

AbstractID: 5374 Title: Conceptual Examination of Conformal, Transparent, Indirect Detection, Active Matrix Mammographic Imagers

Purpose: The recent development of techniques to create high-quality amorphous silicon (a-Si:H) at relatively low deposition temperatures enables the creation of active matrix arrays of thin-film transistors (TFTs) on very thin, flexible plastic sheets, rather than on thick, rigid glass substrates. In this presentation, an examination of the potential advantages and theoretical performance of indirect detection mammographic imagers based upon such arrays will be reported.

Methods and Materials: Prototype active matrix arrays of thin-film transistors based on low-temperature a-Si:H and deposited on plastic substrates have demonstrated TFT performance essentially equivalent to that of devices produced with conventional a-Si:H. In addition, other prototype imagers have demonstrated that the incorporation of continuous photodiode structures can provide improved signal gain compared to arrays with discrete photodiodes at small pixel pitches. Techniques based on Monte Carlo simulations and cascaded systems analysis, parameterized by empirical information obtained from these early prototypes, have been employed to explore the performance of optimized imaging array designs operated under mammographic imaging conditions.

Results: The excellent performance of transistors and photodiodes fabricated from low temperature a-Si:H, coupled with the incorporation of continuous photodiode structures, provides good signal and noise characteristics, even for sub-100 μm pitch designs. In addition, the flexibility and x-ray transparency of a thin plastic substrate allows for the possibility of conforming the shape of the detector to an arc and to position the scintillator (and opposing active matrix array circuits) on the opposite side of the substrate relative to the x-ray source – leading to improvements in spatial resolution and DQE.

Conclusion: Early investigations of the potential performance of indirect detection active matrix mammographic imagers based on low-temperature a-Si:H and fabricated on plastic substrates suggest that significant advantages would accrue from the development and implementation of such devices.