

Development of UV-Sensitive GaN Single Photon Geiger-Mode Avalanche Photodiodes

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Silicon photomultipliers (SiPMs) have had a transformational impact on many important experiments in high-energy and astrophysics. However, the SiPM is intrinsically limited in its photoresponse below ~ 300 nm, a critical wavelength range for liquid noble scintillation detectors. An alternative to silicon for the fabrication of UV avalanche photodiodes (APDs) are the wide-bandgap III-N semiconductors AlGaN and GaN, which have a tunable direct bandgap energy and better sensitivity in the UV than Si detectors. With the commercial availability of high-quality native III-N substrates, we have successfully fabricated single GaN APDs and demonstrated enhanced UV sensitivity and Geiger-mode operation. Encouraged by these results, we improved our device design to reduce tunneling currents and device mesa edge breakdown, which we believe are the most significant contributors to the dark count rate near avalanche. We present measurements of our latest III-N APD devices with beveled mesas and a modified internal structure that lowered the dark current density 30,000 times.

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No

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