Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals
Tech ID: 21921 / UC Case 2007-809-0

BRIEF DESCRIPTION
A method to grow polyhedron-shaped GaN bulk crystals, which are not possible using existing growth methods.

BACKGROUND
In order to eliminate the problems arising from heteroepitaxial growth, gallium nitride wafers sliced from bulk GaN crystals must be used. A new technique for growing bulk GaN crystals is based on using supercritical ammonia, which has high solubility of source materials, and which has high transport speed of dissolved precursors. This ammonothermal method has a potential for growing large GaN crystals. However, existing technology is limited by the crystal size, because the growth rate is not fast enough to obtain large crystals.

DESCRIPTION
Researchers at the University of California, Santa Barbara have developed a method to grow polyhedron-shaped GaN bulk crystals, which are not possible using existing growth methods. This shape of GaN crystals has an advantage over the existing platelet-shaped GaN since GaN wafers of any orientation can be obtained simply by slicing the polyhedron.

ADVANTAGES
▶ Allows simple production of GaN wafers of any orientations
▶ Less impurities on the crystals compared to previous grow methods
▶ Faster than previous methods and easily scalable
▶ Cost effective

APPLICATIONS
▶ Gallium nitride wafers

This technology is available for a non-exclusive license. See below for a selection of the patents and patent applications related to this invention. Please inquire for full patent portfolio status.

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>Issued Patent</td>
<td>9,243,344</td>
<td>01/26/2016</td>
<td>2007-809</td>
</tr>
<tr>
<td>United States Of America</td>
<td>Issued Patent</td>
<td>8,253,221</td>
<td>08/28/2012</td>
<td>2007-809</td>
</tr>
</tbody>
</table>

RELATED CASES
2007-809-0

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
▶ Edge-Emitting Laser Diode with Via-Activated Tunnel Junction Contact
▶ 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

CONTACT
University of California, Santa Barbara Office of Technology & Industry Alliances
dobis@tia.ucsb.edu
tel: View Phone Number.

INVENTORS
▶ Hashimoto, Tadao
▶ Nakamura, Shuji

OTHER INFORMATION
KEYWORDS
GaN, Gallium Nitride Crystals, indssl, indbulk, cenIEE

CATEGORIZED AS
▶ Engineering
▶ Energy
▶ Lighting
▶ Other
▶ Materials & Chemicals
▶ Other
▶ Semiconductors
▶ Design and Fabrication
Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
Internal Heating for Ammonothermal Growth of Group-III Nitride Crystals
Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
Phosphor-Free White Light Source
Control of Photoelectrochemical (PEC) Etching by Modification of the Local Electrochemical Potential of the Semiconductor Structure
Low Temperature Deposition of Magnesium Doped Nitride Films
Transparent Mirrorless (TML) LEDs
Improved GaN Substrates Prepared with Ammonothermal Growth
Laser Diode With Tunnel Junction Contact Surface Grating
Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes
Method for Enhancing Growth of Semipolar Nitride Devices
III-Nitride Tunnel Junction with Modified Interface
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
Method for Manufacturing Improved III-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected III-Nitride LEDs
High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
Method for Growing High-Quality Group III-Nitride Crystals
Near-Infrared, Flip-Chip, TCO-Clad, InGaN Quantum Dot Laser Diode
Incorporating Temperature-Sensitive Layers in III-N 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
Heterogeneously Integrated GaN on Si Photonic Integrated Circuits
(Al, In,Ga, B)N Device Structures
Growth of Group III-Nitride Crystals using Supercritical Ammonia and Nitrogen
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
Growth of Semipolar III-V Nitride Films with Lower Defect Density
III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
Multifaceted III-Nitride Surface-Emitting Laser
Tunable White Light Based on Polarization-Sensitive LEDs
Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
III-Nitride VCSEL with a High Indium Content Active Region
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
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
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