

Laser Diode Edge Sealing Process



Overview

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Key Takeaways

Laser diode edge sealing is typically achieved using laser hermetic sealing, which provides a durable, precise, and low-thermal-impact method to protect the diode from moisture and contaminants.

Laser diode edge sealing involves creating a hermetic barrier around the edges of the diode package to prevent environmental degradation. This is critical because laser diodes are sensitive to moisture, oxygen, and particulate contamination, which can reduce performance and lifetime. The process uses a focused laser beam to fuse or weld the package materials, forming a strong, airtight seal.

Common Techniques

- Laser Welding (Fusion Welding)
- Uses a high-intensity laser, often Nd:YAG, to melt and fuse metals or metal-ceramic interfaces.
- Provides minimal heat-affected zones, reducing thermal stress on the diode.
- Can handle reflective materials and tolerates minor misalignments better than resistance welding.
- Allows for complex geometries and precise control over the seal location.

- Laser-Assisted Additive Sealing
- Involves micro-sized glass frits or bonding inks cured with a continuous-wave laser .
- Suitable for glass-to-glass or ceramic-to-glass seals.
- Optimized for low thermal budgets, preserving sensitive diode structures.
- Achieves high bonding strength (e.g., 5–6 MPa) while maintaining hermeticity.

Advantages Over Other Methods

- Non-contact process: Reduces mechanical stress on delicate diode structures .
- High reliability: Produces hermetic seals that meet aerospace and military standards .
- Fast processing: Laser systems can be CNC-programmed for high throughput .
- Material flexibility: Can seal metals, ceramics, and some mixed-material packages .
- Minimal thermal distortion: Critical for maintaining diode alignment and optical performance .

Design Considerations

- Material compatibility: Metals and ceramics must be chosen to avoid intermetallic issues and ensure proper fusion .
- Laser parameters: Power, spot size, and travel speed must be optimized to prevent cracking or incomplete sealing .
- Inspection: Closed-circuit TV or optical systems are often used to align the laser precisely with the package edge .
- Thermal management: Rapid cooling can affect weld quality; careful control is required for mixed-metal packages .

Summary

Laser diode edge sealing is a high-precision, reliable method for creating hermetic seals that protect sensitive semiconductor lasers. By using laser welding or laser-assisted bonding, manufacturers can achieve durable, low-thermal-impact seals suitable for high-performance applications in telecommunications, medical devices, and aerospace . Proper material selection, laser parameter optimization, and inspection are essential to ensure long-term reliability and performance.

Article Content

Basic Diode Laser Engineering Principles

To develop a good understanding of diode laser operation, key electrical, optical and thermal parameters and characteristics are

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