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A scalable scientific detector platform (SSDP)

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As X-ray micro-CT applications drive development of the next generation of detectors to offer larger and variable fields of view combined with micron scale pixel resolution and high conversion efficiency, a scalable hybrid X-ray detector technology is under development. Direct hybrid X-ray detectors using amorphous Selenium (a-Se) deposited on 3T CMOS readout ASICs have been demonstrated with pixel sizes less than 7µm. Using reticle stitching methodologies available at CMOS foundries, readout ASIC's may be seamlessly patterned to create multiple sizes of die up to and including a die size that fits within a 200mm wafer (~ 90mm x 90mm FOV). To create larger FOV X-ray panel detectors using CMOS Readout ASIC technology, detector tiles (CMOS die + a-Se) are formed and physically aligned and closely butted together on a common substrate. Three side tileable ROIC tile designs may be constructed to enable 2 x N tile X-ray panel sizes.

There is a need in for high resolution X-ray imagery to be performed on increasingly large sample sizes, up to and including, mammographic and chest X-ray fields of view. It has been a challenge to obtain both large field of view combined with micron scale pixel pitch at affordable cost from commercially available detector sources. This work will combine the advantages of global shutter 4T pixel design (reduced motion blur in CT imaging), micron scale sampling resolution (phase contrast enhancement) variable die size reticle stitching, high frame rate, and 2 x N detector tile panel assembly, plus modular camera electronics design, to enable a detector platform that is scalable to meet the application and target size. The platform will be configured such that the modular camera electronics can accommodate 1 to 2N detector tiles using a common I/O bus and camera operational software. Development of a-Se deposition and patterning technology over large area die with 100 µm to 200 µm thickness and low defect density, will be required.

Once the development is completed, the scalable direct X-ray detector platform will enable researchers to scale up their imaging benches by adding detector tiles while using the modular camera electronics base. Researchers will not be forced to purchase expensive new X-ray cameras to accommodate changes of the experimental configuration and target size. This work will enable cost effective configuration of X-ray still imaging, dynamic imaging (fluoroscopic), and XCT applications.

Early Career

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