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The Development of Silicon Carbide Low Gain Avalanche Detector

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High-energy and high-luminosity collision experiments on the future collider demand higher radiation resistance and time resolution detectors due to events pile-up. Silicon Low-gain avalanche detectors (LGADs) with excellent time resolution have been identified for use in collider experiments, such as ATLAS and CMS experiments. However, due to the inherent properties of silicon material, the operating voltage and temperature requirements for irradiated Si LGADs are even more demanding. Especially in environments with irradiation fluences exceeding $10^{16} n_{eq}/cm^2$ and under general detector operating conditions, there is a need to explore new solutions.

In comparison to silicon, silicon carbide (SiC) offers lower intrinsic carrier concentration, faster carrier saturation drift velocity, higher breakdown electric field, and greater theoretical radiation resistance. This makes it a promising candidate for applications in collider experiments.

In recent years, with the increasing demand for commercial silicon carbide power devices, related silicon carbide processing technologies have rapidly advanced. This has made it possible to fabricate multi-layer epitaxial structures of silicon carbide devices, such as SiC LGAD. However, the fabrication of SiC LGAD also imposes additional requirements on the processing technology, such as ultra-low-doped silicon carbide epitaxial layers, precise control of epitaxial layer doping concentration and thickness, and small bevel angle termination etching. We will report on the latest developments in SiC LGAD conducted by Lawrence Berkeley National Laboratory(LBNL) and North Carolina State University (NCSU).

Early Career

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