfully acquired high-quality images of a slit-type lead phantom with a Contrast-to-Noise Ratio (CNR) of 8.4-8.5 under 60 kV irradiation. These results demonstrate that the integrated electrospun nanocomposite and F-PCB platform provides a promising solution for high-performance, conformal X-ray imaging applications.

Notably, this entire system was successfully realized utilizing the specialized infrastructures of the Radiation Equipment Research and Fabrication Center (Radiation Equipment Fab.) at KAERI. The device was fabricated and evaluated through standardized processes within its crystal growth room, semiconductor clean room, machining room, and characterization room.

In this presentation, we will provide a comprehensive overview of how these state-of-the-art facilities were utilized to develop and verify the performance of advanced radiation devices.

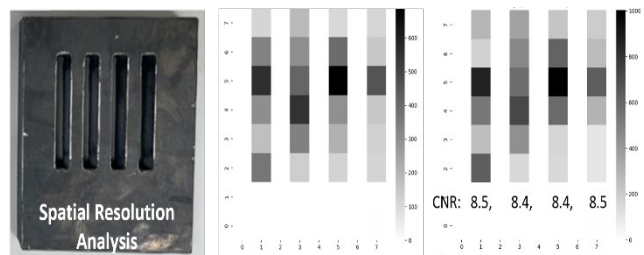


Fig.2. (a) Silt-type lead phantom and (b) its corresponding X-ray imaging result at 60 kV and 25 mA (CNR ~ 8.4)

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