Improving aluminium alloys for hydrogen mobility: with scandium

About this project

AluScaL

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Markets:

Material: Aluminium, Intermetallic alloys

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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

Aluminium alloys are key to lightweight construction in order to make vehicle, air and shipping components even lighter and more resilient. Such solutions are particularly in demand for hydrogen mobility, where components have to withstand extreme pressures while remaining lightweight. One promising approach is the targeted addition of small quantities of scandium. This rare element significantly increases the strength, stability at high temperatures and service life of the alloy.

Until now, its use was considered too expensive. The price of scandium was high and supply was concentrated in just a few countries. Companies are now developing new deposits in Canada, Australia and Europe. More efficient extraction methods are significantly reducing costs. This creates new scope for the use of aluminium-scandium (Al-Sc) alloys on a larger scale - for hydrogen valves, for example, which were previously made of stainless steel or conventional aluminium. This is where the AluScaL project comes in: The partners are investigating how these high-performance alloys can be specifically developed and used in industry.

Purpose

The project team wants to further develop aluminium-scandium alloys so that they are suitable for highly stressed lightweight components in hydrogen mobility. The aim is to create materials that can be processed using conventional methods, can be mass-produced and at the same time fulfil the mechanical requirements. The researchers are investigating which compositions and process routes are technically and economically suitable - for forging, extrusion and additive manufacturing.

In doing so, they are closing a gap between materials research and industrial implementation. Until now, there has been a lack of reliable data on properties, manufacturability and long-term behaviour under the influence of hydrogen. The project provides this data and transfers it to specific applications. This creates the basis for the series use of new lightweight materials that reduce weight, costs and emissions - and at the same time meet higher component requirements than previous aluminium alloys.

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Procedure

The project team is developing new aluminium-scandium alloys that are suitable for forging, extrusion and additive manufacturing. The researchers are varying the scandium content, investigating the forming behaviour and optimising the heat treatments. The focus is on a hydrogen valve for high-pressure storage tanks - a safety-relevant component that was previously made from stainless steel or standard aluminium. The team manufactures this component in different variants and tests it under mechanical stress.

The data obtained is fed into simulation models in order to digitally map and further develop components and manufacturing processes. At the same time, the researchers are evaluating new sources of raw materials - such as by-products from titanium oxide production - and examining their integration into an industrial supply chain.

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Funding duration:

Funding sign:	03LB3032	**Funding amount:**	EUR 2.1 million

Final report

Further websites

foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3032A - AluScaL in the federal funding catalogue

www.dlr.de/de/fk/forschung-transfer/projekte/werkstoff-und-verfahrensanwendungen-gesamtfahrzeug/aluscal - DLR project website

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Project coordination

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English (EN){{ Projektpartner }}

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Materials	✓
Services & consulting Testing and trials, Engineering	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight material construction	✓
Functional integration	
Measuring and testing technology	
Modelling and simulation Loads & stress, Materials	✓
Plant construction & automation	
Recycling technologies	
Manufacturing process	
Additive manufacturing 3D printing	✓
Coating (surface engineering)	
Fibre composite technology	
Forming Forging, Extrusion moulding	✓
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites	
Fibres	
Functional materials	
Metals Aluminium, Intermetallic alloys	✓
Plastics	
Structural ceramics	
(Technical) textiles	