Ultra-high-strength steels for lightweight construction: adaptive production reduces scrap

About this project

UHSS4Lightweight

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Markets:

Material: Steel

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

Lightweight construction is a key technology for resource-saving mobility. Until now, car manufacturers have relied on different materials depending on the number of units and price segment: high-strength steels in large series, aluminium in medium series and carbon fibre-reinforced plastics in small series. However, all three variants have considerable disadvantages in terms of production: they require energy-intensive processes, which partially erode the CO# advantage during use.

With electrification, vehicle weight is also becoming less important as the sole benchmark for the carbon footprint - emissions from production are becoming more important. Ultra-high-strength steels (UHSS) offer a way out here: they achieve strengths of over 1350 megaspascals (MPa) - a measure of the mechanical load-bearing capacity of materials, can be cold-formed and have a significantly better carbon footprint over their entire life cycle. However, the production of complex car body parts with UHSS has hardly been economically viable to date, as springback and dimensional deviations lead to high reject rates. This is where the researchers in the UHSS4Lightweight project come in.

Purpose

The project team is pursuing the goal of making ultra-high-strength steels usable for large-scale production. To this end, the researchers are developing an adaptive process chain with which components made of UHSS can be manufactured precisely, economically and in a resource-saving manner. The aim is to largely avoid rejects and manual reworking. The team is working on a digital process that records material properties in real time, predicts springback and automatically compensates for it.

In the long term, this approach should be able to replace resource- and energy-intensive lightweight materials such as aluminium or CFRP - without sacrificing component quality and with high CO# savings potential. The technology not only offers advantages for the automotive industry, but also potential for transfer to other sectors, such as commercial vehicle construction or micromobility.

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Procedure

The project team is looking at the entire value chain. During the forming process, the scientists record the material properties of each individual sheet metal blank. They use AI-supported models to calculate the expected springback. A laser beam levelling process then automatically compensates for the deviations - within a few seconds and under strict temperature control in order to maintain the material strength.

At the same time, the researchers are developing a digital process image that bundles all the data and makes it usable for the control system. Quality assurance is also being digitalised: Augmented reality technologies enable high-precision measurement directly in production and deliver the results back to the process model in real time. In the end, the participants will develop a demonstrator that shows that UHSS components can be manufactured economically and with high dimensional accuracy.

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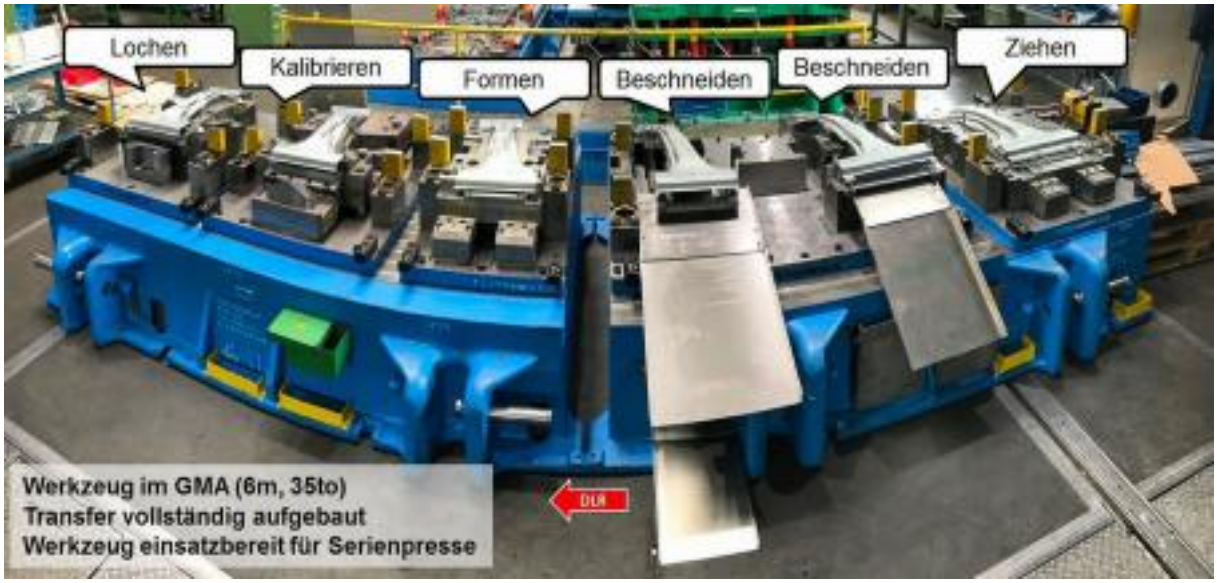

Funding duration:

Funding sign: 03LB3070 **Funding amount:** EUR 1.9 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3070A - UHSS4Lightweight 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	✓
Services & consulting Testing and trials, Prototyping, Validation, Simulation, Technology transfer	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight manufacturing	✓
Functional integration	
Measuring and testing technology Component and part analysis, Environmental simulation	✓
Modelling and simulation Life-cycle analysis, Optimisation, Materials	✓
Plant construction & automation Handling technology	✓
Recycling technologies Recycling	✓
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining Others (Laser beam alignment)	✓
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 Steel	✓
Plastics	
Structural ceramics	
(Technical) textiles	