Method for Manufacturing Improved III-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected III-Nitride LEDs

Tech ID: 23890 / UC Case 2014-416-0

BRIEF DESCRIPTION
A novel device structure for III-nitride devices grown on non-polar or semipolar planes.

BACKGROUND
The usefulness of III-nitrides has been well established for fabrication of visible and ultraviolet optoelectronic devices and high power electronic devices. Growing these devices on nonpolar or semipolar planes of the crystal is a popular solution for reducing the polarization effects. One of the challenges of nonpolar and semipolar growth is that when green III-nitride LEDs and LDs are grown with active regions with high indium contents, the active region can form extended defects and can easily be degraded by subsequent high temperature growth steps. This degradation is due to the growth of the p-type layers after the growth of the active region, which uses high temperatures and impedes device performance.

DESCRIPTION
A novel device structure has been developed for III-nitride devices grown on non-polar or semipolar planes that does not involve the growth of p-type layers after the active region. This configuration reduces the defects and device degradation common in III-nitride LEDs and LDs grown on semipolar planes, and has the potential for creating green III-nitride LEDs and LDs with improved performance and higher wall-plug efficiency.

ADVANTAGES
• Reduced contact resistance, absorption loss, and spreading resistance in p-GaN devices
• Decreased operating voltage of LEDs and LDs leads to increased wall-plug efficiency
• Reduced thermal losses from resistive p-GaN layers

APPLICATIONS
• Light emitting diodes (LEDs)
• Laser diodes (LDs)

PATENT STATUS

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<td>United States Of America</td>
<td>Issued Patent</td>
<td>10,186,835</td>
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RELATED CASES
2014-416-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
- 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
- GaN-Based Thermoelectric Device for Micro-Power Generation
- Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
- Improved Manufacturing of Semiconductor Lasers
- LED Device Structures with Minimized Light Re-Absorption
- Growth of Planar Semi-Polar Gallium Nitride
- UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaN Alloys
- III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-150)
- Suppression of Defect Formation and Increase in Critical Thickness by Silicon Doping
- Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD