Developing a lightweight cooling system for electric drives: powerful and resource-saving

About this project

KoLibri

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Markets:

Material: Thermoplastics, Aluminium, Others (Galvanic coating with copper), Closed-pore, Open-pore

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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

With the shift in mobility towards electric drives, the need for efficient temperature management is increasing. This is because electric motors and power electronics generate considerable heat loss during operation. However, currently installed heat sinks such as aluminium pin-fin or flat tube systems are reaching their limits - they are often too heavy, too expensive or too large. This limits the range and efficiency of electric cars because they take up a lot of installation space and mass.

An efficient, lightweight cooler is key to making electric drives more powerful, durable and climate-friendly. This is where the KoLibri project comes in.

Purpose

The project team is developing cooling modules with lightweight materials. The partners are aiming to increase the cooling capacity by 20 to 50 per cent. Alternatively, the component weight should be halved while maintaining the same performance. To achieve this, the researchers are using open and closed-cell metal foams and metallised plastics. These materials dissipate significantly more heat.

At the same time, the team aims to reduce production costs by up to 75 per cent compared to pure 3D printing processes by using low-cost investment casting and electroplating processes. The partners are also developing recycling-friendly construction methods that close material flows and conserve resources. In this way, they aim to reduce CO# emissions by around 25 per cent over the entire life cycle.

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Procedure

The researchers start with virtual flow tests. In these CFD (computational fluid dynamics) simulations, they test how air or coolant flows best through the open pores of the metal foam. The partners then produce the first prototypes: either they pour liquid aluminium into a mould and remove the wax model, or they coat plastic moulds with a fine metal film in an electroplating bath.

They then mount the foam coolers directly onto the power modules - without conventional cooling plates. In this way, they reduce the thermal resistance between the semiconductor chips and the cooler. At the same time, they develop separation processes in order to separate galvanised layers from the metal again. Finally, the team evaluates the environmental and cost indicators using specialised software. This allows the partners to recognise which production steps are particularly energy- or material-intensive at an early design stage and adapt the design accordingly.

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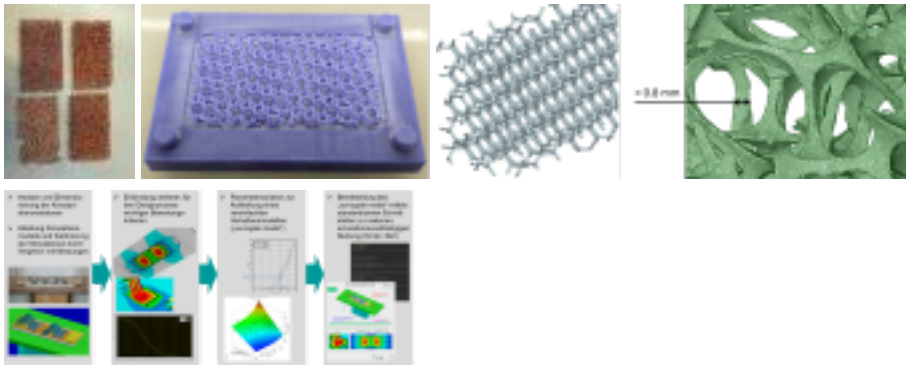

Funding duration:

Funding sign:	03LB3039	**Funding amount:**	EUR 3.2 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3039A - KoLibri in the federal funding catalogue

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Project coordination

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English (EN){{ Projektpartner }}

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Machines and plants, Software & databases, Materials, Tools and moulds	✓
Services & consulting Consulting, Testing and trials, Funding, Engineering, Prototyping, Validation, Simulation, Technology transfer	✓
Field of technology	
Design & layout Lightweight manufacturing, Lightweight design, Hybrid structures, Lightweight construction concepts, Lightweight material construction	✓
Functional integration Material functionalisation	✓
Measuring and testing technology Component and part analysis, Visual analysis (e.g. microscopy, metallography), Environmental simulation, Materials analysis, Destructive analysis, Non-destructive analysis	✓
Modelling and simulation Multiphysics simulation, Optimisation, Structural mechanics, Materials, Reliability validation	✓
Plant construction & automation Plant construction	✓
Recycling technologies Downcycling, Material separation, Recycling, Upcycling	✓

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing 3D printing, Others	✓
Coating (surface engineering) Galvanising	✓
Fibre composite technology	
Forming Compression moulding, Others (Incremental forming)	✓
Joining Adhesive bonding, Soldering	✓
Material property alteration Mechanical treatment	✓
Primary forming Others (Investment casting prototypes, mainly in steel and aluminium)	✓
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials) Closed-pore, Open-pore	✓
Composites	
Fibres	
Functional materials	
Metals Aluminium, Others (Galvanic coating with copper)	✓
Plastics Thermoplastics	✓
Structural ceramics	
(Technical) textiles	