

# Proposal of Silicon on Insulator Reach-through APDs for soft X-ray imaging optimized by TCAD simulation

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To study surface science of material and spintronics application, experiments using soft X-ray (0.1-4keV) is now paid attention to in the next generation synchrotron radiation facility. In order to perform such experiment, a new high-resolution, high-sensitive soft X-ray imager is required. For that purpose, we are developing an imager, Silicon on Insulator-Reach Through-Avalanche Photo Diodes (SOI-RT-APD). This imager integrates an amplifier for each detector in an SOI layer which is just top of the SOI-RT-APD in a handle wafer to enhance detector's fill factor and reduce the pixel size for high spatial resolution. To obtain sufficient gain, APD's Pwell formation conditions are optimized. In order to realize back-side illumination of soft X-ray, a high-resistivity floating zone (FZ) wafer was applied to achieve full depletion. Because of mechanical weakness of FZ wafer, no high temperature furnace annealing but high energy implantations and rapid thermal annealing are newly introduced to form Pwell. TCAD simulation of this proposed SOI-RT-APD confirms sufficient high gain ( $>10$ ) and low noise factor (ionization ratio  $k$  factor  $< 0.2$ ).

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