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Evaluation of Different Thicknesses of Chromium Compensated Gallium Arsenide Sensors Using Photon Counting Readout Electronics

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Gallium arsenide is extensively studied for about seven decades as an excellent material for semiconductor lasers, LEDs, and microwave electronics. GaAs has noticeable advantages over silicon and Cd(Zn)Te for radiation detectors. Particularly GaAs has higher electron mobility compared to Si and Cd(Zn)Te; higher average atomic number compared to Si; and lower probability and energy of the fluorescence photons compared to the Cd(Zn)Te [1].These advantages result in a fast charge
collection and a better uniformity compared to Cd(Zn)Te. High absorption efficiency up to 80 keV is required in medical computed tomography and security applications that can be achieved with 2 mm thick GaAs sensors. Other applications for the GaAs are foreseen in mammography, small animal imaging, electron microscopy, synchrotrons, XFELs and non-destructive testing of composite materials.
Advafab has developed chromium compensation of commercially available 3"n-type GaAs wafers to produce high resistivity and high flux tolerant GaAs sensors supported by [2]. In the process wafers are annealed in quartz reactor; processed by lapping and polishing; and lithographically patterned, metallized, and diced. Earlier we have demonstrated a wafer-level processing of 500 um thick GaAs sensors using designs compatible with different type of readout ASICs. Recently we have been able to
fabricate thicker, up to 2 mm thick, GaAs sensors to match the absorption efficiency of 750 um thick Cd(Zn)Te sensors. High resistive GaAs sensor wafers with thicknesses of 1-, 1.5- and 2-mm were fabricated. High photon-flux operation was evaluated using a medical CT X-ray tube in an open-beam configuration. It will be shown that 2 mm thick GaAs sensors with a 330 μm pitch tolerate and operate stably in extreme X-ray fluxes of up to 1.100 Mcnt/s/mm2.

[1] A.Owens, A.Peacock, Compound semiconductor radiation detectors, Nucl. Instr. and Methods A
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