Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation

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OTHER INFORMATION

KEYWORDS

indfeat, VCSELs, LiFi, Augmented Reality, Virtual Reality, quantum wells, m-plane, semiconductors

CATEGORIZED AS

- **Communications**
  - Other
- **Energy**
  - Lighting
- **Imaging**
  - 3D/Immersive

RELATED CASES

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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 VCELs 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

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,532,922	12/20/2022	2018-250

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation
- III-Nitride-Based Vertical Cavity Surface Emitting Laser (VCSEL) with a Dielectric P-Side Lens
- Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
- Ultraviolet Laser Diode on Nano-Porous AlGaN template

- Improved Reliability & Enhanced Performance of III-Nitride Tunnel Junction Optoelectronic Devices
- (In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
- Thermally Stable, Laser-Driven White Lighting Device
- Methods for Fabricating III-Nitride Tunnel Junction Devices
- Contact Architectures for Tunnel Junction Devices
- III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- Novel Multilayer Structure for High-Efficiency UV and Far-UV Light-Emitting Devices
- A Method To Lift-Off Nitride Materials With Electrochemical Etch
- High-Intensity Solid State White Laser Diode
- Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
- High-Efficiency and High-Power III-Nitride Devices Grown on or Above a Strain Relaxed Template
- III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture

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