FRAUNHOFER INSTITUTE FOR MATERIAL AND BEAM TECHNOLOGY IWS

PRESS RELEASE

Intelligent Laser Welding with Dynamic Beam Shaping Eliminates Filler Wire Use

Fraunhofer IWS Opens New Pathways for Automotive, Aerospace, and Steel Industries

(Dresden, 08/29/2025) Laser processes with dynamic beam shaping create stable joints even in challenging material combinations. Recent applications demonstrate how to eliminate filler materials while improving quality, energy efficiency, and production logic. Fraunhofer Institute for Material and Beam Technology IWS will present laser welding solutions at the trade fair "Schweißen & Schneiden 2025" that expand both design freedom and economic potential. The focus is on intelligently guided beam processes that operate without filler wire and can be transferred into real production scenarios. Industries already applying the technology include lightweight structures for e-mobility, aerospace tanks, and load-bearing components in heavy steel construction.

Several current development projects rely on laser-based joining. A precisely controlled beam actively influences melt behavior, eliminating the need for filler wire. "We demonstrate that even the most demanding welding tasks – such as joining of difficult-to-weld material alloys or welding of heavy sections – can be performed robustly and productively with less energy, material, and rework," said Dr. Axel Jahn, Head of the Joining Department at Fraunhofer IWS. "The combination of high-frequency scanner technology, flexible power modulation, and our open system control enables design options and application perspectives that conventional arc welding cannot provide."

Aluminum Battery Housing: Crack-free, Pore-minimized, and Without Wire

In the EU project ALBATROSS, Fraunhofer IWS developed an innovative laser-fabricated battery housing for electric vehicles and successfully demonstrated it at full component scale. The lightweight design combines aluminum extrusion profiles with die-cast aluminum parts, featuring walls up to five millimeters in thickness.

Conventional approaches reach physical limits with this pairing: die cast tends to form pores, while aluminum extrusion alloys of the 6000 series are prone to hot cracking. "Our solution relies on targeted oscillation of the laser beam, which moves the melt pool, reduces pores, and produces metallurgically stable welds," Jahn explained. "This

Visit us

Schweißen & Schneiden 2025

15.–19.09.2025
Hall 6, booth 6D26

More Information:
s.fhg.de/SCH25-en

The ALBATROSS project has received funding from the European Union's Horizon 2020 research and innovation programme under the European Union's Horizon 2020 grant agreement No 963580, and the Zeit project was funded by the German Federal Ministry for Economic Affairs and Climate Protection based on a resolution by the German Bundestag under grant agreement No 20M2113B.

Federal Ministry for Economic Affairs and Climate Action

Funded by the European Union

Head of Corporate Communications
Markus Forytta | Fraunhofer Institute for Material and Beam Technology IWS | Phone +49 351 83391-3614 | Winterbergstraße 28 | DE-01277 Dresden | www.iws.fraunhofer.de | markus.forytta@iws.fraunhofer.de

Division Manager Joining
Dr.-Ing. Axel Jahn | Fraunhofer Institute for Material and Beam Technology IWS Dresden | Phone +49 351 83391-3237 | Winterbergstraße 28 | DE-01277 Dresden | www.iws.fraunhofer.de | axel.jahn@iws.fraunhofer.de

allows us to generate high-quality aluminum welds without the filler material usually required."

The housing has already been integrated and tested in a real vehicle model. Within the Fraunhofer lead project FutureCarProduction, the technology is now being advanced for secondary aluminum and cast-to-cast joints, alongside a sustainability assessment.

3D Tank Bottom: Crack-free Welds for Demanding Conditions

For aerospace applications, Fraunhofer IWS has developed a laser welding process to produce closed tank structures from high-strength 2000-series aluminum alloys. Since these alloys tend to form hot cracks, conventional welding typically requires the use of filler wire to adjust the alloy composition. In contrast, the new laser process operates without filler material and achieves stable, low-heat welding even on three-dimensional contours. "The process is ideal for closing rotationally symmetric containers and is also under study for pipe welding," Jahn said. "It delivers tight, mechanically strong joints with minimal distortion and high seam strength."

The process was developed within an aviation project funded by the German Federal Ministry for Economic Affairs and Climate Action (BMWK, today: BMWE). In parallel, Fraunhofer IWS is testing friction stir welding (FSW) for sheets and electromagnetic pulse welding (EMP) for hybrid pipe joints.

Crane Boom: Productivity Boost for Steel Construction

Manufacturers of large steel structures now have a new option for joining thick profiles with wall thicknesses over 20 millimeters. Fraunhofer IWS demonstrated this on a four-meter-long crane boom. The process uses high-performance multilayer welding in a single clamping with up to 24 kilowatts of laser power. V-groove preparation has been optimized to opening angles below five degrees. "As a result, we reduce weld volume, save up to 90 percent filler material, and largely eliminate distortion," Jahn noted. "Straightening large assemblies – often an energy-intensive manual step – becomes unnecessary in many cases."

The project was funded through SAB and aims to transfer into bridge building, wind energy, and shipbuilding. Initial industrial feedback confirms strong interest in integrating the technology into existing production lines.

Visit us

Schweißen & Schneiden 2025 –

15.–19.09.2025
Hall 6, booth 6D26

More Information:
s.fhg.de/SCH25-en

Materials and Lasers – Competence with a System: **The Fraunhofer Institute for Material and Beam Technology IWS** develops complex system solutions in materials and laser technology. We define ourselves as idea drivers developing customized solutions based on laser applications, functionalized surfaces as well as material and process innovations – from easy-to-integrate custom solutions to cost-efficient solutions for small and medium-sized enterprises to industry-ready one-stop solutions. Our research focuses on aerospace, energy and environmental technology, automotive, medical and mechanical engineering, toolmaking, electrical engineering and microelectronics, and photonics and optics sectors. In our five future and innovation fields of battery technology, hydrogen technology, surface functionalization, photonic production systems and additive manufacturing, we are already creating the basis today for the technological answers of tomorrow.

Laser, Materials, and Systems from a Single Source

The demonstrators illustrate how material science, process know-how, and system integration come together. Fraunhofer IWS not only develops joining technologies but also supports their transfer into production environments. “We bring our solutions into application with integrated sensors, advanced control, and continuous process quality evaluation,” Dr. Jahn concluded.

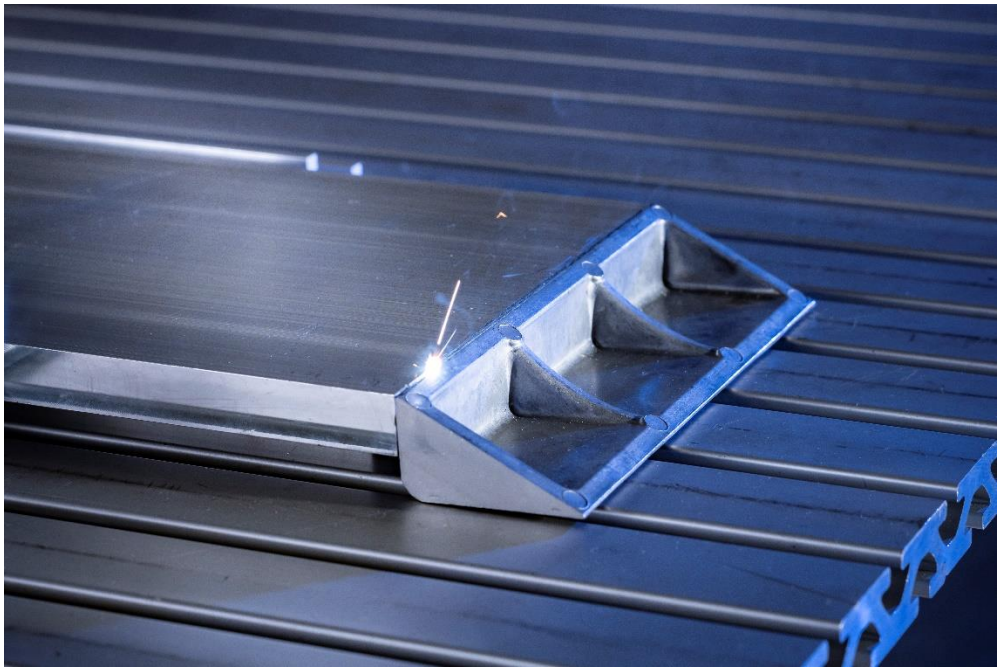
Visit us

Schweißen & Schneiden 2025 –

15.–19.09.2025
Hall 6, booth 6D26

More Information:
s.fhg.de/SCH25-en

Materials and Lasers – Competence with a System: **The Fraunhofer Institute for Material and Beam Technology IWS** develops complex system solutions in materials and laser technology. We define ourselves as idea drivers developing customized solutions based on laser applications, functionalized surfaces as well as material and process innovations – from easy-to-integrate custom solutions to cost-efficient solutions for small and medium-sized enterprises to industry-ready one-stop solutions. Our research focuses on aerospace, energy and environmental technology, automotive, medical and mechanical engineering, toolmaking, electrical engineering and microelectronics, and photonics and optics sectors. In our five future and innovation fields of battery technology, hydrogen technology, surface functionalization, photonic production systems and additive manufacturing, we are already creating the basis today for the technological answers of tomorrow.



Fraunhofer IWS demonstrates in the EU project ALBATROSS a process-stable laser welding method for aluminum die castings and extruded profiles that eliminates the need for filler material, producing crack-free, low-porosity seams at the absolute component scale.
© René Jungnickel/Fraunhofer IWS

Visit us

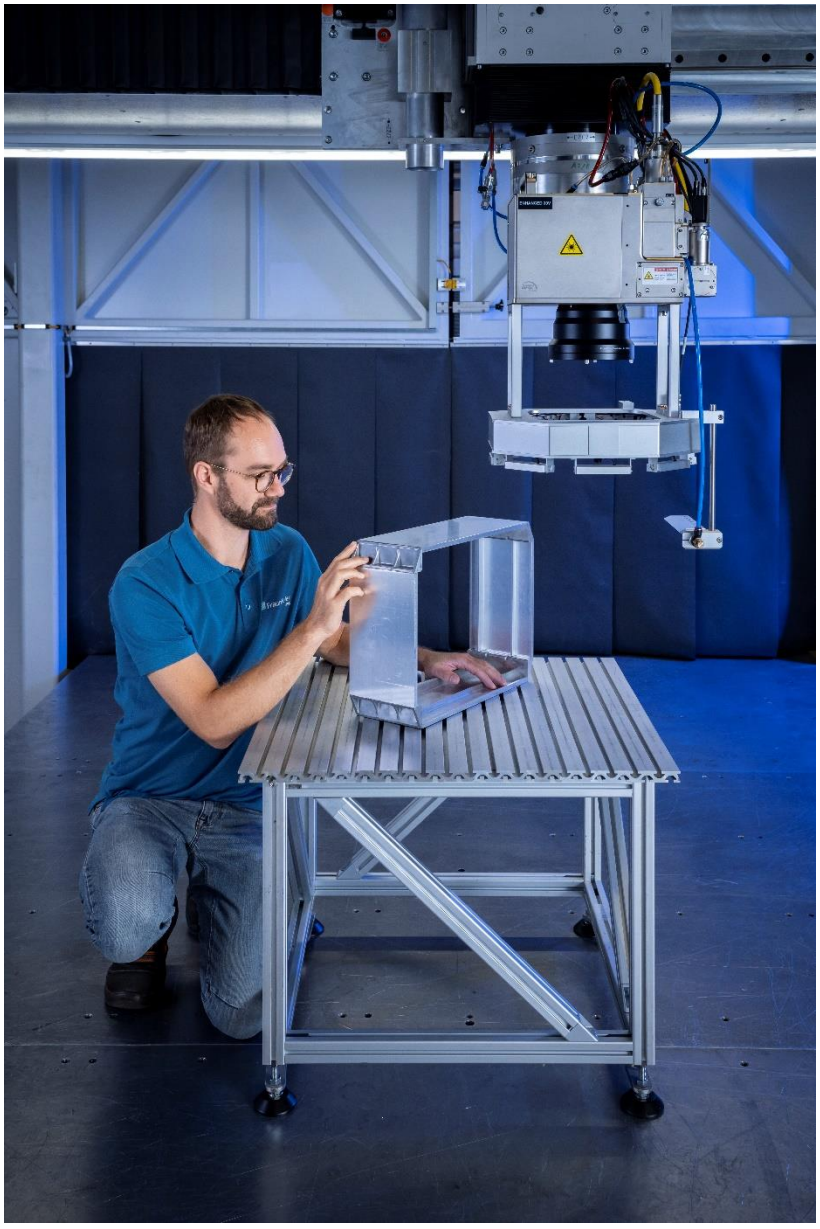
Schweißen & Schneiden 2025
–

15.–19.09.2025
Hall 6, booth 6D26

More Information:
s.fhg.de/SCH25-en

Materials and Lasers – Competence with a System: **The Fraunhofer Institute for Material and Beam Technology IWS** develops complex system solutions in materials and laser technology. We define ourselves as idea drivers developing customized solutions based on laser applications, functionalized surfaces as well as material and process innovations – from easy-to-integrate custom solutions to cost-efficient solutions for small and medium-sized enterprises to industry-ready one-stop solutions. Our research focuses on aerospace, energy and environmental technology, automotive, medical and mechanical engineering, toolmaking, electrical engineering and microelectronics, and photonics and optics sectors. In our five future and innovation fields of battery technology, hydrogen technology, surface functionalization, photonic production systems and additive manufacturing, we are already creating the basis today for the technological answers of tomorrow.

PRESS RELEASE
No. 10 | 2025
August 29, 2025 || Page 5 | 7



Laser-welded aluminum battery housing at full component scale: combining die-cast elements with extruded profiles in a lightweight design.
© René Jungnickel/Fraunhofer IWS

Visit us

Schweißen & Schneiden 2025
–
15.–19.09.2025
Hall 6, booth 6D26

More Information:
s.fhg.de/SCH25-en

Materials and Lasers – Competence with a System: **The Fraunhofer Institute for Material and Beam Technology IWS** develops complex system solutions in materials and laser technology. We define ourselves as idea drivers developing customized solutions based on laser applications, functionalized surfaces as well as material and process innovations – from easy-to-integrate custom solutions to cost-efficient solutions for small and medium-sized enterprises to industry-ready one-stop solutions. Our research focuses on aerospace, energy and environmental technology, automotive, medical and mechanical engineering, toolmaking, electrical engineering and microelectronics, and photonics and optics sectors. In our five future and innovation fields of battery technology, hydrogen technology, surface functionalization, photonic production systems and additive manufacturing, we are already creating the basis today for the technological answers of tomorrow.

Laser welding produces tight, low-distortion seams on rotationally symmetric aluminum tank structures without filler wire.
© René Jungnickel/Fraunhofer IWS

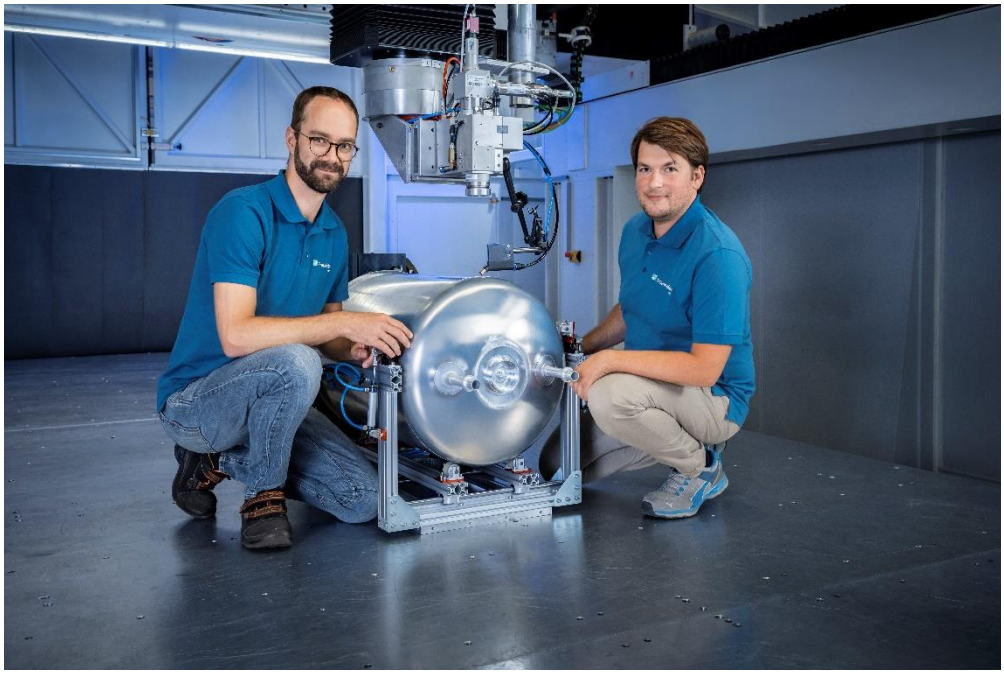
Visit us

Schweißen & Schneiden 2025
–

15.–19.09.2025
Hall 6, booth 6D26

More Information:
s.fhg.de/SCH25-en

Materials and Lasers – Competence with a System: **The Fraunhofer Institute for Material and Beam Technology IWS** develops complex system solutions in materials and laser technology. We define ourselves as idea drivers developing customized solutions based on laser applications, functionalized surfaces as well as material and process innovations – from easy-to-integrate custom solutions to cost-efficient solutions for small and medium-sized enterprises to industry-ready one-stop solutions. Our research focuses on aerospace, energy and environmental technology, automotive, medical and mechanical engineering, toolmaking, electrical engineering and microelectronics, and photonics and optics sectors. In our five future and innovation fields of battery technology, hydrogen technology, surface functionalization, photonic production systems and additive manufacturing, we are already creating the basis today for the technological answers of tomorrow.



Fraunhofer researchers developed a process-stable laser welding method for closed aluminum tank structures.
© René Jungnickel/Fraunhofer IWS

PRESS RELEASE
No. 10 | 2025
August 29, 2025 || Page 7 | 7

Visit us

Schweißen & Schneiden 2025
–
15.–19.09.2025
Hall 6, booth 6D26

More Information:
s.fhg.de/SCH25-en

Materials and Lasers – Competence with a System: **The Fraunhofer Institute for Material and Beam Technology IWS** develops complex system solutions in materials and laser technology. We define ourselves as idea drivers developing customized solutions based on laser applications, functionalized surfaces as well as material and process innovations – from easy-to-integrate custom solutions to cost-efficient solutions for small and medium-sized enterprises to industry-ready one-stop solutions. Our research focuses on aerospace, energy and environmental technology, automotive, medical and mechanical engineering, toolmaking, electrical engineering and microelectronics, and photonics and optics sectors. In our five future and innovation fields of battery technology, hydrogen technology, surface functionalization, photonic production systems and additive manufacturing, we are already creating the basis today for the technological answers of tomorrow.