Large Cavity Laser Diode



Overview

Sacher Lasertechnik is technology leader for tunable high power external cavity diode lasers. Applications incl.

Key Takeaways

Large cavity laser diodes are high-power semiconductor lasers with extended resonator lengths, offering narrow linewidth, high output power, and enhanced wavelength stability.

Overview

Large cavity laser diodes are designed with extended optical cavities, often several millimeters long, to improve performance characteristics such as spectral linewidth, output power, and temperature stability. These diodes can be implemented as broad-area lasers or integrated with distributed feedback (DFB) gratings to maintain a stable wavelength and narrow linewidth, even under high-power operation (e.g., 24. 8 W output at 940 nm with a 4 mm cavity length).

The extended cavity reduces mode competition and allows for better beam quality and higher slope efficiency.

Design Features

Cavity Length: Large cavities, typically several millimeters, increase the effective resonator length, which narrows the spectral linewidth and improves mode stability. Stripe Width: Broad-area diodes often have wide stripes (e.g., 200 µm) to support higher output power while maintaining beam quality. Grating Integration: First-order DFB gratings or volume Bragg gratings (VBGs) are incorporated to stabilize the emission wavelength and reduce linewidth, enabling precise spectral control.

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External-

Cavity Configurations: Some large cavity diodes are combined with external cavities, such as Littrow or Littman-Metcalf arrangements, to allow tunable, narrow-linewidth operation and mode-hopping-free wavelength scanning.

Performance Characteristics

High Output Power: Large cavity diodes can achieve multi-watt output, suitable for industrial, scientific, and nonlinear optical applications. Narrow Linewidth: Linewidths can be reduced to sub-nanometer or even kilohertz levels when combined with external cavities or DFB gratings, improving coherence for spectroscopy and coherent communication. Temperature Stability: Extended cavities and grating feedback provide a wide temperature locking range, maintaining wavelength stability across varying operating conditions.

Tunable Operation: External-cavity designs allow continuous wavelength tuning over tens of nanometers without mode hopping, which is critical for applications like optical sensing and coherent detection.

Applications

Large cavity laser diodes are widely used in: Optical communications: Narrow linewidth and tunable lasers improve transmission distance and spectral efficiency. Precision spectroscopy and atomic physics: High coherence and tunability enable accurate measurements. Nonlinear optics: Dual-wavelength or high-power diodes are used for frequency conversion, terahertz generation, and Raman spectroscopy.

Industrial and medical applications: High-power output supports material processing, pumping of solid-state lasers, and medical laser systems.

Summary

Large cavity laser diodes combine extended resonator lengths, grating feedback, and broad-area designs to achieve high power, narrow linewidth, and tunable operation. They are versatile tools for applications requiring stable, coherent, and high-intensity laser sources, and their performance can be further enhanced through external-cavity configurations or dual-wavelength setups. These features make them essential in both research and industrial laser systems.

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Article Content

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Sacher Lasertechnik is technology leader for tunable high power external cavity diode lasers. Applications incl. Absorption and Raman spectroscopy, environmental analysis, process control,

Study on external cavity diode laser with a wide mode

Abstract A wide mode-hopping free and narrow linewidth tunable laser diode source with a Littman-Metcalf arrangement based on a diffraction grating is

High-power 940 nm DFB laser diode with large optical

In this study, we introduce a first-order distributed feedback (DFB) grating into an asymmetric large-cavity laser diode operating around 940 nm. This design

Wide Tunable Spectrum and High Power Narrowed

We demonstrate a dual-wavelength broad-area diode laser system with narrow linewidth and wide spectral tunability using a composite external

Precisely Tunable 780 nm External Cavity Diode Laser

In this study, we present a 780 nm tunable external cavity diode laser (ECDL) with narrow linewidth. An angle-adjustable interference filter (IF) is

Widely tunable and narrow-linewidth violet lasers enabled by UV ...

Here, we demonstrate the first integrated, extended cavity diode laser based solely on UV-transparent materials. We integrate aluminum oxide waveguide circuits with gallium nitride

DL pro – Tunable External Cavity Diode Laser | Narrow

As one of the most trusted narrow linewidth lasers in its class, the DL pro combines excellent spectral performance with usability. A fully digital controller ensures

Design and optimization of a grating-free external cavity diode laser ...

Abstract A novel grating-free tunable external cavity diode laser has been designed and optimized, featuring an impressive phase-continuous tuning range exceeding 6 THz. The laser cavity

High-Power Low-Divergence 852 nm single transverse mode diode

By introducing the structure of a coupled large optical cavity (CLOC) and optimizing the position and thickness of the coupled waveguide layer, a high-power single mode semiconductor

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Fabrication of laser diode array

U.S. Patent Application - for a process of making a laser diode device includes these steps: applying a bonding layer such as molybdenum manganese to surfaces of first and second bodies of dielectric

External Cavity Diode Lasers for Atom Gravimetry: A Review of ...

External cavity diode lasers (ECDLs), with their narrow linewidth, high frequency stability, and tunable wavelengths, are key light sources in atom gravimeters (AGs). As these instruments evolve toward

Semiconductor laser diode with shortened cavity length

A semiconductor laser diode (LD) with a shortened cavity length is disclosed. The LD provides a rectangular substrate and, on the substrate, a cavity structure including a mesa with facets forming

Compact and Highly Efficient Laser Pump Cavity

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Laser Diode Market by Type, Doping Material, Technology, Mode of ...

Laser Diode Market by Type, Doping Material, Technology, Mode of Operation, Application - Global Forecast 2026-2032 - The Laser Diode Market is projected to grow by USD 23.62 billion at a

LASER DIODE BONDER | Semiconductor Equipment Corp. | New

The model 860 Omni laser diode bonder is suitable for use with vertical-cavity surface-emitting lasers, edge-emitting laser diodes and laser bars and arrays. Semiconductor Equipment Corp. says it aligns

Parameter Overview of Laser Diodes by Dr. Kamran S. Mobarhan

Parameter Overview of Laser Diodes. Specification Comparison Site. Hundreds of Laser Diode Controllers. ALL OF THE BRANDS on One Site.

Injection locking of a low cost high power laser diode at 461 nm

Mentioning: 15 - Stable laser sources at 461 nm are important for optical cooling of strontium atoms. In most existing experiments this wavelength is obtained by frequency doubling infrared lasers, since

Suppression of higher-order modes in a large-optical-cavity waveguide ...

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The calculated and experimental results provide us with new insight into the design of large-optical-cavity waveguide-structure diode lasers. When the asymmetry of the studied waveguide

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This document is for preliminary research. Verify specifications against current standards, product documentation and project requirements.

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