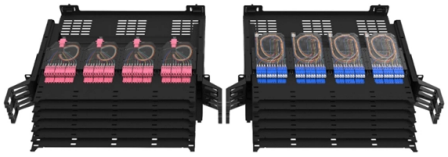
Converting a laser diode to white light



Overview

White Light Generation and Stability Analysis of High-Power BlueIn this paper, we analyzed the implementation and characteristics of white light generated.

Key Takeaways

White light can be generated from laser diodes by using phosphor converters or nonlinear optical processes in fibers, producing broadband, high-luminance light suitable for lighting, automotive, and industrial applications.

Phosphor-

Based Conversion

One of the most common methods uses a blue or near-UV laser diode to excite a phosphor material, which absorbs part of the laser light and re-emits it across a broad spectrum, creating white light. For example, high-power blue diode lasers at 450 nm can illuminate a rotating phosphor wheel, producing luminous fluxes exceeding 100,000 lumens with high luminance levels up to 1,500 cd/mm², suitable for solar simulation, metrology, or event lighting. Nichia's GigaWhite™ technology combines a blue laser diode with phosphor to produce ultra-bright, uniform white light for automotive headlights and industrial lighting, achieving brightness roughly ten times higher than conventional LEDs.

This approach allows compact designs and high optical efficiency while maintaining color stability.

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Fiber-

Based Nonlinear White Light Generation

Another approach uses ultrashort pulsed lasers coupled into tapered or photonic crystal fibers. The high peak power of femtosecond or picosecond pulses induces nonlinear optical effects such as self-phase modulation, soliton formation, and Raman shifting, which broaden the narrow laser spectrum into a white light continuum spanning 400–1400 nm. Diode-pumped solid-state lasers, such as Yb:glass femtosecond oscillators, can serve as pump sources, enabling compact and cost-effective white light lasers with output powers up to several hundred milliwatts.

Advantages of Laser-

Driven White Light

Compared to LEDs, laser diodes maintain efficiency at high currents without droop, and the emitted light can achieve higher luminance and longer projection distances. The combination of laser diodes and phosphor or fiber-based systems allows tunable color temperatures, high color rendering indices, and stable output suitable for precision applications like spectroscopy, optical coherence tomography, and advanced microscopy.

Summary

In practice, converting laser diode light to white light involves either: Phosphor conversion, where blue or near-UV laser light excites phosphors to emit broadband white light, enabling high-power, compact, and uniform illumination. Nonlinear fiber continuum generation, where ultrashort laser pulses broaden the spectrum through nonlinear effects in specialized fibers, producing a wide spectral range. Both methods leverage the high brightness and coherence of laser diodes to achieve efficient, high-quality white light for industrial, scientific, and automotive applications.

Article Content

White Light Generation and Stability Analysis of High-Power Blue

In this paper, we analyzed the implementation and characteristics of white light generated by the excitation of transmissive single crystal remote YAG phosphors using high optical power blue

Blue Skies for High Power White Light by Blue Diode Lasers

Irradiating the phos-phor wheel with blue laser light leads to an efficient conversion into a broadband light spectrum. The result is white light with a wavelength spectrum of about 450 to 750 nm and high

Method and apparatus for converting into white light under laser ...

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A method and apparatus for converting into white light under laser excitation, and specific applications of the method and the apparatus in the field of lighting.

From blue laser to high-power white light

The systematic combination of the established phosphor conversion process with blue Laserline high-power diode lasers has ultimately resulted in a process that provides unprecedented

Novel Laser-Diode Based White Light Source with Increased Radiant

Novel high-luminance light sources are being investigated for applications such as car headlights and street lighting. The availability of efficient and powerful blue laser diodes, makes it possible to realize

(PDF) Efficiency and stability of a phosphor-conversion white light ...

We fabricated a phosphor-conversion white light emitting diode (LED) using an InGaN chip that emits 400 nm near-ultraviolet (n-UV) light and phosphors that emit in the blue and yellow...

Laser-driven phosphor-converted white light source for

Our paper describes the design and construction of a domestic/office-type solid-state luminaire driven by light from an integrated violet laser-diode

Efficiency and stability of a phosphor-conversion white light source ...

We have studied in this preliminary study a phosphor-conversion white light source based upon a blue light-emitting laser diode. The next step is the characterization of the ageing over a

High-Brightness Phosphor-Converted White LDs With High Color

Abstract: To realize both high luminance and excellent color rendering for laser lighting, a novel phosphor-converted white laser diode (pc-wLD) was proposed by combining blue laser diode

Laser-driven dual-ceramic converters enabling high-luminance white

This work overcomes the inherent limitations of spontaneous fluorescence radiation and lateral photon transport in transparent ceramics under laser excitation, establishing a transformative

Laser Lighting: White-light lasers challenge LEDs in directional ...

Diode-pumped phosphor To produce these white-light laser SMDs and luminaires, a high-power blue indium gallium nitride (InGaN) semipolar laser diode excites a very small remote phosphor target

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Blue Skies for High Power White Light by Blue Diode Lasers

LDMblue diode lasers and rotating phosphor converters revolutionize white light generation The generation of high-power white light with more than 100,000 lumens has so far encountered

Efficiency and stability of a phosphor-conversion white light source ...

A white light source using direct phosphor-conversion excited by a blue laser diode is presented. In this preliminary study we have investigated the influence of phosphor''s thickness and

Phosphor-conversion white light using InGaN ultraviolet laser diode

We fabricated a phosphor-conversion white light using an InGaN laser diode that emits $405phantom{rule{0.3em}{0ex}}mathrm{nm}$ near-ultraviolet (n-UV) light and phosphors that emit

Laser Diodes

The Laser Diodes work, how laser light is produced at atomic level. Laser pumping and stimulated emission of photons, Laser diodes and LEDs, Laser safety classifications.

Heat Dissipation Enhancement of Phosphor-Converted White Laser Diodes ...

Laser-driven white lighting has been considered as a next-generation high-brightness white lighting source. Thermally stable color converter is an essential down-conversion material for

Laser-Driven White Light Source With High Luminescence Saturation ...

In this letter, a laser-driven white light source with high luminescence saturation was fabricated by combining blue laser chips and an Al2O3-doped reflective color converter. The

How to Build a Laser Diode Circuit

In this article, we will show how to connect and build a simple laser diode circuit to get light output from a laser diode.

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