AbstractID: 3722 Title: Development of Direct Detection Active Matrix Flat-Panel Imagers Employing Mercuric iodide for Diagnostic Imaging

Purpose:

To characterize the performance of prototype direct-detection active matrix flat-panel imagers (AMFPIs) employing recently improved forms of polycrystalline mercuric iodide photoconductors as x-ray converters for fluoroscopic imaging.

Methods and Materials:

While direct and indirect detection flat-panel imagers offer good performance for many applications, their modest signal per interacting x-ray limits the DQE performance under imaging conditions of low exposure such as in fluoroscopy. One possible pathway to overcome this limitation involves the use of a high gain photoconductive x-ray converter such as mercuric iodide (HgI_2). Accordingly, performance results from a number of AMFPI prototypes employing two types of polycrystalline HgI_2 (a form created through physical vapor deposition, PVD, and a particle-in-binder form involving screen printing, PIB) are reported. Each prototype incorporates an array with a pixel format of 768x768 and a pixel pitch of 127 μm, and was operated under fluoroscopic conditions. The measured performance was compared to theoretical calculations based on a cascaded systems model.

Results:

Performance of the prototypes is reported in terms of pixel properties as well as MTF, NPS and DQE. Recent significant improvements in the properties of HgI_2 photoconductors, such as chemical stability, low dark current (< 10 pA/mm^2), low lag, and high x-ray sensitivity (corresponding to an effective ionization energy approaching the theoretical limit of ~5 eV) resulted in a high DQE performance at low exposures. Pixel-to-pixel non-uniformities, which tend to reduce the dynamic range, remain high (~10% to 30%) and thus require further optimization.

Conclusions:

While the development of polycrystalline HgI_2 as an x-ray converter for AMFPIs has achieved important milestones related to various material properties, various challenges remain. Nevertheless, the high x-ray sensitivity and DQE observed at low exposures demonstrate the potential for input-quantum-limited fluoroscopic operation. This work was supported by NIH grant R01-EB000558.