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DynAMITe: A Wafer Scale Sensor for Biomedical Applications

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Wafer scale detector technology represents an alternative approach for biomedical imaging where currently Flat Panel Imagers (FPIs) are the most common option. However, FPIs possess several key drawbacks such as large pixels, high noise, low frame rates, and excessive image artifacts. Recently Active Pixel Sensors have gained popularity overcoming such issues and are now scalable up to wafer size by appropriate reticule stitching. Detectors for biomedical imaging applications require high spatial resolution, low noise and high dynamic range. These figures of merit are related to pixel size and as the pixel size is fixed at the time of the design, spatial resolution, noise and dynamic range cannot be further optimized. The authors report on a new rad-hard monolithic APS, named DynAMITe (Dynamic range Adjustable for Medical Imaging Technology), developed by the UK MI-3 Plus consortium. This large area detector (12.8 x 12.8 cm2) is based on the use of two different diode geometries within the same pixel array with different size pixels (50 um and100 um). Hence the resulting camera can possess two inherently different resolutions each with different noise and saturation performance. The small pixels and the large pixels can be reset at different voltages, resulting in different depletion widths. The larger depletion width for the small pixels allows the initial generated photo-charge to be collected by the small pixels, which ensures an intrinsically lower noise and higher spatial resolution. After these pixels reach near saturation, the larger pixels start collecting so offering a higher dynamic range whereas the higher noise floor is not important as at higher signal levels performance is set by Poisson noise. Further different reset voltage can selectively choose the operating resolution of the detector leading to a true pixel binning.
The overall architecture and detailed characterization of DynAMITe will be presented in this paper.

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