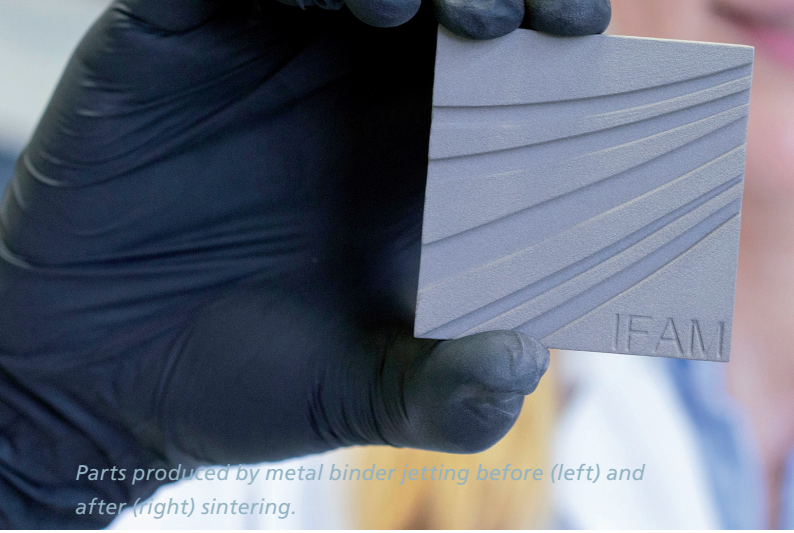
Fraunhofer
IFAM

If AM then IFAM

Additive Manufacturing in Aviation



Parts produced by metal binder jetting before (left) and after (right) sintering.

Economical, resource-saving, versatile – additive!

Additive manufacturing from powder to component

A broad spectrum of additive manufacturing processes is being researched at the Bremen and Dresden sites of Fraunhofer IFAM. All of them are characterized by enormous geometric freedom, a high degree of individualization and excellent raw material efficiency. And this along the entire value chain: from the generation of 3D data models and manufacturing to the final machining and inspection of the components.
Fraunhofer IFAM offers the full range of metal powder-based AM processes to provide comprehensive access to the various possibilities of additive manufacturing technologies.

The Bremen site has the complete process chains of laser beam melting (PBF-LB) and metal binder jetting at its

R&D expertise

- Material development
- Consulting for material and technology selection
- Paste development and characterization
- Powder analysis
- Component design, manufacturing and testing
- Production of prototypes and small series
- Support for implementation in series production
- Process efficiency (depending on material and component)
- Process chain integration
- Economic efficiency considerations

comprehensively equipped additive manufacturing technical center.

The Innovation Center Additive Manufacturing ICAM® at Fraunhofer IFAM in Dresden brings together under one roof the technologies of Selective Electron Beam Melting, 3D Screen Printing, Fused Filament Fabrication, Gel Casting, MoldJet® and Lithography-based Metal Manufacturing (LMM) to demonstrate the various possibilities of additive manufacturing at one central location. The portfolio is completed by process control during heat treatment, including debinding and sintering processes, as well as powder analysis.

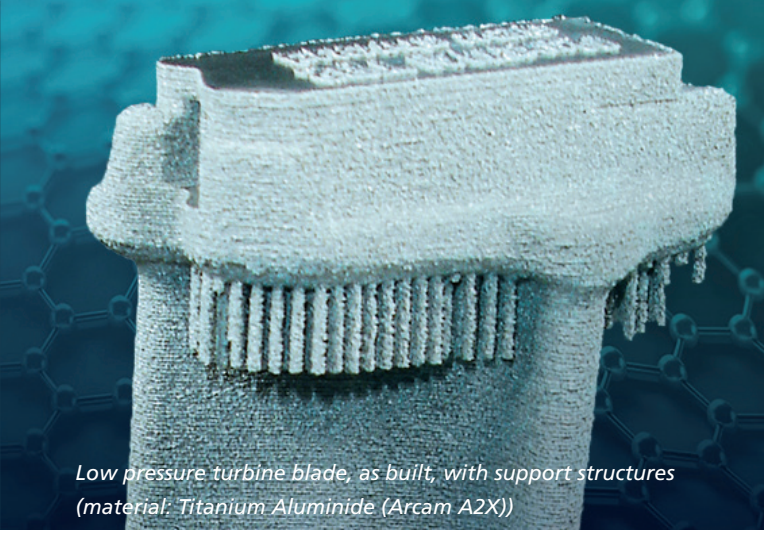
Study of a ring nozzle, status after sintering

Metal Binder Jetting closes a gap

The gap between tool-less prototype as well as small series production using PBF-LB and tool-based mass production using, for example, Metal Injection Moulding (MIM) can be closed by Metal Binder Jetting. In aviation especially where part volumes often do not reach high numbers, Metal Binder Jetting offers an alternative way to produce geometrically complex parts with a very high build rate. In addition, the process allows the processing of materials that were previously impossible to process with other AM processes, for example metal alloys that cannot be welded at all or that are difficult to weld. The operation of four Metal Binder Jetting printers plus an extensive sintering furnace equipment completes the technical portfolio of Fraunhofer IFAM. We thus have comprehensive technical equipment and expertise along the entire process chain of Metal Binder Jetting.

Example: **Ring nozzle**
Material: Inconel 718
Part specifics:

- Demonstrator part
- Optimized internal gas flow
- Design optimized for MBJ



Low pressure turbine blade, as built, with support structures (material: Titanium Aluminide (Arcam A2X))

Components - Case studies

Low Pressure Turbine Blade

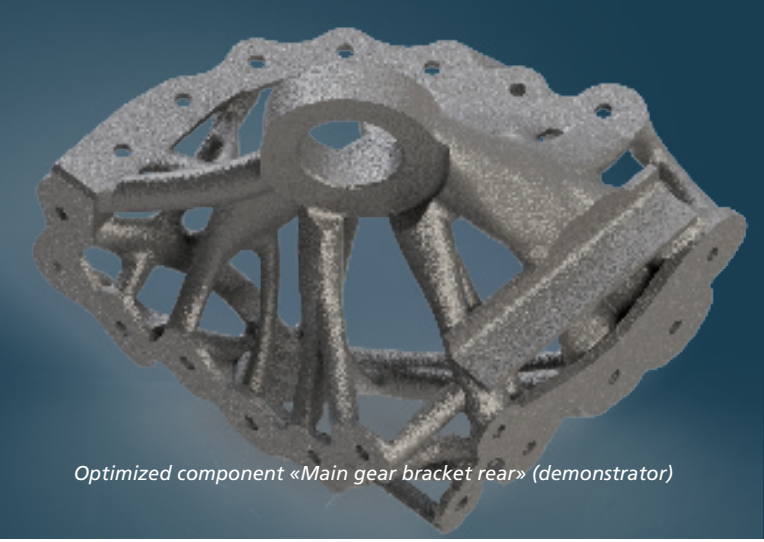
Technology: PBF-EB
Material: Titanium Aluminide (Arcam A2X)
Part Specifics:

- Material composition has been optimized for part performance, processing only possible by PBF-EB
- Demostrators (> 10 parts) manufactured successfully
- Post-processing could be performed in the same way as for the conventionally manufactured part.

FCRC Bracket

Technology: PBF-EB
Material: Ti-6Al-4V (Arcam Q20+)
Part Specifics:

- -75 % weight decrease possible by topology optimization
- Weight advantage over PBF-LB (up to 17 %), because the amount of support structures is much lower
- Max. loads were exceeded in rig test



Optimized component «Main gear bracket rear» (demonstrator)

Components - Case studies

Main Gear Bracket

Technology: PBF-EB
Material: Ti-6Al-4V (Arcam Q20+)
Part Specifics:

- Safety-critical part ⇨ R_a < 3 µm needed on whole part
- Surface treatment: electochemical polishing & CNC
- Rig test successfully completed
- -40 % weight decrease possible by topology optimization
- High degree of complexity with respect to support structures ⇨ manufacturing preferential for PBF-EB

The institute covers the entire value chain for the additive processes available at Fraunhofer IFAM – from the generation of the 3D data models and manufacturing to the final machining and inspection of the components.

AM increases productivity, profitability and resource efficiency.«

Our experts

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