Abstract ID: 16195 Title: Finding the optimal thickness of thin film CdTe detector under diagnostic x-ray beams

Purpose: Recent developments in large area photovoltaic applications of have moved cadmium telluride (CdTe) to the frontiers of thin-film manufacturing, making the photoconductor a promising candidate for large-area flat panel digital x-ray detectors. We model thin-film CdTe detector in direct detection configuration to find its intrinsic imaging characteristics, such as MTF (modulation transfer function), NPS (noise power spectrum), and DQE (detective quantum efficiency), as well as its electronic properties with the objective of determining the optimal thickness of CdTe.
Material and Methods: The intrinsic imaging characteristics of thin-film CdTe detector under diagnostic spectra were modeled with Monte Carlo simulation package, MCNP5. They were compared to those of other two photoconductors used in direct detection imaging, a-Se and HgI2. The electronic properties of CdTe were studied with SCAPS simulation software, routinely used for photovoltaic device modeling.
Results: While MTF decreases with increasing film thickness, the resultant DQE(f) increased with the thickness. The optimal thickness of CdTe under diagnostic x-ray beams was found to be around 300μm, taking into account the resolution and detection efficiency factors. Although a-Se shows better MTF under 80kVp, the DQE(f) of thin-film CdTe is superior to that of a-Se because of its much higher absorption efficiency. Electronic properties' study demonstrated that thin-film CdTe device can provide adequate output under diagnostic x-ray beams. We also found that increasing CdTe thickness beyond 300μm does not improve the output signal significantly.
Conclusion: Our results show that the detector system based on thin-film CdTe is capable of achieving high resolution as well as high quantum efficiency in diagnostic imaging applications. It also provides easily measurable signal output under this energy range. The optimal thickness of thin film CdTe for diagnostic x-ray imaging is determined to be around 300μm.