A Pixel Array Detector for Time-resolved X-ray Diffraction*

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An all silicon pixel array detector (PAD) with 150 micrometer pixels has been designed and tested as a prototype. The PAD is a two-layer charge-integrating device consisting of a diode layer bump-bonded to a MOS electronic storage and readout layer. The advantages of this design are essentially no x-ray dose rate limitation and no requirement for intermediate conversion of the energy to visible light. The diode layer, fabricated on 300 micrometer thick silicon, converts greater than 99% of 8 keV x-rays and provides full coverage of the active area with no gaps between pixels. The electronic layer stores charge from the diodes for eight successive frames at 1-microsecond (or longer) intervals before readout. The PAD can also be operated continuously. A 4 x 4 pixel prototype was tested and shown to have a well-depth of about 20,000 8 keV x-rays, noise corresponding to five 8 keV x-rays, linearity within 0.2%, and no measurable cross-talk between pixels. Operational characteristics and radiation tolerance will be discussed. A 100 x 92 array with 151.2 mm square pixels and a single readout port has been constructed and is currently being tested. A 100 x 92 device with a gallium arsenide diode array has also been fabricated.

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