AbstractID: 11324 Title: Monte Carlo Simulation of Thin-Film CdTe Detector Performance for Diagnostic Imaging Applications

Purpose: As a semiconductor material of high atomic number and density, cadmium telluride (CdTe) is highly suitable for direct radiation detection, producing electronic signal in response to incoming x-rays. Development of thin-film CdTe deposition techniques in recent years allows for manufacturing of low cost large-area detectors with superior imaging capabilities and outstanding radiation hardness. We investigate performance on thin-film CdTe based detector under a range of energies relevant to diagnostic imaging applications.

Method and Materials: Our analysis is based on Monte Carlo modeling of the detector performance with MCNP5 package. In order to calculate input spectra for different tungsten anode voltages (kVp) of our clinical simulator unit, we performed series of output measurements required for spectra generation with Tungsten Anode Spectral Modeling using Interpolating Polynomials (TASMIP) algorithm. In the next step these generated spectra were ran through a 20 cm water phantom, representing an imaged patient and resulting in a set of primary photon spectra used for detector characterization. Finally, x-ray beam is set to fall normally at the detector surface through a narrow slit, following a typical setup for line spread function LSF(x) measurement.

Results: We calculate frequency-dependent pre-sampling detective quantum efficiency DQE(f) for kVp voltages from 40 to 140 kV. Thickness of CdTe was varied from 10 to 1000 microns, covering the range of feasible thin-film devices.

Conclusion: Thin-film CdTe based detector offers high performance and high spatial resolution due to low signal spreading inherent of direct detection design. In combination with low manufacturing cost of large-area flat panel device, the detector is decidedly suitable for critical all the diagnostic imaging applications.