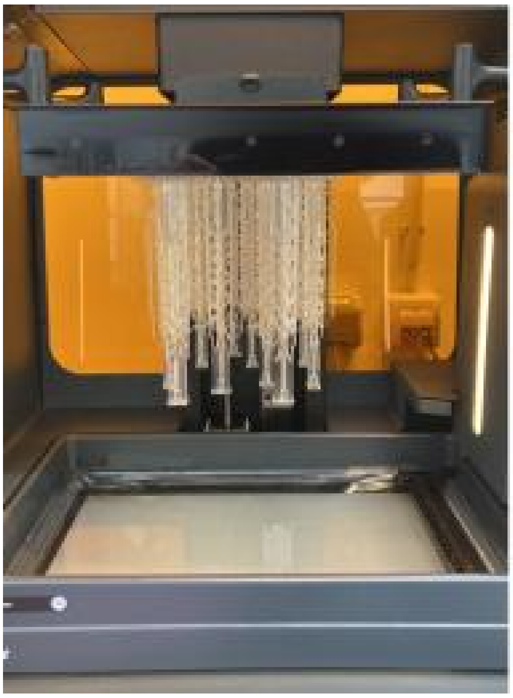
Additive manufacturing of short fibre composites: complex components from recycled carbon

About this project



EMSIG

Additive manufacturing of short fibre composites: complex components from recycled carbon

Markets:

Material: Carbon fibres, Thermoset plastics, 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

Additive manufacturing of short fibre composites: complex components from recycled carbon

About this project

Context

Composite materials made of carbon and glass fibres are widely used in vehicle construction, aviation and sports. They enable lightweight yet resilient structures. For very fine or branched geometries, however, conventional methods such as prepreg or autoclave processes reach their limits. These processes are cost-intensive, energy-intensive and can only be used to a limited extent for complex moulds.

Structures that absorb several forces simultaneously - such as tension, compression, bending and twisting - are particularly challenging. Such complex components are required, for example, in engine mounts, seat structures or filigree connecting elements.

Additive manufacturing processes such as stereolithography (SLA) or the powder bed fusion process offer great design freedom, but only allow a small proportion of fibres or lead to insufficient dimensional accuracy. At the same time, there is a growing need to reduce CO# emissions and replace metallic structures. Recycled carbon fibres have great potential here, but have hardly been used to date. This is where the EMSIG project comes in and develops a new approach for precise and resource-saving composite structures.

Purpose

The project team is developing a hybrid process that combines a precisely printed shell structure with a fibre-reinforced core. The sheath structure is created using stereolithography - a light-based 3D printing process in which liquid synthetic resins harden layer by layer. The researchers then inject a resin-bonded carbon short fibre mixture, which hardens inside the structure and absorbs the mechanical load.

The researchers' aim is to produce complex lightweight components with a high fibre content and clearly defined load paths. The components should contain at least 35 per cent carbon fibres, rely entirely on recycled fibre material and achieve around 50 per cent higher stiffness than comparable SLA components. Compared to aluminium structures, the team is aiming for a weight reduction of at least 40 percent.

The new approach is intended to create an alternative to metal and prepreg structures and expand the range of applications for fibre-reinforced materials - for example for components of unmanned aerial vehicles, seat structures or connecting elements subject to high mechanical loads.

Additive manufacturing of short fibre composites: complex components from recycled carbon

About this project

Procedure

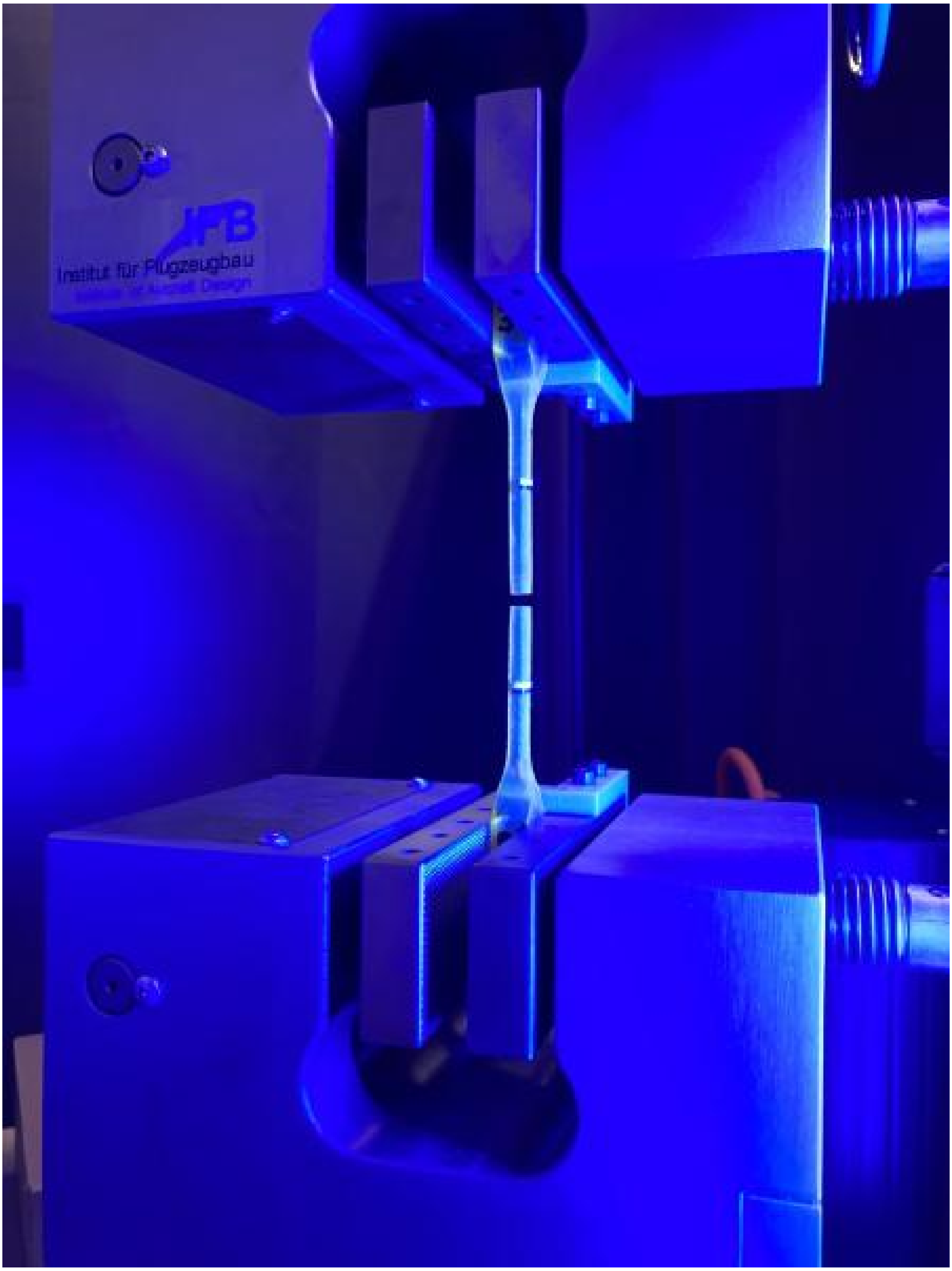
The researchers combine material development, simulation and process design. They are developing a flow model that defines the geometry and opening diameter of the core channels and thus creates the basis for a directional alignment of the short fibres along the load paths. The team is also analysing the sedimentation behaviour of the fibres and linking process parameters with the resulting component quality.

At the same time, the scientists are developing resins for the printed cladding structure and for the injected core matrix. They are also formulating sizing media that stabilise the short fibres and enable homogeneous distribution in the resin. This results in resin systems that absorb high fibre contents and reliably fill the fine channels.

In the next step, the researchers design thin-walled jacket structures, determine suitable wall thicknesses and support strategies and develop the injection and curing process. The end result is a prototype hybrid production process for complex short fibre composite structures.

Additive manufacturing of short fibre composites: complex components from recycled carbon

About this project



Additive manufacturing of short fibre composites: complex components from recycled carbon

Project coordination

Contact:

Mr Dipl.-Ing. Alex di Maglie

+49 06152 9231-37

ad@4dconcepts.de

Organisation:

4D Concepts GmbH

Frankfurter Straße 74
64521 Groß-Gerau
Hesse
Germany

www.4dconcepts.de

English (EN){{ Projektpartner }}

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Materials	✓
Services & consulting Testing and trials, Prototyping, Validation, Simulation	✓

Additive manufacturing of short fibre composites: complex components from recycled carbon

Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight manufacturing, Hybrid structures	✓
Functional integration	
Measuring and testing technology Component and part analysis, Destructive analysis	✓
Modelling and simulation Processes, Materials	✓
Plant construction & automation	
Recycling technologies Others (Use of recycled carbon fibres)	✓
Manufacturing process	
Additive manufacturing 3D printing, Stereolithography	✓
Coating (surface engineering)	
Fibre composite technology Others (SLA printed sheath and core made of carbon fibre-reinforced injection resin)	✓
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology	

Additive manufacturing of short fibre composites: complex components from recycled carbon

Lightweighting classification

	Realisation
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	