Fraunhofer Kompetenzfeld Additive Fertigung

Fraunhofer EMI

L-PBF Parameterentwicklung für Sonderwerkstoffe und zum Mikrostrukturdesign

Process Parameter Development for Special Alloys and Materials

Parameter Development for Pure Tungsten and Pure Tantalum

- Microstructures and therefore material properties are highly dependent on process parameters
- Ca. 50 - 130 process parameters necessary

Examples of common L-PBF alloys:

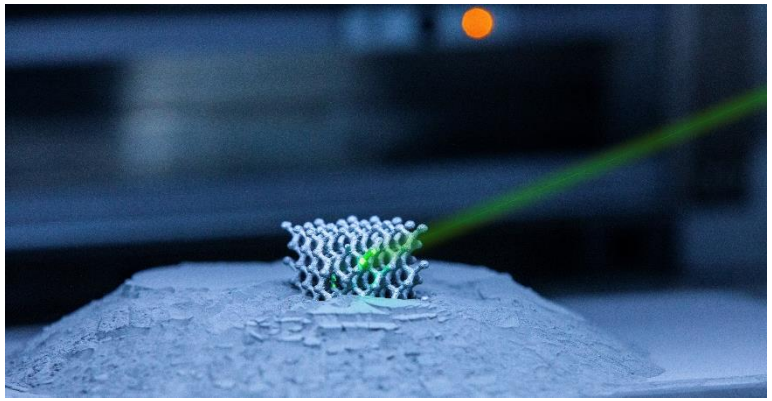
- Aluminium & Ti64 (lightweight design)
- IN714 (high temperature applications)
- MS1 (tooling)
- 316L (stainless steel for work of art)

Issue:

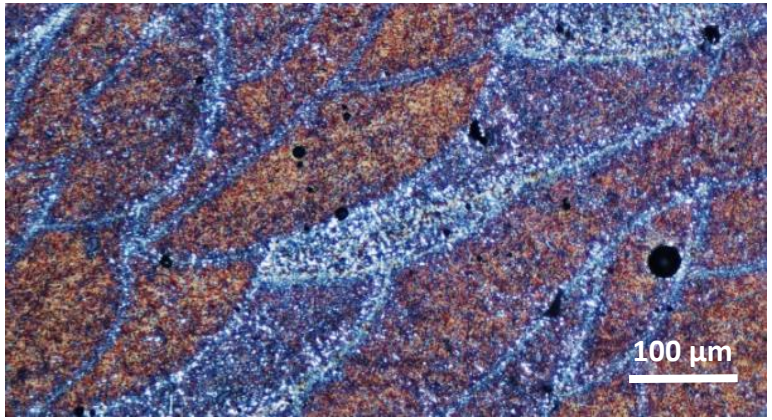
- Single alloys are used for whole sectors of application.

➡ Own development of process parameters for ideal materials for defense & security technologies

Examples: Tungsten, Tantalum, Steels, MMCs



Manufacturing parameter development for materials and parts.



Microstructures and therefore material properties are highly dependent on process parameters.

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Pure-Tungsten and -Tantalum Additively Manufactured

In-house Development

Tungsten (19,25 g/cm³):

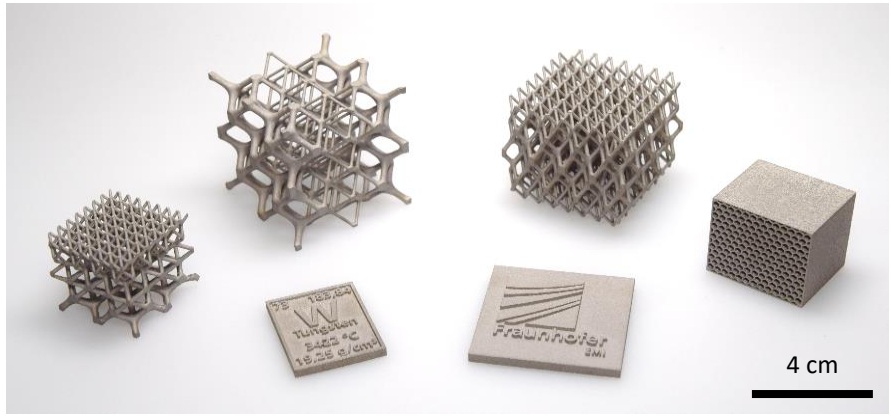
- Achieved relative Density: ca. 99,5 %
- Highest value in literature: < 98 %
- Reduced micro cracks

Tantalum (16,65 g/cm³):

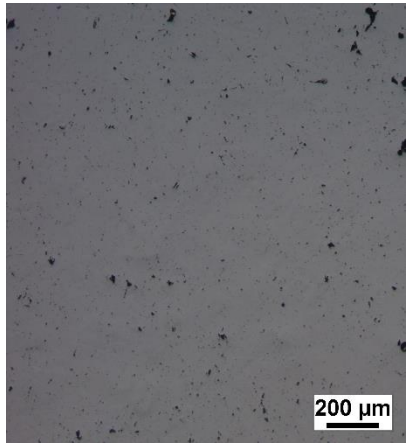
- Ductile properties
- Outstanding relative density (ca. 99,99 %)

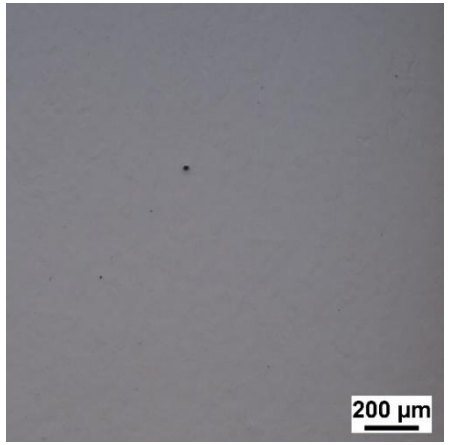
- Parameters suitable for bulk material as well as lattice structures
- Parameters can be optimized and adapted for specific applications, parts or machines.

On request: Parameters can be optimized and adapted for specific applications, parts or machines.



Bulk material and complex lattice structures made of pure-tungsten by L-PBF.





Images showing the resulting characteristic microstructure. Left: Tungsten. Right: Tantalum.

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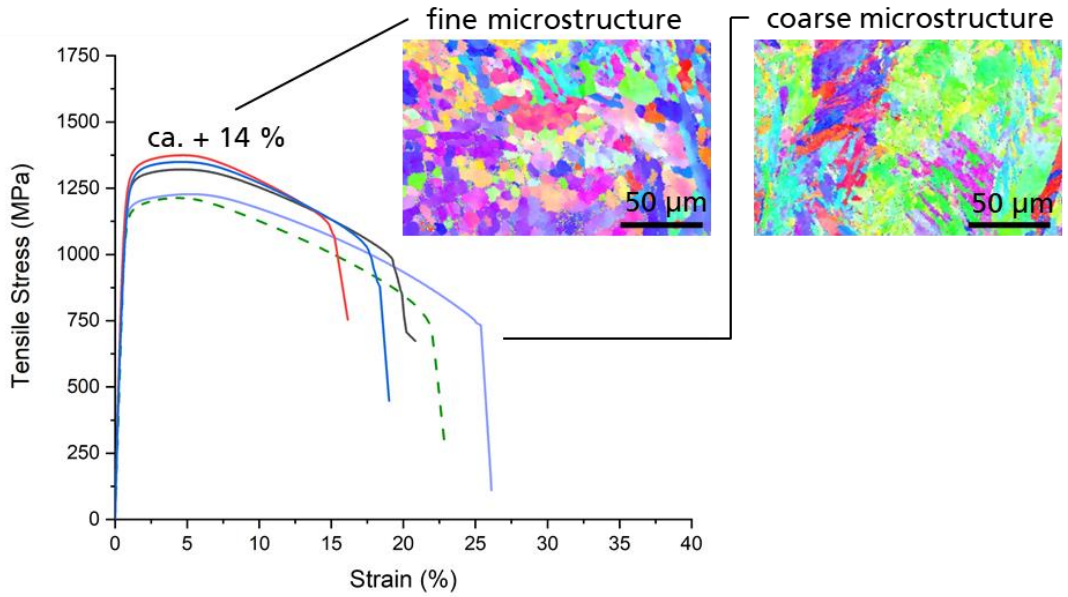
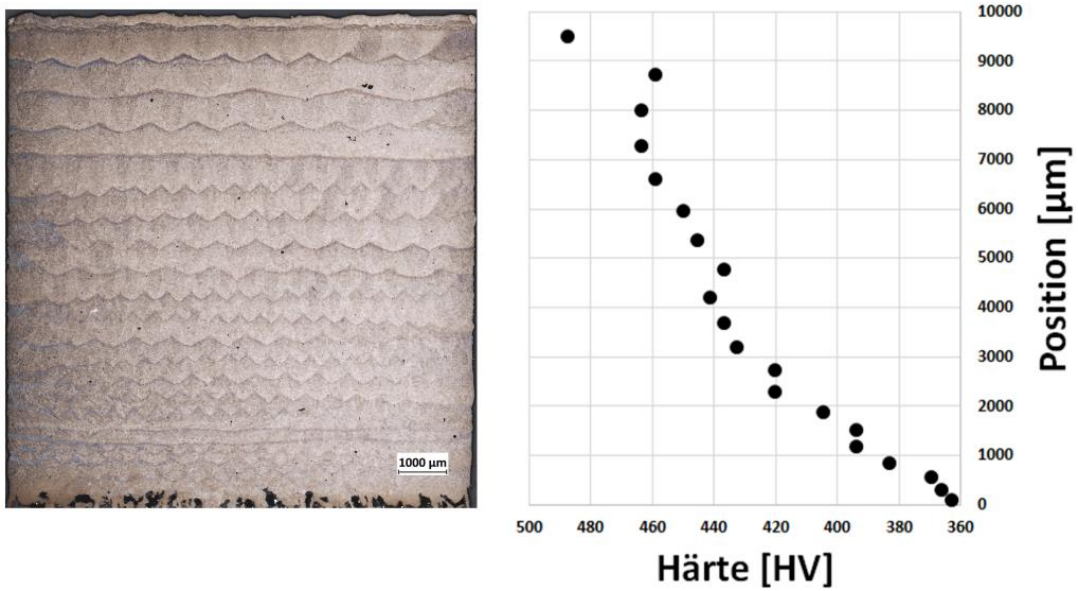
Functionally Graded Steels by L-PBF

Reinforced and Gradient Materials

Material showing increased tensile strength due to a finer microstructure resulting from adapted process parameters



Sample exhibits a gradient in hardness realized by changing process parameters resulting in a hardness from ca. 360 HV up to ca. 500 HV



Characteristic of Additive Manufacturing:
Material properties are generated during the manufacturing process.

→ Microstructure and there material properties depend on the set manufacturing parameters **(Pfaff, Hoschke, et al. 2018)**

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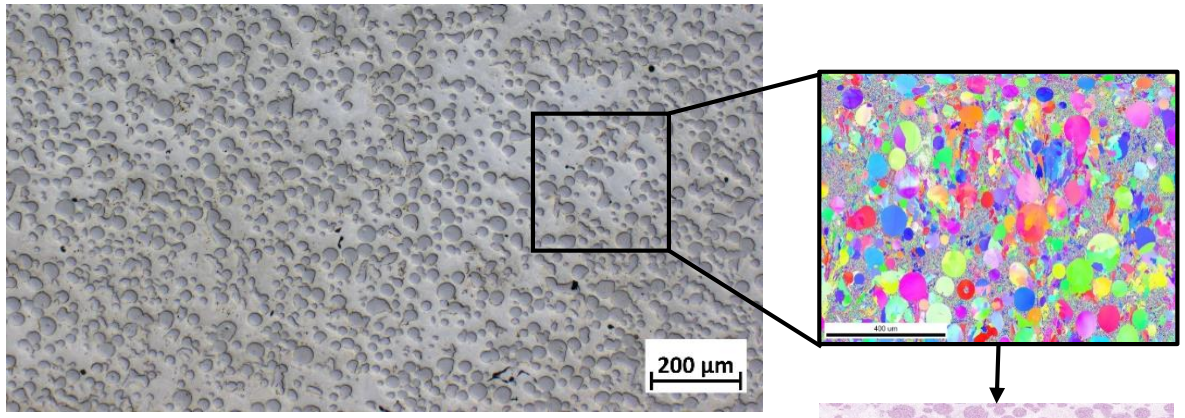
Metall Matrix Composites (MMCs)

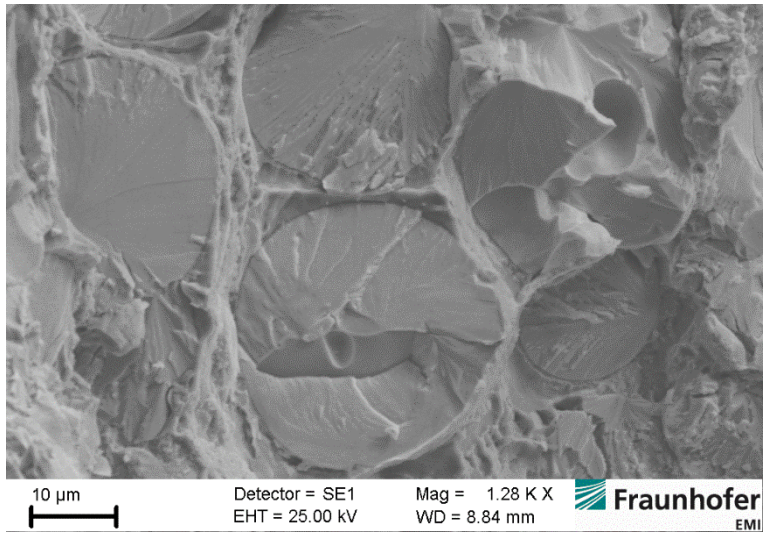
Example here: Tungsten in a steel matrix

- MMCs combine the mechanical properties of their components.
- Mechanical properties can be superior than from each component itself.
- Multiple combinations of materials possible.
  - Metal particles
  - Ceramic particles
- Showcase: Embedding of Tungsten particles in a steel matrix

→ Development of manufacturing parameters for different material combinations



Tungsten particles embedded in a steel matrix by L-PBF.



Failure analysis of a tensile test specimen.

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Kontakt

Aron Pfaff
Teamleiter Additive Manufacturing
Tel. +49 761 2714-522
aron.pfaff@emi.fraunhofer.de

Fraunhofer-Institut für Kurzzeitdynamik, Ernst-Mach-Institut, EMI
Ernst-Zermelo-Straße 4,
79104 Freiburg,
Germany
www.fraunhofer.de

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