Ill-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture
Tech ID: 31857 / UC Case 2019-934-0

BACKGROUND

Conventional planar mirrors used in vertical-cavity surface-emitting lasers (VCSELs) suffer from more diffraction loss the longer they become. However, the length of the cavity that is formed by these mirrors can also provide advantages such as tighter mode spacing and better thermal management. There is a need for devices that can realize the advantages of longer cavities while avoiding the diffraction loss that typically accompanies them.

DESCRIPTION

Researchers at the University of California, Santa Barbara have incorporated a curved mirror formed above the p-side of a III-nitride VCSEL to minimize diffraction loss and extend the lifetime and reliability of the device. When using a curved mirror, the reflected light can be focused back into the center of the aperture, thus minimizing diffraction loss. The curved mirror also affords the use of a long cavity, allowing for better thermal management and significant reduction of thermal rollover, thus increasing lifetime and reliability of the VCSEL. Additionally, the tight mode spacing of this technology allows for a greater tolerance of the cavity length, which increases the yield during device growth and fabrication.

ADVANTAGES

▶ Minimized diffraction loss
▶ Longer device lifetime
▶ Improved device reliability

APPLICATIONS

▶ VCSELs

PATENT STATUS

<table>
<thead>
<tr>
<th>Country</th>
<th>Type</th>
<th>Number</th>
<th>Dated</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States Of America</td>
<td>Published Application</td>
<td>20220239068</td>
<td>07/28/2022</td>
<td>2019-934</td>
</tr>
</tbody>
</table>

CONTACT

Pasquale S. Ferrari
ferrari@tia.ucsb.edu
tel:...

INVENTORS

▶ Back, Joonho
▶ Cohen, Daniel A.
▶ Kearns, Jared A.
▶ Nakamura, Shuji

OTHER INFORMATION

KEYWORDS

mirror, VCSEL, curved

CATEGORIZED AS

▶ Optics and Photonics
  ▶ All Optics and Photonics

RELATED CASES

2019-934-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

▶ Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation
III-Nitride-Based Vertical Cavity Surface Emitting Laser (VCSEL) with a Dielectric P-Side Lens
Aluminum-cladding-free Nonpolar III-Nitride LEDs and LDs
Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
Low Temperature Deposition of Magnesium Doped Nitride Films
Transparent Mirrorless (TML) LEDs
Improved GaN Substrates Prepared with Ammonothermal Growth
Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
Method for Enhancing Growth of Semipolar Nitride Devices
Ultraviolet Laser Diode on Nano-Porous AlGaN template
Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals
Nonpolar III-Nitride LEDs With Long Wavelength Emission
Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices
Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
Method for Growing High-Quality Group III-Nitride Crystals
Controlled Photoelectrochemical (PEC) Etching by Modification of Local Electrochemical Potential of Semiconductor Structure
Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
Group III-N Light Emitting Devices Enhanced By Stress From Post-Growth Deposited Films
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
Low-Droop LED Structure on GaN Semi-polar Substrates
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
III-Nitride-Based Devices Grown On Thin Template On Thermally Decomposed Material
Growth of Semipolar III-V Nitride Films with Lower Defect Density
III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
Tunable White Light Based on Polarization-Sensitive LEDs
Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
Growth of High-Performance M-plane GaN Optical Devices
Packaging Technique for the Fabrication of Polarized Light Emitting Diodes
Improved Anisotropic Strain Control in Semipolar Nitride Devices
Novel Multilayer Structure for High-Efficiency UV and Far-UV Light-Emitting Devices
III-V Nitride Device Structures on Patterned Substrates
Method for Increasing GaN Substrate Area in Nitride Devices
High-Intensity Solid State White Laser Diode
Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
GaN-Based Thermoelectric Device for Micro-Power Generation
Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
LED Device Structures with Minimized Light Re-Absorption
Growth of Planar Semi-Polar Gallium Nitride
High-Efficiency and High-Power III-Nitride Devices Grown on or Above a Strain Relaxed Template
UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaN Alloys

Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD