Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
Tech ID: 29210 / UC Case 2018-250-0

BRIEF DESCRIPTION
An m-plane VCSEL with an active region that has thick quantum wells and operation in continuous wave.

BACKGROUND
Vertical-cavity surface-emitting lasers (VCSELs) are semiconductor laser diodes that emit light normal to the substrate. This design has many advantages over edge-emitting lasers and light-emitting diodes, such as low threshold current, circular mode profile, high-speed direct modulation, ability for single longitudinal mode operation, and two-dimensional arraying capability. As opposed to arsenide and phosphide-based devices, electrically-injected III-nitride VCSELs have been relatively difficult to create, and only eight research groups have successfully demonstrated these devices in the past decade. While most of the reports have been on c-plane, m-plane VCSELs have been demonstrated and have many advantages, such as lack of the quantum confined Stark effect, higher material gain, and anisotropic gain that leads to 100% polarization ratio. However, m-plane VCSEL devices have not been able to achieve continuous wave operation.

DESCRIPTION
Researchers at the University of California, Santa Barbara have created an m-plane VCSEL with an active region that has thick quantum wells and operation in continuous wave. This is the first report of a VCSEL capable of continuous wave operation. Thicker quantum wells (QWs) are possible on semipolar of nonpolar m-plane GaN, in contrast with standard c-plane GaN. These devices have improved thermal performance and a longer cavity length.

ADVANTAGES
- III-nitride VCSEL with continuous wave operation
- 100% polarized VCSEL emission

APPLICATIONS
- VCSELs
- AR/VR
- High-resolution displays
- LiFi
- Visible wavelength LIDAR

PATENT STATUS
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<th>Type</th>
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<td>United States Of America</td>
<td>Published Application</td>
<td>20-0244036</td>
<td>07/30/2020</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
- 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
- III-Nitride-Based Devices Grown With Relaxed Active Region
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
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
Low Temperature Deposition of Magnesium Doped Nitride Films
Transparent Mirrorless (TML) LEDs
Improved GaN Substrates Prepared with Ammonothermical Growth
Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
Size-Independent Forward Voltage Micro-LED with an Epitaxial Junction
Method for Enhancing Growth of Semipolar Nitride Devices
III-Nitride Tunnel Junction with Modified Interface
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
Increased Light Extraction with Multistep Deposition of ZnO on GaN
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
Method for Growing High-Quality Group III-Nitride Crystals
Controlled Photoelectrochemical (PEC) Etching by Modification of Local Electrochemical Potential of Semiconductor Structure
Oxyfluoride Phosphors for Use in White Light LEDs
Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
(In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
Thermally Stable, Laser-Driven White Lighting Device
MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
Highly Compact, High-Index Dielectric Nanostructures for Deep-Ultraviolet Devices
Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDs
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
Photoelectrochemical Etching Of P-Type Semiconductor Heterostructures
Semipolar-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
Improved Manufacturing of Solid State Lasers via Patterned of Photonic Crystals
High Efficiency III-Nitride Devices with Smooth Relaxed InGaN Buffer and Strain Compliant Template
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
High Light Extraction Efficiency III-Nitride LED
III-V Nitride Device Structures on Patterned Substrates
Activation of P-Type Layers of Tunnel Junctions in Micro-LEDs
Method for Increasing GaN Substrate Area in Nitride Devices
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
Nonpolar (Al, B, In, Ga)N Quantum Well Design