

[Request Information](#)

[Permalink](#)

Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation

Tech ID: 29210 / UC Case 2018-250-0

CONTACT

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

INVENTORS

- ▶ DenBaars, Steven P.
- ▶ Forman, Charles A.
- ▶ Kearns, Jared A.
- ▶ Lee, SeungGeun
- ▶ Nakamura, Shuji
- ▶ Speck, James S.
- ▶ Young, Erin C.

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

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 or 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](#)
- ▶ [Methods to Produce and Recycle Substates for III-Nitride Materials with Electrochemical Etching](#)

- 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
- 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
- Epitaxial Light Control Features in Light Emitting Diodes
- High-Efficiency Vertical Cavity Surface Emitting Laser Fabrication
- A Wafer-Scale, Low Defect Density Strain Relaxed Template for III-Nitride-Based High Efficiency and High-Power Devices
- 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

University of California, Santa Barbara
Office of Technology & Industry Alliances
342 Lagoon Road, Santa Barbara, CA 93106-2055 |
<https://www.tia.ucsb.edu>
Tel: 805-893-2073 | Fax: 805.893.5236 | padilla@tia.ucsb.edu



© 2018 - 2022, The Regents of the University of California
[Terms of use](#)
[Privacy Notice](#)