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Development of Large-Area Imaging Arrays Using Epitaxially Grown Thick Single Crystal CdTe Layers on Si Substrates

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We have been studying development of a large-area two-dimensional (2-D) pixel-type x-ray, gamma ray imaging array using metalorganic vapor-phase epitaxy (MOVPE) grown thick single crystal CdTe epilayers on Si substrates. We have previously reported on the spectroscopic performance of our detectors[1], as well as development of (8x8) imaging arrays[2]. We further optimized our detector array development and bonding technique to achieve large-area arrays with uniform response. Recent results on the (8x8) arrays evaluation as well as our progress towards developing larger arrays will be reported.

The detector arrays possess a p-CdTe/n-CdTe/n^+-Si heterojunction diode structure, which are developed by growing an n-type CdTe buffer layer on the (211)n^+-Si substrate and then growing thick p-like CdTe layer on the top. The device consists of a full-area electrode of evaporated gold on the n+-Si side, while pixel patterns with segmented gold electrodes are made on the p-CdTe side. The pixel patterns, which were typically 1.12x1.12 mm^2 sized in a 1.27 mm pitch, were defined by making deep vertical cuts orthogonally from the p-CdTe side using a diamond blade saw. We further developed a conductive epoxy based low temperature bonding technique to connect the array to the read out electronics, which produces very good bonding yields. All pixels in the (8x8) array exhibited uniform reverse bias leakage currents, typically 3 nA at 100 V reverse bias per pixel. As in Fig. 1, the array showed uniform counting response which was recorded from the entire pixels at a set threshold by irradiating with low energy x-rays (30 kVp, 1mA). With these improvements, we further developed a prototype of (20x20) array (detector size 25mmx25mm). Preliminary array evaluation using I-V measurement is very encouraging, with very uniform reverse bias leakage currents. Details on detector array development and their performances will be discussed.

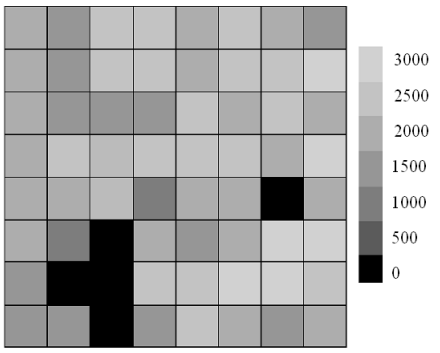

Fig. 1. Mapping of the counts from the (8x8) array obtained with low energy x-ray irradiation.

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1. K. Yasuda *et al*., The 70th Autumn Meeting, The Japan Society of Applied Physics, Symposium 9p-TF-3/0, 2009.
2. T. Kondo *et al*., The 59th Spring Meeting, The Japan Society of Applied Physics, 17a-C4-10, 2012.