

Efficient production of electric motors: with copper die casting and 3D printing

About this project



ATREA

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Markets: 

Material: Others (Rotors with 3D structures and a conductivity $> 56 \text{ MS/m}$),
Others (Copper and copper alloys | Nickel alloy Inconel 718)

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[Technology Transfer Programme Leichtbau](#)

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Context

Electric vehicles face the challenge of being as energy-efficient, resource-saving and powerful as possible. Drive technology is particularly challenging in this respect. Until now, machines with permanent magnets have dominated - but their dependence on rare earths is problematic both ecologically and geopolitically. Asynchronous machines (ASM) are considered a robust and cost-effective alternative, but they quickly reach their technical limits at high speeds. At the same time, the demands on performance and resource efficiency are increasing. This is precisely where the ATREA project comes in. The aim is to make electric drives fit for the future - with new design approaches and modern production technologies.

Purpose

The researchers want to further develop asynchronous machines for use in high-speed drives - for example in electric cars - and thus realise the full potential for electromobility in an ecologically sensible way. To do this, they are combining two key technologies. Firstly, additive manufacturing of mechanically resilient 3D support structures. Secondly, copper die-casting for rotor rotors - the rotating part of the electric motor in which the electricity is generated for movement. This combination should lead to a new generation of lightweight, efficient and sustainable electric motors. The focus is not only on increasing the power density - i.e. more power with less mass - but also on reducing material costs and dispensing with critical raw materials such as rare earths. The project team wants to show that asynchronous machines with copper rotors are an alternative to today's standard drives. By combining innovative materials, customised designs and new production methods, the researchers are aiming for a solution that is ready for series production.

Procedure

On the one hand, the researchers are reinforcing the areas of the asynchronous machine that are subject to particular mechanical stress - such as the rotor rings - with additively manufactured structures. These structures not only have to withstand high centrifugal forces at speeds of over 21,000 revolutions per minute, but also have to be optimised electromagnetically and thermally. They are also continuing to develop the copper die-casting process so that it can be precisely combined with additive components. The focus here is on the optimum mould design, the behaviour of the material during solidification and the process-related requirements. The team is trialling various material combinations in numerous tests and evaluating them with the help of simulations. The results are incorporated into optimised designs and innovative manufacturing processes.

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Funding duration:

Funding sign:

03LB3033

Funding amount:

EUR 1.1 million

Final report

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3033A - ATREA in the federal funding catalogue

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Project coordination

Contact:

Mr Manuel Rutjes

+49 0731 944-9551

manuel.rutjes@wieland.com

Organisation:

Wieland eTraction Systems GmbH

Ziegeleiweg 20
42555 Velbert / Langenberg
North Rhine-Westphalia
Germany

wieland

🔗 www.wieland.com/de/ueber-uns/wieland-weltweit/wieland-etraction-systems

English (EN){ { Projektpartner } }



Oerlikon AM Europe GmbH

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Lightweighting classification	
	Realisation
Offer	
Products Machines and plants, Others (3D printing additive manufacturing (metal))	✓
Services & consulting Training, Testing and trials, Simulation	✓
Field of technology	
<i>Design & layout</i>	
Functional integration Actuator technology	✓
<i>Measuring and testing technology</i>	
Modelling and simulation Multiphysics simulation, Materials	✓
<i>Plant construction & automation</i>	
<i>Recycling technologies</i>	

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Lightweighting classification	
	Realisation
Manufacturing process	
Additive manufacturing 3D printing	✓
<i>Coating (surface engineering)</i>	
<i>Fibre composite technology</i>	
<i>Forming</i>	
<i>Joining</i>	
<i>Material property alteration</i>	
Primary forming Casting, Others (Casting of rotors with minimal porosity (Zero Porosity Rotor, ZPR®), also with inlaid 3D structures (porosity < 1 % in both longitudinal and cross-section))	✓
<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>	
<i>Composites</i>	
<i>Fibres</i>	
Functional materials	
Others (Rotors with 3D structures and a conductivity > 56 MS/m)	✓
Metals	
Others (Copper and copper alloys Nickel alloy Inconel 718)	✓
<i>Plastics</i>	
<i>Structural ceramics</i>	
<i>(Technical) textiles</i>	