Burying Impurities And Defects In Regrown III-Nitride Structures
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BACKGROUND

Certain III-nitride device architectures require ex-situ selective-area doping or growth. In special applications, it is necessary to transfer epitaxial layers between two reactors to meet the needs of their complex geometries. This atmospheric exposure causes interfacial impurities that reduce device performance. Prior to regrowth, certain geometries also require dry etching, which introduces significant damage to the epilayer. The combined detriments of interface impurities and etching-induced damage are adverse to final device performance.

DESCRIPTION

Researchers at the University of California, Santa Barbara have eliminated the effects of interfacial impurities and/or dry etching-induced damage by burying the defects at the regrown junction. The p-n diode structure is inverted to form a p-down structure and a p-GaN spacer layer is introduced prior to the growth of the junction. Due to significantly larger doping levels in the p-side compared to the n-side, the depletion width on the p-side is far less than the n-side. This method is more controllable and industrially-viable compared to alternative ex-situ methods. It can be performed in many growth processes, including plasma-assisted MBE, ammonia MBE, MOCVD and other CVD methods. It also provides a viable path to selective-area doping for complex geometry electronic and optoelectronic devices such as JFETs and CAVETs without the need for complicated processes like ion-implantation.

ADVANTAGES

▶ Eliminates interfacial impurities
▶ Reduces epilayer damage

APPLICATIONS

▶ Optoelectronics
▶ Power Electronics

PATENT STATUS

Patent Pending

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
▶ Flexible Arrays of MicroLEDs using the Photoelectrochemical (PEC) Liftoff Technique
▶ Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
▶ Gallium-containing MicroLEDs for Displays
▶ High Speed Indium Gallium Nitride Multi-Quantum Well (InGaN MQW) Photodetector
▶ Internal Heating for Ammonothermal Growth of Group-III Nitride Crystals
▶ 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
▶ Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
- Volumetric Hole Injection with Intentional V-Defects
- Transparent Mirrorless (TML) LEDs
- Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
- High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes
- Method for Growing Self-Assembled Quantum Dot Lattices
- 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
- 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
- 3D Hole Injectors for InAlGaN Light-Emitting Diodes
- Formation of Transparent Integrated MicroLED Displays
- 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
- In-Situ Methods Of Preventing Interfacial Impurities And Dry Etch-Induced Damage In Regrown III-Nitride Structures
- Enhanced Hole Injection by P-Type Active Region and Lateral Injection in InAlGaN LEDs
- 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
- Photoelectrochemical Etching for Chip Shaping Of LEDs
- Hexagonal Wurtzite Type Epitaxial Layer with a Low Alkali-Metal Concentration
- Method for Increasing GaN Substrate Area in Nitride Devices
- Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
- Single or Multi-Color High Efficiency LED by Growth Over a Patterned Substrate
- 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
- Suppression of Defect Formation and Increase in Critical Thickness by Silicon Doping