AbstractID: 3843 Title: High DQE Megavoltage Imaging Using Active Matrix Flat-Panel Imagers Incorporating Polycrystalline Mercuric Iodide

Purpose:

In order to explore the potential for significantly improving the DQE of megavoltage active matrix flat panel imagers (AMFPIs), two forms of thick, polycrystalline mercuric iodide (HgI_2) photoconductors have been investigated.

Methods and Materials:

Prototype direct-detection AMFPIs with an effective pitch of 508 μm and a pixel format of 192×192 were coated with two types of HgI_2: a “PVD” form created through physical vapor deposition and a “PIB” (particle-in-binder) form involving screen-printing. Results were compared to those from a conventional indirect-detection megavoltage AMFPI employing a phosphor screen. Data were obtained fluoroscopically, using a 6 MV beam at very low doses, equivalent to ~0.004 to 0.04 cGy.

Results:

Compared to PVD, the PIB array exhibits much lower dark current, lower dark drift, slightly higher lag and similar non-uniformity, linearity and DQE. For both PVD and PIB, MTF and DQE results are in a good agreement with theoretical expectations, and the MTF is higher than that from the conventional megavoltage AMFPI. Moreover, the DQE results show input-quantum-limited behavior, even at very low doses. Finally, zero-frequency DQE values are ~1.4% and 1.2% for PVD and PIB, respectively, matching the theoretical upper limits for the thickness of the converters used. Given the modest photoconductor thickness of these early prototypes, the DQE values compare favorably to values of ~1% obtained from conventional megavoltage AMFPIs.

Conclusion:

These initial studies indicate that AMFPIs incorporating polycrystalline HgI_2 have the potential for significant dose reduction in megavoltage imaging. The use of HgI_2 offers the promise of increased quantum efficiencies through the development of substantially thicker converters than have thus far been achieved, without significant degradation of the spatial resolution. In addition, compared to PVD, PIB appears to provide better prospects for such thick coatings, leading to higher DQE. This work is supported by NIH grant R01-CA51397.