



Fiber Laser Solutions for **E-MOBILITY APPLICATIONS**





THE WORLD LEADER IN FIBER LASERS

IPG Photonics is the inventor and world's leading producer of high-power fiber lasers, which enable greater precision, higher-speed processing, more flexible production methods and enhanced productivity. IPG fiber lasers combine the advantages of semiconductor diodes, with the high amplification and precise beam qualities of unique optical fibers to deliver superior performance, reliability and usability.

IPG has continually pioneered the development and commercial production of numerous unique technologies related to fiber lasers combining deep materials science expertise and process know-how with a vertically-integrated business model. All key components of its fiber laser technology are produced in-house, enabling:

- **Faster product development**
- **More efficient production methods**
- **Industry leading product delivery times**
- **Better performing, higher quality solutions**
- **Highest wall-plug efficiencies that lower overall energy consumption and costs**

IPG PHOTONICS
WWW.IPGPHOTONICS.COM
+1 508-373-1100
Sales.US@ipgphotonics.com


 **FOUNDED
1990**

43,000
DEVICES SHIPPED
IN 2018 

 **350
PATENTS**
450 PENDING

+100K
INSTALL BASE 

 **13M** LESS TONNES OF
GLOBAL CO₂ EMISSION WHEN OPERATING
IPG LASERS COMPARED TO OTHERS

 **+66%** OF FIBER LASERS
MANUFACTURED WORLDWIDE

IPG Innovation Drives E-MOBILITY MANUFACTURING

57%

OF ALL PASSENGER
VEHICLE SALES BY 2040
WILL BE ELECTRIC*

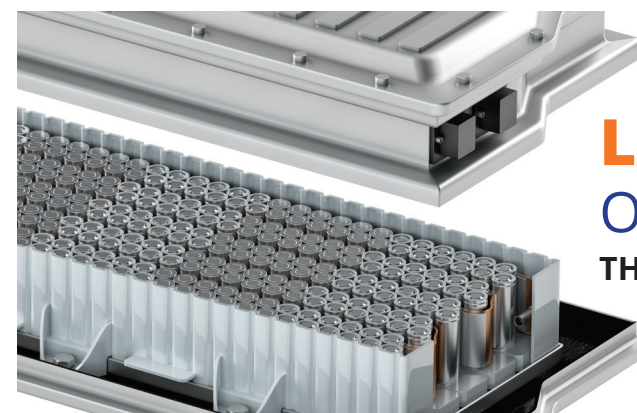
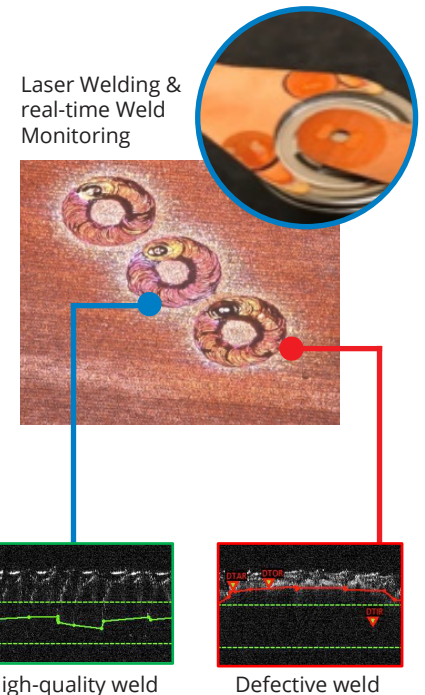
As EV manufacturers aim to improve production efficiencies they turn to IPG more than any other industrial laser provider. Through continuous innovation and total vertical integration, **IPG provides the most reliable, energy efficient, productive and powerful lasers in the world.** IPG has longstanding, proven and trusted integration within the automotive industry and intimately understands the demanding requirements of automotive production.

High reliability laser welding is needed for the millions of cylindrical batteries, pouches and prismatic cells requiring billions of welds to produce safe and efficient battery packs. IPG has committed extensive global resources towards the development and deployment of the most productive laser processing systems to enable high yield, high quality electric vehicle production and battery welding solutions.

IPG innovations include automated battery welding systems that not only weld at high speeds but also fully test modules ahead of final assembly. Adjustable mode beam lasers weld complex material configurations and inline weld process monitoring offers unmatched real-time quality assurance.

IPG continuous innovation drives unique and reliable fiber laser solutions to enable the automotive industry to boost quality, improve throughput and decrease manufacturing costs. EV manufacturers integrate IPG fiber laser solutions to address their manufacturing challenges head-on to optimize their overall production processes and produce the highest quality e-mobility components and vehicles.

MILLIONS
OF BATTERY CELLS REQUIRE
BILLIONS of WELDS



LASER WELDING OF CYLINDRICAL BATTERIES
OVER **10X** FASTER & MORE RELIABLE
THAN TRADITIONAL WIRE BONDING METHODS

*Electric Vehicle Outlook 2019, BloombergNEF

Revolutionizing E-Mobility Applications

1. EV BATTERY PACK MANUFACTURING

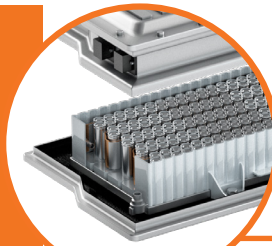
IPG SOLUTION: Complete integrated systems that handle, fixture, weld, test and assemble battery packs

CELLS TO MODULES TO PACKS

- Robotic component handling with barcode tracking
- Individual cell testing and module fixturing
- Busbars welded and assembled with cells
- Modules tested and reworked as needed
- Aluminum or steel enclosures welded into battery packs

LASER WELDING AND MONITORING

- >10 cells processed per second
- AMB lasers eliminate spatter with on-the-fly precision beam tuning
- Scan heads for consistent, reliable, high-quality cell to busbar welds
- Wobble welding for high-speed battery enclosure welding
- Inline process monitoring for real-time quality assurance to reduce defects



1 BATTERIES

Challenge: Reliable and consistent welds to produce safe and efficient battery packs

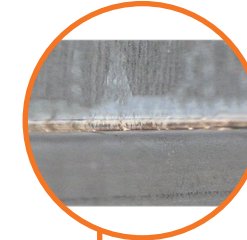
2 FRAME

Challenge: Cutting of ultra high-strength steel that cannot be mechanically trimmed



3 BODY

Challenge: High quality cosmetic welds that can be painted



2. STRUCTURAL STEEL CUTTING

IPG SOLUTION: YLS high-power fiber lasers and high power cutting heads for fast, reliable and clean cutting of ultra high-strength materials

3. BODY IN WHITE BRAZING

IPG SOLUTION: YLS BR trifocal brazing fiber lasers clean and join hot dipped galvanized steel in a single step at high-speeds with aesthetic finishes

4. PASSENGER SEAT WELDING

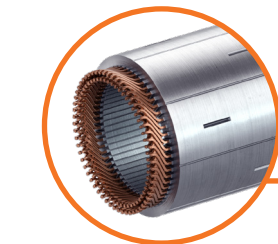
IPG SOLUTION: YLS fiber lasers with remote scan heads, LDD inline process monitoring assures weld quality

5. AIRBAG INFLATOR WELDING

IPG SOLUTION: YLS fiber lasers with remote scan heads, LDD inline process monitoring assures welding quality

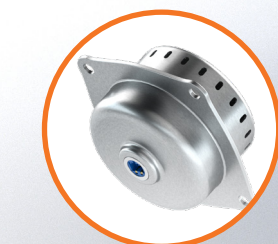
6. ELECTRIC MOTOR WELDING

IPG SOLUTION: YLS AMB dual-beam fiber lasers and remote scan heads optimize welding, LDD inline process monitoring assures welding quality



6 ELECTRIC MOTORS

Challenge: Welding dissimilar materials at high speeds with consistent high-quality



5 SAFETY

Challenge: Reduction of cycle time with weld quality assurance for life-critical components

4 SEATS

Challenge: Reduction of heat input and cycle time with weld quality assurance



IPG Technologies Increase QUALITY, RELIABILITY & SAFETY



IPG Automated Battery Welding Systems (BWS) weld battery cells **10X faster** than traditional wire bonding systems. This integrated solution delivers higher-yield EV batteries and requires less floor space with less part handling than ever before.

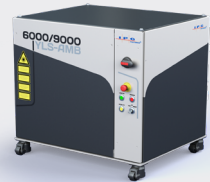
Automated Battery Welding Systems are custom configurable based on welding needs. Typical installations include:

- Battery cell loading
- Cell charge testing
- Assembly of battery cells
- Busbar welding and assembly
- Cells welded in < 0.1 second
- Inline weld monitoring and control
- Bed-of-nails testing: 10s of cells / second
- Traceable test results stored in cloud

Automated Battery Welding System

ADJUSTABLE MODE BEAM (AMB) LASERS

- Spatter reduction on EV batteries for **improved reliability** and **safety**
- **Superior welding quality** of challenging dissimilar materials
- **Faster, more uniform high-speed welding**



HIGH POWER SCAN HEADS

- **Consistent, precise, high-speed** welding of cells to bus bars
- **High strength welds** with **no seal damage**
- **Consistent penetration depth**



INLINE WELD MONITORING

- In-weld real-time monitoring and control for **optimal battery welds**
- **Eliminates the need** for destructive testing
- **Reduces scrap** and **increases overall throughput**
- **Identifies problems before processing begins**



WOBBLE WELDERS

- **Reliable, high-speed** welds for battery enclosures
- **Superior aesthetic finishes** with **no pitting or cracking**
- **Pressure-tested** hermetic seals



Premium Warranty & Support

IPG is committed to providing our customers with the best warranty in the industry. All IPG lasers listed in this brochure are warranted against defects in materials and workmanship, under normal use, for a minimum of two years; three years for the YLS family of lasers with extended warranties available up to ten years.

Unlike conventional laser technologies, IPG fiber lasers require no preventive maintenance. As long as output optics and coolant are properly maintained by the customer, the laser will perform consistently without adjustment or intervention which significantly reduces downtime and maintenance costs. Customer satisfaction is our goal at IPG. Teams of dedicated service professionals and technical support specialists worldwide are available whenever are wherever you need assistance. We strive to make the best fiber lasers and amplifiers in the world and back it up with our commitment to service.

Extensive Laser Solution Development

IPG offers free applications development through any of our Applications Centers worldwide. We offer prototyping and feasibility studies for prospective customers to evaluate fiber lasers for their unique applications. Our industry leading knowledge of fiber laser applications accelerates and improves application development, from industrial processing to micromachining. Each of our applications labs offers customers sample processing and process development recommendations, optical metrology and metallurgy testing, application consultations and a complete results report.



APPLICATIONS CENTERS WORLDWIDE

MATERIALS PROCESSING

- China, Beijing
- China, Shanghai
- China, Shenzhen
- Germany, Burbach
- Italy, Legnano
- India, Greater Noida
- Japan, Yokohama
- South Korea, Daejon
- Russia, Moscow
- USA, Novi, MI
- USA, Marlborough, MA

MICROMACHINING

- USA, Nashua, NH

MID-IR APPLICATIONS

- USA, Birmingham, AL

UV APPLICATIONS

- USA, Santa Clara, CA



IPG Photonics is the world leader in fiber laser technology, enabling greater **PRECISION**, higher **PRODUCTIVITY** and more **FLEXIBLE PRODUCTION** for industrial applications and other diverse end markets

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+1 508-373-1100
Sales.US@ipgphotonics.com