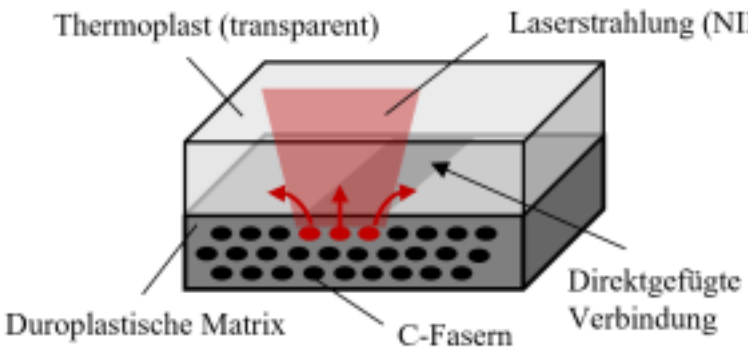
Joining plastics detachably: Laser direct joining replaces gluing and screwing

About this project



LaserDireCt

Joining plastics detachably: Laser direct joining replaces gluing and screwing

Markets:

Material: Thermoset plastics, Thermoplastics, Steel, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP)

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

Industrial companies - for example in the aviation, automotive and wind energy sectors - are faced with the challenge of designing components that are both lighter and more sustainable. Carbon fibre reinforced plastics (CFRP) - in particular thermoset epoxy resins (EP-CFRP) - are a key material for lightweight load-bearing structures in aircraft, vehicles and wind turbines due to their high strength and low weight. In less stressed areas, companies are increasingly turning to thermoplastics (TP), which are easy to mould, cost-effective to process and efficient to recycle.

The combination of TP and CFRP offers great potential for multi-material lightweight construction. However, conventional joining methods such as gluing or screwing are reaching their limits - for example due to material incompatibilities, high resource consumption or limited recyclability. This is precisely where the LaserDireCt research project comes in.

Purpose

The project team is developing a laser-based joining process that can be used to join thermoplastics directly and stably with thermoset CFRP structures. The connection is made completely without adhesives or mechanical connecting elements. The aim is to develop a resource-saving technology suitable for series production that enables detachable joints and avoids structural damage.

The team also wants to significantly reduce the use of materials and energy and improve recyclability. The researchers are specifically analysing influencing variables and defining relevant process limits. They are also demonstrating and evaluating the process under practical conditions that are relevant to the application. In this way, they carry out a holistic assessment of the technology and identify specific industrial application potential. The process should also be flexibly transferable to other material combinations, such as the joining of painted metals or other thermosets.

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Procedure

The project team is initially analysing the physical principles of laser-material interactions in complex material combinations and their effects on the homogeneity of the temperature distribution. It is investigating how the heat from the laser can be introduced into the CFRP structure in a targeted manner without damaging the sensitive fibre matrix. At the same time, the researchers are analysing the melting behaviour of the thermoplastics and the boundary layer between the materials. The aim is to optimise the process parameters in such a way that a stable and reversible bond is created.

At the same time, the project partners are testing the process under practical conditions - for example with fastening elements or stiffening structures. To this end, they are developing demonstrators that can be transferred to industrial series production. An accompanying industrial group brings in requirements from various sectors and supports the subsequent implementation. In this way, scientific findings are channelled directly into applications.

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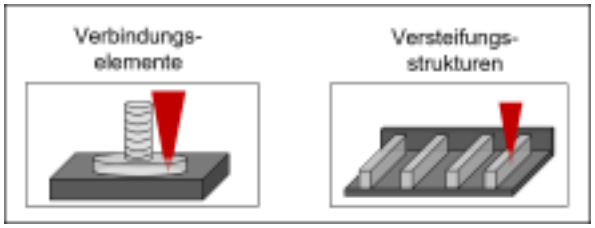

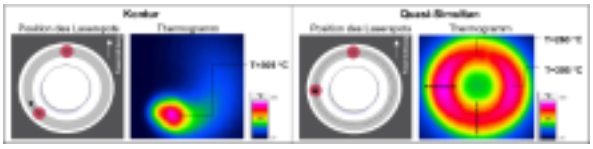

Funding duration:

Funding sign: 03LB3052A **Funding amount:** EUR 519 thousand

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3052A - LaserDireCt in the federal funding catalogue

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Project coordination

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English (EN){{ Projektpartner }}

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts, Machines and plants	✓
Services & consulting Training, Testing and trials, Validation, Technology transfer, Maintenance and repair	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Hybrid structures	✓
Functional integration	
Measuring and testing technology Visual analysis (e.g. microscopy, metallography), Destructive analysis, Non-destructive analysis	✓
Modelling and simulation	
Plant construction & automation Automation technology	✓
Recycling technologies Material separation, Recycling	✓
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining Adhesive bonding	✓
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 Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP)	✓
Fibres	
Functional materials	
Metals Steel	✓
Plastics Thermoset plastics, Thermoplastics	✓
Structural ceramics	
(Technical) textiles	