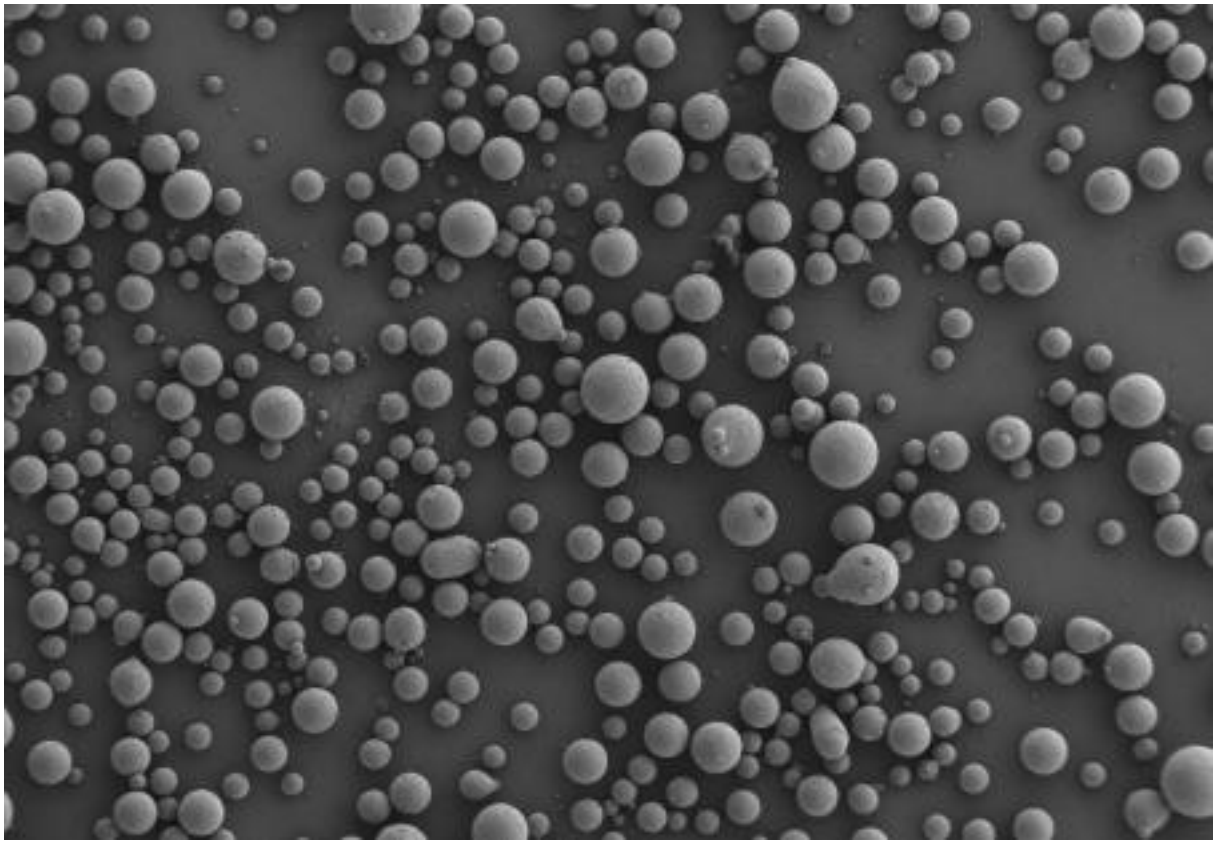
Sustainable 3D printing: reusing metal powder and digitising material flows

About this project



PERU

Sustainable 3D printing: reusing metal powder and digitising material flows

Markets:

Material: Aluminium, Titanium

This project is funded by the Technology Transfer Programme Leichtbau (TTP LB) of the Federal Ministry of Economics and Energy.

Technology Transfer Program Leichtbau

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Context

Additive manufacturing processes such as laser beam or electron beam melting build up components layer by layer from fine-grained metal powder. This results in particularly light yet stable structures. They are material-efficient as there is no chip waste and no casting moulds are required. Studies show that weight reductions of over 40 percent can be achieved with optimised lightweight constructions.

Despite these advantages, companies have hardly utilised metal 3D printing to date. The market share is less than one per cent of the total metal machine market. One of the main reasons: There is a lack of reliable processes to utilise the powder used multiple times. Oxidation, moisture or impurities change the properties of the powder and can impair component quality.

As there are neither established limit values nor standardised measurement methods, many companies only use fresh powder. This increases production costs and prevents closed material cycles. In addition, high CO# emissions are generated - simply through the production of the raw material.

Purpose

This is where the PERU research project comes in. The project partners want to technically safeguard the reuse of metal powder in 3D printing and make it suitable for industrial use. The researchers are developing a method that allows powder to be used multiple times without jeopardising the quality of the components. The aim is to improve material utilisation, cut production costs by at least 50 per cent and significantly reduce CO# emissions at the same time. A particular focus is on regulated markets such as aviation, medical technology and energy technology, where the highest standards of quality and traceability apply.

To achieve this goal, the project team defines limit values for ageing processes. It is developing processes for drying, cleaning and the targeted mixing of powder batches. The partners are also setting up a digital traceability system. This will allow all batches in the production process to be automatically monitored and documented - a prerequisite for reliable series production. The results are to be incorporated into technical guidelines and future standardisation projects. The digitalisation of material flows is also one of the objectives: It enables continuous quality control and helps to make additive manufacturing processes more efficient.

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Procedure

The project partners are initially analysing how metal powder changes during repeated use in additive manufacturing. They are investigating two processes: laser beam melting and electron beam melting. Both work with thin layers of powder that are melted using a laser or electron beam. The researchers record characteristics such as moisture content, particle size distribution, degree of oxidation and foreign contamination - all factors that can influence the quality of the final component.

In order to assess these properties, the team is developing new measurement methods and defining limit values for reusability. The partners are building a test rig to investigate the coating behaviour of the powder under real process conditions. At the same time, they are developing methods for processing, such as drying moist powders or mixing old and new batches.

The development of a digital material cycle plays a central role: all powder batches are continuously documented and their properties are automatically recorded and analysed. This allows changes in the powder stock to be tracked and correlated with the quality of the printed components.

Funding duration:

Funding sign:	03LB5007	**Funding amount:**	EUR 1.5 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB5007A - PERU in the federal funding catalogue

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Project coordination

Contact:

Mr Maximilian Kluge

+49 40 484010-728

maximilian.kluge@iapt.fraunhofer.de

Organisation:

Fraunhofer Research Institution for Additive Manufacturing Technologies

Am Schleusengraben 14
21029 Hamburg
Hamburg
Germany

www.iapt.fraunhofer.de/

English (EN){{ Projektpartner }}

tascon Analytical Services & Consulting

IABG

COLIBRIUM ADDITIVE

Implantcast GmbH

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Lightweighting classification

	Realisation
Offer	
Products Software & databases, Materials	✓
Services & consulting Testing and trials, Standardisation, Technology transfer	✓
Field of technology	
Design & layout	
Functional integration	
Measuring and testing technology Component and part analysis, Materials analysis	✓
Modelling and simulation Life-cycle analysis, Optimisation, Processes, Materials	✓
Plant construction & automation Handling technology	✓
Recycling technologies Downcycling, Recycling	✓

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing 3D printing, Electron beam melting, Selective laser melting (SLM, LPBF, ...)	✓
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology	
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites	
Fibres	
Functional materials	
Metals Aluminium, Titanium	✓
Plastics	
Structural ceramics	
(Technical) textiles	