Optical Module Welding Technology

Overview

Fusing optical coherence tomography and coaxial image for contact Innovative Fusion System: A novel optical system was designed to couple optical coherence.

Key Takeaways

Optical module welding technology uses advanced optical systems like OCT and lens-shifting optics to achieve real-time, high-precision monitoring and control of laser welding processes.Overview

Optical module welding integrates optical measurement and monitoring systems directly into laser welding setups to ensure precise weld placement, consistent quality, and defect prevention. These systems are widely used in industries requiring high accuracy, such as automotive, e-mobility, and battery manufacturing .

Key Technologies

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1. Optical Coherence Tomography (OCT) OCT is a non-contact, high-resolution imaging technique that measures weld penetration and internal structure in real time. By detecting interference between light reflected from the weld and a reference beam, OCT provides micron-level resolution of weld depth and geometry without affecting the workpiece or welding optics . It enables pre-weld inspection, in-process monitoring, and post-weld review, improving yield and reducing manual inspection. 2. Lens Shifting Optics (LSO) LSO systems automatically adjust the laser focus and track the weld seam by shifting lenses laterally and axially. Combined with OCT, LSO ensures precise seam tracking, compensates for positional tolerances, and maintains optimal focus during welding. The system can determine weld joint positions every 10 ms with an accuracy of 0.05 mm, enabling high-speed, high-precision welding . 3. Real-Time Process Monitoring Advanced optical modules, such as LWM and LDD systems, continuously monitor welding parameters, including seam position, weld depth, and surface profile. These systems detect deviations in laser power, focus, or component alignment, providing immediate alerts and enabling AI-assisted quality control. This reduces scrap, rework, and downtime while maintaining consistent weld quality .

Industrial Applications

• Battery Manufacturing: Optically guided laser welding ensures precise alignment of battery cell connectors, allowing continuous welding at speeds up to 1000 mm/sec with real-time corrections, enhancing safety and reliability .

• Automotive and E-Mobility: High-volume laser welds require consistent depth and seam quality; OCT and LSO systems provide inline monitoring to prevent defects and maintain production efficiency .

• General Precision Welding: Optical modules are used in micro-welding and high-performance metal joining, where component tolerances and surface conditions can affect weld integrity .

Benefits

• High Accuracy: Micron-level measurement of weld depth and seam position.

• Real-Time Control: Immediate correction of focus, alignment, and welding parameters.

• Non-Destructive: In-process monitoring without damaging the workpiece.

• Increased Productivity: Faster welding speeds with reduced manual inspection.

• Quality Assurance: Automated detection of defects and process anomalies, ensuring repeatable and reliable welds. Optical module welding technology represents a critical advancement in laser welding, combining precision optics, real-time monitoring, and intelligent control to optimize both efficiency and quality in modern manufacturing processes .

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Article Content

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Innovative Fusion System: A novel optical system was designed to couple optical coherence tomography (OCT) with

Real-Time Weld Measurement

Patented inline coherent imaging technology provides exceptionally accurate weld depth data — but that''s

Optical Communication Module Sealing Device

Automated hermetic sealing through non-contact, zero-pressure laser seam welding. Image recognition

OCT Penetration Online Detection System-JPT Laser

Performs high-resolution OCT imaging without affecting the workpiece or welding optics, ensuring safe and worry-free operation.

Real-time monitoring and optimization techniques for ...

The laser welding method is characterized by optical, thermal, and even acoustic signals. Consequently, the nature of

Laser Soldering Process in 5G Communication and Optical Module ...

In summary, laser soldering technology holds broad application prospects in 5G communication and optical module processing. Its

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Compared to mechanical bonding such as tightening, bending, and contraction, or chemical bonding using adhesives, welding melts

Laser intelligent manufacturing empowers optical module upgrades!

Fly Laser uses core technology to solve SFP/QSFP welding problems. Driven by the dual growth of 5G

YXFiber''s automatic welding machine: How does it achieve zero-error ...

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LASER WELDING USING OPTICAL COHERENCE TOMOGRAPHY

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Just recently this year Siemens and Precitec demonstrated a fully closed-loop controlled LMD process by integrating the OCT

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Fiber laser welding is a welding process that uses a laser beam as the heat source. As non

Optical module

An optical module is a typically hot-pluggable optical transceiver used in high-bandwidth data

Picosecond laser welding of optical to metal components

We report on practical, industrially relevant, welding of optical components to themselves and aluminum alloy

A review of beam shaping technology in laser welding applications

Beam shaping technology has emerged as a key approach for improving weld quality, process stability, and efficiency

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Explore how robotic module welding boosts accuracy, safety, and productivity in manufacturing through advanced

LASER WELDING USING OPTICAL COHERENCE TOMOGRAPHY

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Laser welding monitoring techniques based on optical ...

Finally, future research and challenges in real-time laser welding monitoring technology based on optical diagnostics

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Laser Welding Technology

Laser welding technology, recognized for its advantages such as its fast welding speed, high productivity, and energy

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Laser microwelding for fiber-chip coupling modules with tapered ...

We design a laser welding machine for fabricating butterfly (BFY) modules with an optical coupling setup that is well

Research on electronic optical monitoring technology and system

Abstract Electron beam welding technology is increasingly used in industrial manufacturing due to its high power

Optical Module: A Comprehensive Analysis from Source to Terminal

In the future, with continued technological innovation and breakthroughs, optical modules will play an more critical role

High-performance, digitally power controlled mini-laser welder ...

Owing to the rapid progress in information technology, requirements for optical modules to be used in optical fiber

Real-time monitoring and optimization techniques for ...

In this review paper, the monitoring techniques applied to laser welding are presented and summarized. An on-line

Laser Assisted Bonding (LAB) Technology Leads

From 2016 to 2020, silicon photonics enabled the integration of optoelectronic chips with CMOS

Weld tracking technology for all-position welding of pipes based on ...

The research is conducted on weld seam tracking technology for the all-position welding process of large-sized groove

Progress and perspectives of in-situ optical monitoring in laser beam ...

Fig. 1 shows the content structure of this review, which consists of two mainstream processes. In forward-process (2

Application of laser welding technique for high speed optical ...

In this paper, low PWS (post-weld shift) and large aligning tolerance DFB-LD (distributed feedback laser diode) modules and APD

Special features of the technology of low-temperature brazing of ...

(2006). Special features of the technology of low-temperature brazing of optical modules. Welding International: Vol. 20,

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Everything You Need to Know About Optical Modules

These standards require optical modules with higher data rates and greater power efficiency, which has led to

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The Most Comprehensive Guide Of Optical Modules

Explore the ultimate guide to optical modules. Learn types, functions, performance metrics

Laser Welding Next Generation EV Battery Modules

The first of these technologies is dual-beam fiber laser welding. The second is real-time, in-process weld measurement and

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