

Tool-free production of fibre composite components: with 3D printing and 3D fibre winding

About this project



confidentAM

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Markets:  

Material: Carbon fibres, Thermoplastics, Yarns, rovings, Carbon-fiber reinforced plastics (CFRP)

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[Technology Transfer Program Leichtbau](#)

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Context

Fibre-reinforced plastics save weight and can make components very rigid and resilient. In practice, their use outside of large series often fails due to the production process: Fully automated processes are generally only economical for large quantities because systems and moulds are expensive. Manual processes are often necessary for small series and customised products. This costs time, ties up personnel and leads to fluctuating quality. At the same time, the widespread use of thermoset matrix systems makes it difficult to return the material to the cycle.

An automated process chain without moulding tools that allows complex geometries and the targeted use of continuous fibres is needed so that lightweight structures can be produced economically and in a recyclable manner, even in small quantities and for individual custom-made products. This is where the confidentAM project comes in.

Purpose

The researchers are developing an end-to-end additive manufacturing chain to economically produce fibre-reinforced lightweight structures for small series and individual components.

The team is implementing the process chain with polyamide 6 (PA6) and carbon fibres. PA6 is a thermoplastic material that can be re-melted and re-processed by heating. The participants are developing a recycling process so that the material can be mechanically processed at the end of its life and fed back into the cycle as filament.

As a demonstrator, the team is developing a customisable node element for connecting fibre composite profiles in modular robotic handling systems and a CFRP damper rocker for load transmission in the rear end of full-suspension e-bikes. The participants demonstrate component quality, dimensional accuracy and mechanical performance through tests and evaluate the environmental impact over the life cycle.

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Procedure

The team develops the components digitally and derives fibre guidance and process parameters from this. The participants then first produce the core in 3D printing using the fused filament fabrication process. In this process, a nozzle melts plastic filament and builds up the mould layer by layer.

This is followed by 3D fibre winding technology: an industrial robot places long, thermoplastic-impregnated carbon fibres around the core to form a load-bearing fibre skeleton. The participants coordinate the programming, control and monitoring of the winding process with the component geometry in order to achieve reproducible results.

Finally, they test the demonstrators mechanically, compare them with established solutions and evaluate the use of materials, energy requirements, waste and recycling in a life cycle analysis.



Funding duration:

Funding sign:

03LB3097

Funding amount:

EUR 878 thousand

Final report

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3097A - confidentAM 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

Engineering, Prototyping, Simulation,
Technology transfer



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Lightweighting classification	
	Realisation
Field of technology	
Design & layout Lightweight construction concepts, Lightweight material construction	✓
<i>Functional integration</i>	
Measuring and testing technology Component and part analysis, Visual analysis (e.g. microscopy, metallography), System analysis	✓
Modelling and simulation Structural mechanics	✓
Plant construction & automation Automation technology, Robotics	✓
Recycling technologies Recycling	✓
Manufacturing process	
Additive manufacturing 3D printing, Others (3D skeleton wrapping technique)	✓
<i>Coating (surface engineering)</i>	
Fibre composite technology Filament winding	✓
<i>Forming</i>	
<i>Joining</i>	
<i>Material property alteration</i>	
<i>Primary forming</i>	
<i>Processing and separating</i>	
<i>Textile technology</i>	

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Lightweighting classification	
	Realisation
Material	
<i>Biogenic materials</i>	
<i>Cellular materials (foam materials)</i>	
Composites Carbon-fiber reinforced plastics (CFRP)	✓
Fibres Carbon fibres	✓
<i>Functional materials</i>	
<i>Metals</i>	
Plastics Thermoplastics	✓
<i>Structural ceramics</i>	
(Technical) textiles Yarns, rovings	✓