Analysis and Impact of Point Defects in Vertical GaN on GaN Diodes Grown by MOCVD

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The growing need for high-performance electronics has spurred advancements in wide-bandgap semiconductors, particularly GaN, Ga2O3, and SiC. The shift from lateral to vertical GaN structures marks a crucial development, emphasizing the importance of defect control. This study explores defect mechanisms from stacking faults and dislocations in vertical GaN on GaN diodes.

Vertical GaN PiN diodes were fabricated and examined with Raman spectroscopy to assess lattice stress and defect distribution. Cathodoluminescence (CL) analysis identified substrates with lower defect densities for fabrication. Deep Level Transient Spectroscopy (DLTS) precisely measured point defects' energy levels and concentrations, integral for TCAD Silvaco simulation inputs. These simulations analyzed the diodes' electrical responses to defects.

Raman revealed peaks indicative of the hexagonal lattice, with shifts due to n-type carrier concentration changes. CL identified gallium vacancy spectral lines, highlighting defect densities. This methodology clarifies the relationship between defect types and diode performance, contributing to the advancement of semiconductor technology.