Laser powder bed fusion: producing aluminium components for electric cars cost-efficient

About this project

AutoBeam

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Markets:

Material: Aluminium

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

Technology Transfer Program Leichtbau

Context

Manufacturers of electric vehicles can reduce vehicle weight and use materials efficiently by employing lightweight aluminium components. Components designed to withstand specific loads also offer the possibility of combining several functions in a targeted manner. Additive manufacturing of metal components is becoming increasingly important in order to make such components economically viable to produce.

One key process is powder bed fusion of metals using a laser beam, or PBF-LB/M for short. In this process, a laser fuses metal powder layer by layer to form a component. Companies can use this to manufacture complex aluminium components, combine functions and tailor structures specifically to component requirements.

However, the process is currently only of limited economic viability for wider use in automotive engineering. The build rate is too low for many applications, and production costs are correspondingly high. Furthermore, there is a lack of industrially viable methods for systematically identifying suitable components, combining them and designing them for the additive manufacturing process. It is precisely at this interface between manufacturing technology, design and materials that the project comes into play.

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Purpose

The aim of the researchers in the AutoBeam project is to make powder bed fusion using a laser beam more productive and cost-effective for aluminium materials. The project partners are further developing the process so that the build rate per 1-kilowatt laser increases from around 100 to 250 cubic centimetres per hour. In doing so, they are tackling a major cost driver in additive manufacturing.

The higher build-up rate is intended to expand the use of PBF-LB/M in the automotive industry. This will make more aluminium components suitable for additive manufacturing, particularly in small-batch automotive production. This is particularly relevant for components where low mass, integrated functions and load-bearing design work in concert.

In addition to manufacturing technology, the focus is on the transfer to industrial application. The team is developing methods to enable companies to systematically identify suitable components, combine them effectively and design them for the additive manufacturing process. This lays the foundations for using metal 3D printing more effectively in cost-effective lightweight construction applications.

Procedure

The project partners are investigating new laser beam sources for the PBF-LB/M process. The focus is on beam shaping, i.e. the targeted shaping of the laser beam. This allows different beam profiles to be set and changed quickly. The researchers are investigating how this can enable the laser energy to be transferred more efficiently into the powder bed and which process strategies are suitable for aluminium materials.

At the same time, the researchers are analysing the metal powders used. They are investigating how sustainably produced aluminium powders can be processed with as little waste as possible. In doing so, they are also taking into account broader particle size distributions in order to utilise the powder more efficiently.

The partners are linking process development with component design. They are examining which components are suitable for the process, which functions can be combined, and how the components can be designed to withstand the loads they will be subjected to. The team then uses a life-cycle analysis to assess the energy and resource efficiency of the process chain. The results are incorporated into process strategies, design rules and qualification approaches for industrial application.

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Funding duration:

Funding sign:	03LB2082	**Funding amount:**	EUR 1.8 million

Final report

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2082A - AutoBeam featured in the federal government's funding catalogue

www.pmd.tu-darmstadt.de/forschung_pmd/projekte_pmd/autobeam.de.jsp - TU Darmstadt project website

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English (EN){{ Projektpartner }}

Lightweighting classification

	Realisation
Offer	
Products Materials	✓
Services & consulting Training, Testing and trials, Prototyping, Validation, Simulation, Technology transfer	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight material construction	✓
Functional integration	
Measuring and testing technology Component and part analysis, Materials analysis	✓
Modelling and simulation Loads & stress, Optimisation, Materials	✓
Plant construction & automation	
Recycling technologies	
Manufacturing process	
Additive manufacturing Selective laser melting (SLM, LPBF, ...)	✓
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
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	✓
Plastics	
Structural ceramics	
(Technical) textiles	