Multi-material design for lightweight components: Fibre composite replaces light metals

About this project

MM4R

Multi-material design for lightweight components: Fibre composite replaces light metals

Multi-material design for lightweight components: Fibre composite replaces light metals

About this project

Markets:

Material: Glass fibres, Thermoplastics, Aluminium, Yarns, rovings, Meshes, Glass-fiber reinforced plastics (GFRP)

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

Conventional vehicle structures are often made of light metals such as aluminium and magnesium. These materials require large amounts of energy to manufacture and can cause significant CO# emissions. In addition, the combination of different materials leads to contamination, which prevents efficient recovery in the recycling process. The automotive industry is therefore faced with the challenge of developing stable and efficient components. Hybrid concepts offer a solution here.

An innovative approach combines thermoplastic, fibre-reinforced hollow profiles - lightweight, dimensionally stable components made of plastics - with organic sheets - a special semi-finished product in which plastic and reinforcing fibres are already combined - and thermoplastic injection moulding processes. The use of just one material system, such as glass fibre-reinforced polypropylene (GF/PP), simplifies the recycling process while still allowing a high degree of design freedom. By dispensing with chemical bonding agents and using modern laser surface structuring, a clean separation of the materials is achieved.

Multi-material design for lightweight components: Fibre composite replaces light metals

About this project

Purpose

In the MM4R research project, the project team wants to replace magnesium-based vehicle components - such as the cockpit cross member - with hybrid fibre composite hollow profiles. This changeover reduces energy consumption and offers the opportunity to significantly reduce the global warming potential (GWP).

At the same time, the researchers are aiming to optimise the entire production process. They are raising individual production technologies from an early stage of development to series production readiness. They are already integrating a comprehensive life cycle assessment (LCSA) in the concept phase in order to take ecological, economic and social criteria into account. The result should ensure economically viable, waste-free production and sustainable utilisation of the resources used.

Procedure

The project team is specifically optimising the individual production steps. The researchers are accelerating preforming - a preforming process in which raw materials are moulded into the later component geometry - by a factor of 10 in order to significantly reduce throughput times. They then improve consolidation in order to join thermoplastic FRP hollow profiles with metallic functional elements in an energy-saving manner. In this step, the preformed fibre-reinforced plastics to be brought into their final shape are hybridised with laser-structured metallic functional elements in order to generate both an efficient production process and a high-performance hybrid structure.

Instead of using chemical bonding agents, the team relies on permanent laser surface structuring to ensure a contamination-free bond. At the same time, the researchers recycle the resulting waste directly in the injection moulding process. At the same time, they are developing model-based methods for life cycle assessment in order to identify environmental impacts, costs and social risks at an early stage. An interdisciplinary approach that should pave the way for large-scale production.

Multi-material design for lightweight components: Fibre composite replaces light metals

About this project

Funding duration:

Funding sign: 03LB3026 **Funding amount:** EUR 2.8 million

Final report

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3026A - MM4R in the federal funding catalogue

plattform-forel.de/mm4r/ - FOREL platform for MM4R

iws.fraunhofer.de/de/technologiefelder/trennen-und-fuegen/mikrobearbeiten/mm4r.html - Project website MM4R Fraunhofer IWS

Multi-material design for lightweight components: Fibre composite replaces light metals

Project coordination

Contact:

Mr David Schmidt

+49 0162 993 2945

david.schmidt6@porsche.de

Organisation:

Dr Ing. h.c. F. Porsche AG

Porscheplatz 1
70435 Stuttgart
Baden-Württemberg
Germany

www.porsche.com/germany/

English (EN){{ Projektpartner }}

Multi-material design for lightweight components: Fibre composite replaces light metals

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts, Machines and plants	✓
Services & consulting	
Field of technology	
Design & layout Hybrid structures, Lightweight construction concepts	✓
Functional integration Material functionalisation	✓
Measuring and testing technology	
Modelling and simulation Life-cycle analysis, Optimisation, Materials	✓
Plant construction & automation Plant construction, Automation technology, Handling technology, Robotics	✓
Recycling technologies	

Multi-material design for lightweight components: Fibre composite replaces light metals

Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology Others (Fibre direct compounding (FDC))	✓
Forming Others (Thermoforming with integrated pressing process)	✓
Joining Hybrid joining, Screwing	✓
Material property alteration	
Primary forming Injection moulding	✓
Processing and separating Others (Laser structuring)	✓
Textile technology Braiding, Preforming	✓

Multi-material design for lightweight components: Fibre composite replaces light metals

Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Glass-fiber reinforced plastics (GFRP)	✓
Fibres Glass fibres	✓
Functional materials	
Metals Aluminium	✓
Plastics Thermoplastics	✓
Structural ceramics	
(Technical) textiles Yarns, rovings, Meshes	✓