Lightweight components for drive systems: production of precise fibre composite components

About this project

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SPOTLIGHT

Lightweight components for drive systems: production of precise fibre composite components

Markets: 

Material: Carbon fibres, Thermoset plastics, Yarns, rovings, 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

In mechanical engineering and electromobility, drive systems have so far mainly consisted of metallic components. These enable reliable high precision, tight tolerances and well-defined functional surfaces.

Fibre composites such as carbon fibre reinforced plastics (CFRP) offer advantages such as low weight, high rigidity and good damping. However, there is still a lack of mature manufacturing processes for rotating components with precise interfaces. Long shafts, thin-walled sleeves and other components that have to fulfil high speeds and tight dimensional specifications during operation are particularly challenging.

The winding process is often used to manufacture such components. In this process, continuous fibres impregnated with resin are applied in layers to a rotating core. This produces tubular components with customisable properties. The semi-finished products produced can be manufactured economically, but often do not achieve the required dimensional and shape accuracy.

In order to achieve the required tolerances and surface properties, downstream processing is therefore necessary. Established grinding processes are used for metal components. However, a comparable, widely applicable precision grinding technology is still lacking for fibre composite components. This makes the industrial use of resource-saving lightweight solutions in drive systems more difficult.

Purpose

In the SPOTLIGHT project, the project partners are developing processes to produce high-precision fibre composite components for drive components reliably and economically. The focus is on a continuous process chain from the production of wound semi-finished products to the precise post-processing of the functional surfaces. The aim is to design and manufacture fibre composite components in such a way that they achieve the required dimensional, shape and surface qualities.

In addition, the participants will show how metallic components can be replaced by fibre composite components. This allows them to reduce weight, use energy more efficiently and reduce CO# emissions both in production and in operation. The approaches developed can be transferred to various applications in mechanical engineering and electromobility.

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Procedure

The project partners first analyse the requirements for high-precision rotating fibre composite components and existing manufacturing processes. Based on this, they are developing models with which layer thicknesses and component geometries in the winding process can be predicted more accurately.

The researchers then develop suitable grinding processes for inner, outer and flat surfaces. To this end, they analyse clamping concepts, tools and process parameters as well as suitable cooling and extraction solutions. They also develop testing and measuring techniques to reliably assess dimensional accuracy, surface quality and component properties.

Investigations into friction and wear behaviour show how surface treatment affects friction and wear. As demonstrators, the project team is developing a CFRP motor spindle and other rotating components, which they are testing under realistic conditions.

Finally, the researchers will evaluate the energy requirements and CO# savings potential along the production chain and during operation.

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Funding duration:

Funding sign:	03LB2061	**Funding amount:**	EUR 1.4 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2061A - SPOTLIGHT in the federal funding catalogue

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Machines and plants, Tools and moulds	✓
Services & consulting Testing and trials, Validation	✓
Field of technology	
Design & layout Lightweight design	✓
Functional integration Material functionalisation	✓
Measuring and testing technology Component and part analysis, Visual analysis (e.g. microscopy, metallography), Materials analysis	✓
Modelling and simulation Loads & stress, Optimisation, Materials, Reliability validation	✓
Plant construction & automation Handling technology	✓
Recycling technologies	

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology Filament winding	✓
Forming	
Joining	
Material property alteration Thermochemical treatment	✓
Primary forming	
Processing and separating Grinding	✓
Textile technology	
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Carbon-fiber reinforced plastics (CFRP)	✓
Fibres Carbon fibres	✓
Functional materials	
Metals	
Plastics Thermoset plastics	✓
Structural ceramics	
(Technical) textiles Yarns, rovings	✓