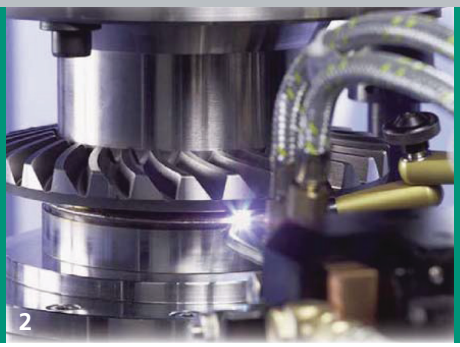
Fraunhofer
USA

FRAUNHOFER USA CENTER FOR LASER APPLICATIONS CLA

1



2

3

1 **Bolted Design vs. Laser Welded Design for an Automotive Differential Unit**

2 **Laser Welding Process**

3 **Laser Welded Powertrain Components**

Fraunhofer USA Center for Laser Applications CLA

46025 Port Street
Plymouth, MI 48170

Contact

Craig Bratt
Executive Director
cbratt@fraunhofer.org

www.cla.fraunhofer.org

LASER WELDING

Laser Beam Welding of Powertrain Components

We are the experts in laser welding technology and have successfully developed many new applications which have now been transferred into volume production improving efficiency and product quality for our many industrial clients.

Laser welding can be carried out autogenously (without filler material) or using metal filler wire or powder. Fraunhofer CLA has state-of-the-art equipment for both wire and powder delivery for specialist applications where it is required to close gaps or to improve the alloy composition of the weld metal.

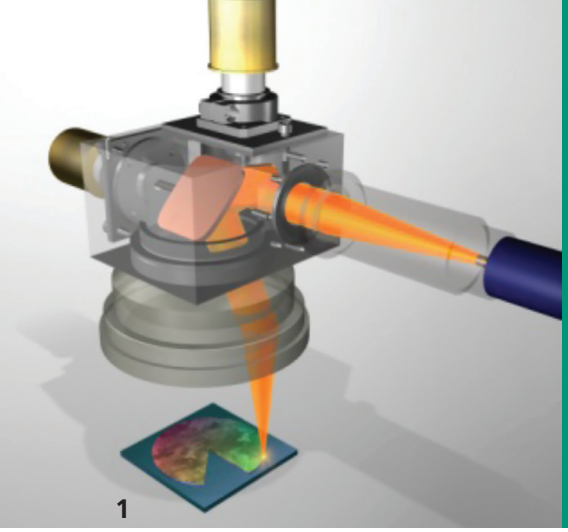
Process Advantages

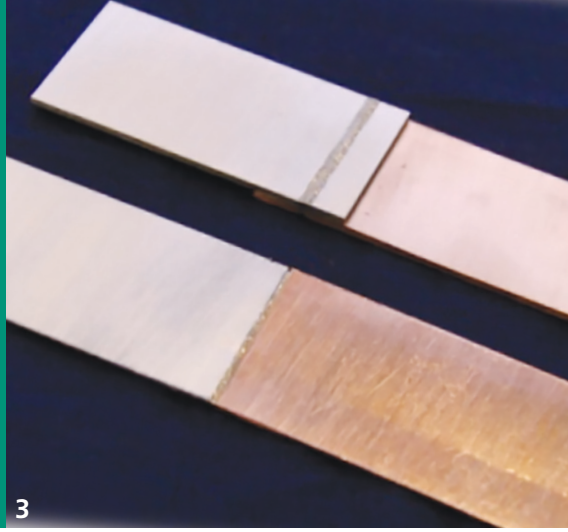
- High process speeds
- Low heat input and low distortion
- High automation and repeatability of the process
- Material and weight savings (by avoiding bolted assembly method and reduced flange sizes)

Laser Welding with Filler Wire

Cast Iron is used extensively in automotive powertrain components, particularly for differentials. In most conventional part designs a hardenable steel ring gear is bolted to a cast iron housing. If the bolting process can be replaced with welding, cost savings can be achieved through reduced material and processing costs, and an overall part weight reduction can be accomplished.

Laser beam welding with filler wire addition can be used for joining cast iron to steel for powertrain components. The filler material changes the composition of the weld, preventing the formation of hard and brittle phases and improves the weld properties. This also makes it possible to weld heat treatable steels to cast iron without removing the carburized layer.





E MOBILITY – BATTERY WELDING

Laser Welding of Bus Bars to Li-Ion Cell Terminals

Laser welding is fast and precise, and repeatable high weld quality can be achieved. We have successfully developed laser welding processes for a wide range of Lithium-Ion battery welding applications and transferred these into volume production.

For high performance applications such as electric vehicles, multiple Li-Ion cells are combined into large modules and packs, in which the terminal(s) of each cell is connected to the terminal(s) of the next cell(s) via a metal bus bar.

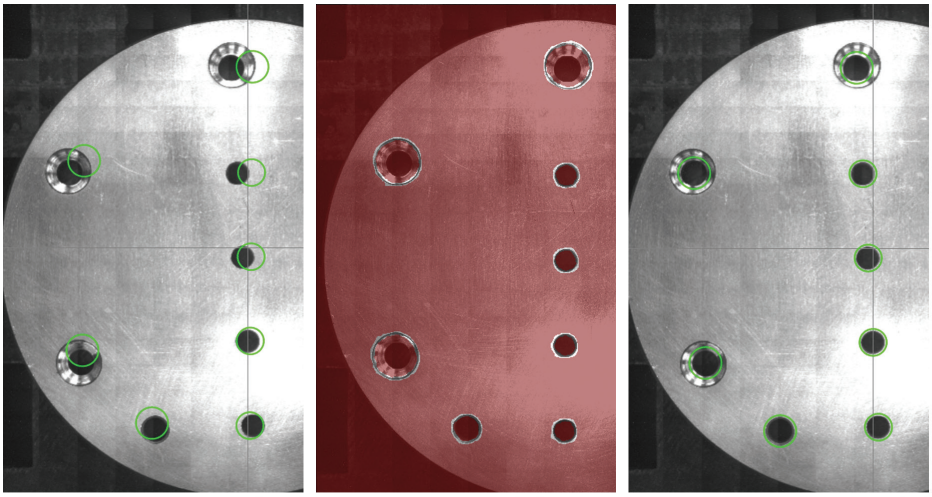
Typically our lasers can produce welded connections between the bus bar and the cell terminals using either overlap or butt joint configurations. Laser welds have excellent electrical and mechanical properties making them ideal for this application.

Fraunhofer has also developed a laser welding process using a highly dynamic beam scanning unit in order to significantly improve the quality of laser welds on materials such as copper, aluminum and for dissimilar metal joints. The laser beam is rapidly scanned along and across the weld joint using motorized optics. During the welding process, the laser beam can be oscillated, wobbled from side to side or scanned in various geometries in order to optimize the melt pool shape and weld penetration profile for optimum performance. Single mode and multi mode lasers can be used.

Machine Vision Technology

We have state of the art machine vision technology for automatic part feature recognition and laser beam to joint alignment.

This enables high accuracy weld placement with part to part alignment correction capability in conjunction with a precision scanner which can focus single mode and multi mode laser beams and produce complex weld geometries with high precision.



Example of feature recognition and realignment of weld locations using camera based machine vision technology

1 **Laser Scanner Technology**

2 **Copper Laser Welding**

3 **Dissimilar Metal Joining**