AbstractID: 11103 Title: Thick monolithic pixelated scintillator array for megavoltage imaging

We describe the fabrication and evaluation of a thick pixelated scintillator for megavoltage (MV) imaging composed of a ceramic containing over 99.9% gadolium oxysulfide. This sintered material offers a 59% increase in density over the Lanex Fast B (LFB) phosphor screens most commonly employed in MV imaging. The sintered pixelated array (SPA) is fabricated from a single slab of ceramic. This obviates the need to assemble over a million separate crystals in order to cover a 40.96cm x 40.96cm detector area. As a consequence, the design is amenable to fabrication using methods of mass production.

Method and Materials: A 1.8mm-thick 274 x 250 pixel SPA with 0.4mm pixel pitch is attached to the light-sensitive surface of an amorphous silicon flat panel detector (Perkin Elmer XRD1640AN). Image quality is characterized using 1MU exposures of the 6MV beam of a Siemens Primus Linac. A QC-3V phantom is employed to calculate the modulation transfer function (MTF) and contrast-to-noise ratio (CNR). The detective quantum efficiency (DQE) is computed. A LFB screen is then evaluated under identical conditions for comparative purposes. Cone beam CT (CBCT) imaging is performed with four arrays tiled side-by-side on the detector surface.

Results: The half-maximum value of MTF occurs at 0.32 and 0.34lp/mm for the SPA and LFB, respectively. The DQE(0.1lp/mm) of SPA is 5.8%, versus 1.0% for LFB. The SPA offers a 235% improvement in CNR over LFB. Previously undetectable low-contrast phantom inserts are clearly visible in SPA MV-CBCT images.

Conclusions: The SPA appears to offer a practical and cost-effective means of attaining major improvements in MV image quality. The measured MTF and DQE values underestimate the achievable performance, since the SPA and detector photodiode arrays were imperfectly aligned during these evaluations. A DQE(0) value closer to the maximum attainable 7.8% is expected.

Conflict of Interest: Sponsored by Siemens