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X-RAY IMAGING WITH CDTE-BASED HYBRID PHOTON COUNTING DETECTORS AND NANOFOCUS X-RAY TUBE

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Summary: We present a nano-CT setup consisting of a nanofocus X-ray tube and a CdTe Hybrid Photon Counting (HPC) pixel detector. With a geometrical magnification factor of 1,340 the setup was able to resolve features of a test pattern with a size of 150 nm.

1. INTRODUCTION

Combining a nanofocus X-ray tube with a Hybrid Photon Counting (HPC) pixel detector [1] is a promising configuration for phase-contrast imaging and nano CT. HPC detectors employ an energy threshold on each pixel for noise-free photon counting and deliver extremely sharp images due to the direct detection of X-rays.

A PILATUS3 CdTe 300K-W detector with 172 µm pixel size was used to characterize a newly developed nanofocus X-ray tube. The NanoTube N1 of Excillum contains a tungsten transmission target on diamond window and was operated at 60 kVp with a spot size of 300 nm. The sensor of the detector is CdTe of 1 mm thickness. This high-Z semiconductor material provides excellent stopping power resulting in a detection efficiency of above 80% up to 80 keV X-ray energy (Figure 1, bottom right). The background and noise free HPC technology enables long exposure times needed in the low flux condition inherent to nanofocus tubes.

Images were acquired in 300 seconds. Extreme geometrical magnification of 1,340 was realized by placing the test pattern ˜0.4 mm in front of the source at a source-to-detector distance of 555 mm resulting in an effective pixel size of 128 nm, allowing the 150 nm features of the test pattern to be resolved.

References

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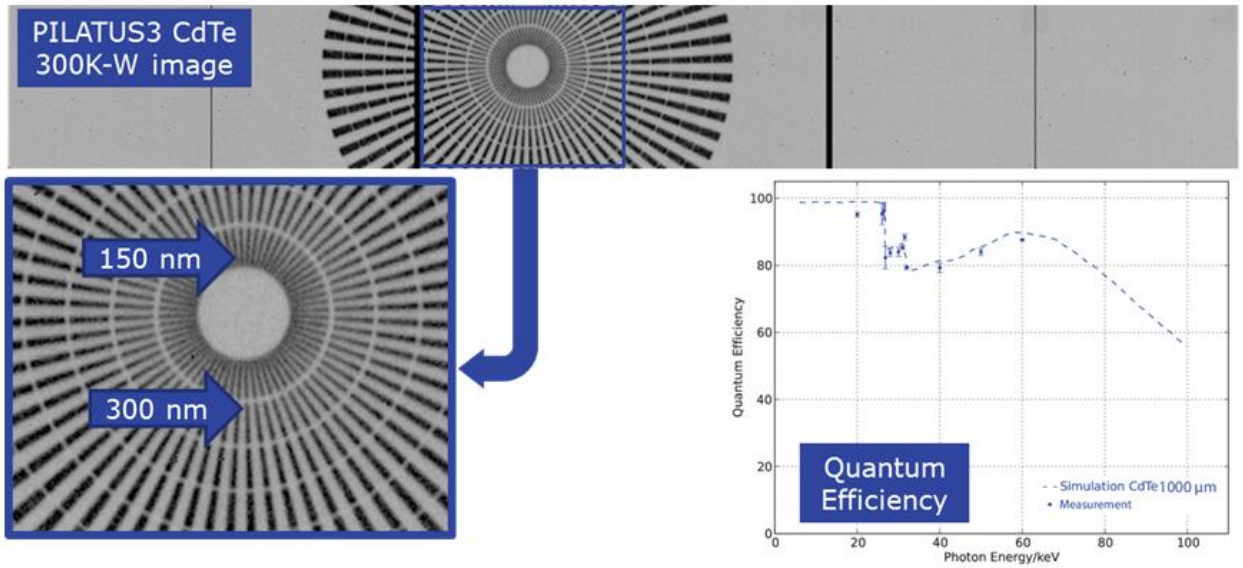

Figure 1: (Top/left:) X-ray test pattern (Siemens star, tungsten on diamond window) imaged using Excillum NanoTube N1 60 kV and PILATUS3 X CdTe 300K-W detector. (Right:) Quantum efficiency of the detector measured in cooperation with PTB at the BAM beamline at BESSY II [2].