How to weld diodes using laser welding

Overview

This page describes the difference between semiconductor (LD) laser welding, also called laser diode (LD) welding, and gas laser or solid-state laser welding.

Key Takeaways

Laser welding diodes involves using a semiconductor laser as a precise heat source to join materials with minimal thermal impact, requiring careful control of power, alignment, and part positioning.

Understanding Diode Lasers

A laser diode is a semiconductor device that emits coherent light when an electrical current passes through a p-n junction, creating population inversion and stimulated emission of photons ( ). Diode lasers are compact, energy-efficient, and can operate in continuous wave (CW) or pulsed modes, making them suitable for precision welding applications ( ).

Principles of Diode Laser Welding

Semiconductor laser welding uses the laser beam generated by the diode as the heat source to melt and join materials ( ). Unlike traditional lasers (CO_2 or YAG), diode lasers do not require a lamp for excitation, allowing for compact setups and reduced maintenance ( ). The high-quality, high-energy beam can achieve welds comparable to electron beam welding, but strict control of the gap between parts is necessary to ensure consistent results ( ).

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Equipment and Setup

Laser Diode Selection: Choose a diode with appropriate wavelength, power, and beam quality for the material being welded. Fiber-coupled high-power diodes are commonly used for remote or automated welding ( ). Mounting and Alignment: Secure the diode and workpiece to minimize vibration.

Precise alignment ensures the laser energy is focused on the weld joint ( ). Power Control: Use a laser driver to regulate current and pulse duration. Pulsed operation can reduce heat input and prevent damage to sensitive components ( ).

Material Preparation: Clean surfaces to remove oxides or contaminants. Proper fixturing ensures consistent gap and contact during welding ( ). Safety Measures: Always use protective eyewear and shielding to prevent exposure to high-intensity laser light ( ).

Welding Process

Position the parts with minimal gap tolerance, as diode lasers are sensitive to spacing ( ). Apply the laser beam either in continuous or pulsed mode, depending on material thickness and thermal sensitivity ( ). Monitor the weld visually or with sensors to ensure penetration and avoid overheating.

Post-weld inspection may include microscopy or electrical testing to verify joint integrity.

Applications

Diode laser welding is widely used in electronics, automotive, and body-in-white manufacturing, particularly for joining aluminum or thin metal sheets where traditional spot welding is less effective ( ). Advantages include low heat input, narrow weld seams, high process speed, and reproducible results ( ). By carefully selecting the diode, controlling power, and maintaining precise alignment, laser welding with diodes can produce high-quality, reliable joints suitable for sensitive or high-precision applications.

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Article Content

Semiconductor (LD) laser welding

This page describes the difference between semiconductor (LD) laser welding, also called laser diode (LD) welding, and gas laser or solid-state laser welding. This page also explains the excitation

Conduction, Transition & Keyhole Welding: Laser Welding Modes

The three main laser welding modes—conduction, transition, and keyhole welding—are examined in this article, with an emphasis on keyhole welding''s methodology, uses, and the ways diode lasers

Diode Lasers and Remote Welding

While nowadays diode la-sers in car-body construction are the industry standard for brazing, cutting and welding of aluminum and steel, a new promising technology in body-shell work emerges: remote

Research on Hybrid Blue Diode-Fiber Laser Welding Process of T2

This research proposes a non-penetration lap welding process for joining T2 copper power module terminals in high-frequency and high-power electronic applications, using a hybrid

Welding with High Power Diode Lasers

In particular, it compares the capabilities and characteristics of diode lasers with other welding laser technologies, reviews the applications best suited for diode welding and provides some guidance on

Application of Laser Welding in Electric Vehicle Battery ...

Laser welding has the advantages of non-contact, high energy density, accurate heat input control, and easy automation, which is considered to be the ideal choice for electric vehicle

Copper Welding: Efficent Methods & Tips

Here, the welding of hairpins is tested using a laser system consisting of a blue diode laser from Laserline combined with the SUPERSCAN IV-30 deflection unit from RAYLASE.

Monitoring of Welding Using Laser Diodes

From the beam profile results, we can conclude that the emission pattern of the laser diode is narrow, and hence, it is possible to use a cluster of laser diodes for illumination without the need to deliver

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Diode laser welding

Before delving further into welding with diode lasers, it makes sense to discuss the different laser welding techniques: keyhole and conduction welding. Both of these are typically

Laser Welding Fundamentals

The diode laser is a well-established laser technology that been used for many plastic welding applications, notably in the automotive industry for welding the rear light housing.

How Do I Weld Aluminium? A Definitive Guide to the

Similarly to laser welding, electron beams are good at producing fast welds and small weld pools. Electron beams are also better at producing welds in very thick

Best Laser Welder For Workshops, Repairs, And Small Metal Fabrication

Conclusion The best laser welder is the one that fits your actual work—helping you weld cleaner, move faster, reduce finishing, and maintain consistent quality. Dynalasers M, D, and S

Laser Microwelding

The weld quality can also be affected by non-laser conditions such as fit-up between the parts, variation in input materials, contamination (oil or dust), focus position and oxidation of the work surface. Thus

Is Laser Welding a Good Fit for Your Operation? | MillerWelds

Laser welding advancements The use of laser welding continues to grow in automated welding applications, due to advancements that have made the technology more accessible and affordable.

Welding with High Power Diode Lasers

As a result, diode lasers are poised to replace traditional laser sources for some applications and also expand laser welding implementation into entirely new areas. This article provides an introduction to

Method for laser welding metal workpieces using a combination of weld ...

U.S. Patent Application US20200171603A1 for a method of laser welding together two or more overlapping metal workpieces (12, 14, or 12, 150, 14) included in a welding region of a workpiece

Diode Lasers: Definition, How They Work, Types,

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Laser diodes are widely used across various industries, including telecommunications, material processing, and medical treatments. This article

Benefits of Direct Diode Lasers for Welding

The autogenous welding of 304 SS was also investigated with the direct diode laser using the six-axis robot. The goal of this investigation was to obtain complete penetration of the specimen, while

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