

# On-line APD detectors for deterministic doping low energy single heavy atoms in silicon

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Recently single ion implantation technology based on the PiN detector architecture [1] has been successfully applied in the construction of single-donor nano-scaled Si devices and qubits [2] with typical 14 keV single P<sup>+</sup> ions stopping at a 20 nm implantation depth in Si. For a further improvement of the single ion detection limit and for a better single-to-noise-ratio, we explored the technology of avalanche-photo-diodes (APDs) to replace the conventional PiN diodes for even heavier and lower energy single ion implantation event detection. We applied the method of Ion Beam Induced Charge (IBIC) to image the charge gain distribution over the entire active area of the APD device with a focused 500 keV He<sup>+</sup> ion beam. We investigated the linear operation of the APDs with controlling internal charge gain less than 10 for the detection of 6.4 keV x-rays. A potential for a large improvement of detection limit for the low energy ion detection is demonstrated in the APDs; this will lead to a reliable fabrication process for deterministic doping single atoms in semiconductors.

## Reference

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