Engineering of V-Defects for Efficient III-Nitride LEDs
Tech ID: 32659 / UC Case 2021-570-0

BACKGROUND

The reduced efficiency of GaN-based LEDs at high injection levels (current droop) has not yet been solved. V-shaped defects have been employed to address current droop by reducing forward voltage and creating a lower barrier for hole injection in the sidewalls of the V-defects. However, current demonstrations’ reduction of current droop is marginal at best due to inhomogeneous lateral hole injection and large sidewall barriers. Successfully addressing current droop with V-defects will require a more reliable and comprehensive approach.

DESCRIPTION

Researchers at the University of California, Santa Barbara have created an engineered structure that tunes intentional V-defects to optimize lateral hole injection in GaN-based LEDs and laser diodes (LDs). This structure reduces and/or eliminates sidewall barriers to ensure volumetric injection in the whole quantum well (QW) stack. Unlike standard QW stacks, this invention leverages different compositions and thicknesses of QWs to circumvent the issue of preferential hole injection into the lowest energy QWs. This technology can be applied to other III-nitride light emitting structures such as micro-LEDs, UV LEDs, or lasers.

ADVANTAGES

▶ Improves efficiency in high-power LEDs
▶ Enables wider active regions with large QW numbers
▶ Produces higher modulation bandwidth for white LEDs
▶ Easily scaled with standard industrial equipment and procedures
▶ Compatible with all wavelength LEDs and LDs

APPLICATIONS

▶ III-nitride emitters
▶ LEDs and micro-LEDs
▶ UV LEDs
▶ Laser Diodes

PATENT STATUS

Patent Pending

CATEGORIZED AS

▶ Optics and Photonics
▶ Energy
▶ Lighting

RELATED CASES

2021-570-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

▶ Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates
▶ Enhanced Optical Polarization of Nitride LEDS by Increased Indium Incorporation
▶ Etching Technique for the Fabrication of Thin (Al, In, Ga)N Layers
▶ Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
▶ Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
▶ Defect Reduction in GaN films using in-situ SiNx Nanomask
▶ Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
▶ Photonic Structures for Efficient Light Extraction and Conversion in Multi-Color LEDs
▶ Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
▶ Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
Transparent Mirrorless (TML) LEDs
Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
III-Nitride Tunnel Junction with Modified Interface
Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices
Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
Method for Manufacturing Improved III-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected III-Nitride LEDs
Selective-Area Mesoporous Semiconductors And Devices For Optoelectronic And Photonic Applications
High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
Methods for Fabricating III-Nitride Tunnel Junction Devices
Contact Architectures for Tunnel Junction Devices
Semi-polar LED/LD Devices on Relaxed Template with Misfit Dislocation at Hetero-interface
Semi-polar-Based Yellow, Green, Blue LEDs with Improved Performance
Growth of Semipolar III-V Nitride Films with Lower Defect Density
III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
Improved Manufacturing of Solid State Lasers via Patterned of Photonic Crystals
Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
Growth of High-Performance M-plane GaN Optical Devices
Improved Anisotropic Strain Control in Semipolar Nitride Devices
High Light Extraction Efficiency III-Nitride LED
Method for Increasing GaN Substrate Area in Nitride Devices
Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
Growth of Planar Semi-Polar Gallium Nitride
Defect Reduction of Non-Polar and Semi-Polar III-Nitrides