Analog Pixel Array Detectors for Time-Resolved X-ray Applications

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Area semiconductor Pixel Array Detectors (PADs) utilize integrated circuit technology to make x-ray detectors in which each pixel has built in signal processing electronics. PAD efforts divide into two broad strategies: Digital PADs, in which each stopped x-ray is digitally counted and analog integrating PADs (APADs), in which the signal is analog integrated with subsequent digitization. APADs have advantages in situations of high local count-rates, such as for high-flux radiography and proposed x-ray free electron laser applications. Characterization and applications of two prototype bump-bonded Cornell APAD designs are described. In the first design the signal is stored as a voltage on a series of in-pixel capacitors. CMOS switching between these capacitors allows up to 8 images to be stored at microsecond rates, after which the images are slowly read out via off-chip analog-to-digital converters. This detector has been used for time-resolved radiography applications. The second APAD is being designed for experiments at the SLAC Linac Coherent Light Source. It involves in pixel digitization and continuous framing at 120 Hz.