Series production of aluminium-iron components: Rotary friction welding in vehicle construction

About this project

HyLight

Series production of aluminium-iron components: Rotary friction welding in vehicle construction

Markets:

Material: Aluminium, Steel, Others (Cast iron)

This project is funded by the Technology Transfer Programme Leichtbau (TTP LB) of the Federal Ministry of Economics and Energy.

Technology Transfer Program Leichtbau

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Context

With the expansion of electromobility, the need for lighter vehicle components is increasing in order to further improve range, energy consumption and driving dynamics. The potential for lightweight construction is particularly high for rotating masses such as gear wheels or brake discs. Until now, these components have mostly been made of solid steel or cast iron, as they have to withstand high mechanical loads.

Aluminium is significantly lighter, but does not meet the requirements for rigidity and thermal load-bearing capacity on its own. Both weight and function can be optimised through a combination with ferrous materials. The strong connection of these materials poses a particular technical challenge.

Rotary friction welding offers a suitable solution here: it produces high-quality joints through controlled friction and pressure. For aluminium-iron joints, the process is not yet reliable enough for series production. The development of robust joining processes is therefore a decisive step for the industrial use of hybrid lightweight components.

Purpose

In the HyLight research project, the partners want to make the rotational friction welding of aluminium-iron joints usable for series production in vehicle construction. To this end, they are developing resilient hybrid components that are subject to high mechanical and thermal loads - specifically a gear wheel made of aluminium and steel and a brake disc made of aluminium and cast iron. Both components should be lighter than today's series solutions and at the same time fulfil all safety-relevant requirements.

The project team is working towards mastering the entire joining process with process reliability - from material behaviour to component design. The researchers are not only redesigning the joining technology, but also the production processes. The partners are thus paving the way for the industrial use of hybrid lightweight components and enabling applications that were previously considered technically unfeasible.

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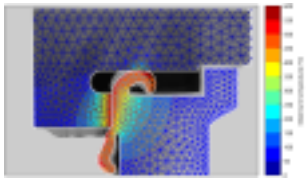
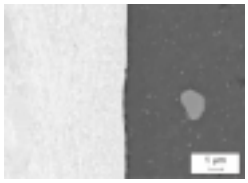
Procedure

The project partners are analysing the friction welding process for aluminium-iron joints. In test series, they vary process parameters such as friction and compression pressure, friction time and speed. The researchers are investigating how these factors affect the microstructure, bonding quality and strength of the joint. In addition, they analyse the welding zones microscopically and evaluate possible failure mechanisms. The aim is to develop a stable process with which the required component quality can be reliably produced.

At the same time, the project team is developing suitable strategies for preparing the friction surfaces, for heat treatment and for testing the joined components. The partners digitally map the entire process chain. They then validate the manufactured components under real-life conditions. In this way, they create the basis for a transfer to other component geometries and series production.

Funding duration:

Funding sign:	03LB2026	**Funding amount:**	EUR 1.7 million

Final report

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2026A - HyLight in the federal funding catalogue

www.hylight-leichtbau.de/ - Project website HyLight

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Project coordination

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LimFox GmbH

Lightweighting classification

	Realisation
Offer	
Products Parts and components	✓
Services & consulting	

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Hybrid structures	✓
Functional integration	
Measuring and testing technology	
Modelling and simulation Processes	✓
Plant construction & automation Others (Automotive series production)	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining Welding, Others (Friction welding)	✓
Material property alteration	
Primary forming	
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites	
Fibres	
Functional materials	
Metals Aluminium, Steel, Others (Cast iron)	✓
Plastics	
Structural ceramics	
(Technical) textiles	