AbstractID: 5491 Title: Empirical Studies of Polycrystalline Silicon-Based Flat-Panel Imagers Incorporating Pixel-Amplifiers

Purpose: To investigate the potential of achieving significant improvements in the DQE performance of active-matrix flat-panel imagers at low fluoroscopic exposures and high spatial frequencies through incorporation of novel pixel architectures based on polycrystalline silicon thin-film transistors (TFTs).

Methods and Materials: Detailed empirical studies have recently been performed on the signal and noise characteristics of a series of arrays incorporating poly-Si TFTs. These indirect detection designs involved three pixel architectures employing either a single TFT switch, a single-stage amplifier, or a dual-stage amplifier – along with a continuous photodiode structure. Determinations of MTF, NPS, and DQE, as well as of individual pixel properties (sensitivity, linearity, trapping, noise) were performed under fluoroscopic and radiographic conditions. Circuit simulations were also performed to explore the potential performance of these and other hypothetical array designs.

Results: The studies indicate that the high mobilities of poly-Si lead to potential frame rates of at least an order of magnitude greater than those of conventional arrays with a-Si:H TFTs. In addition, the single- and dual-stage pixel-amplifier arrays demonstrate signal gain (~×10 and ~×25, respectively) very close to design expectations. Furthermore, empirical data taken from these early prototypes demonstrate a small, but non-negligible enhancement in signal-to-noise performance compared to that of similar arrays using conventional designs, as a result of pixel amplification and the use of repeated, non-destructive readout. Analysis based on these empirical results and circuit simulations indicates that, with circuit design optimization and improved TFT quality, further significant enhancement of performance should be possible.

Conclusion: These results indicate that substantial improvements in DQE performance are possible through incorporation of poly-Si circuits in flat panel pixel designs. Factors limiting the performance of present designs will be described and future steps in the development of this technology will be discussed. This work is supported by NIH grant R01 EB000558.