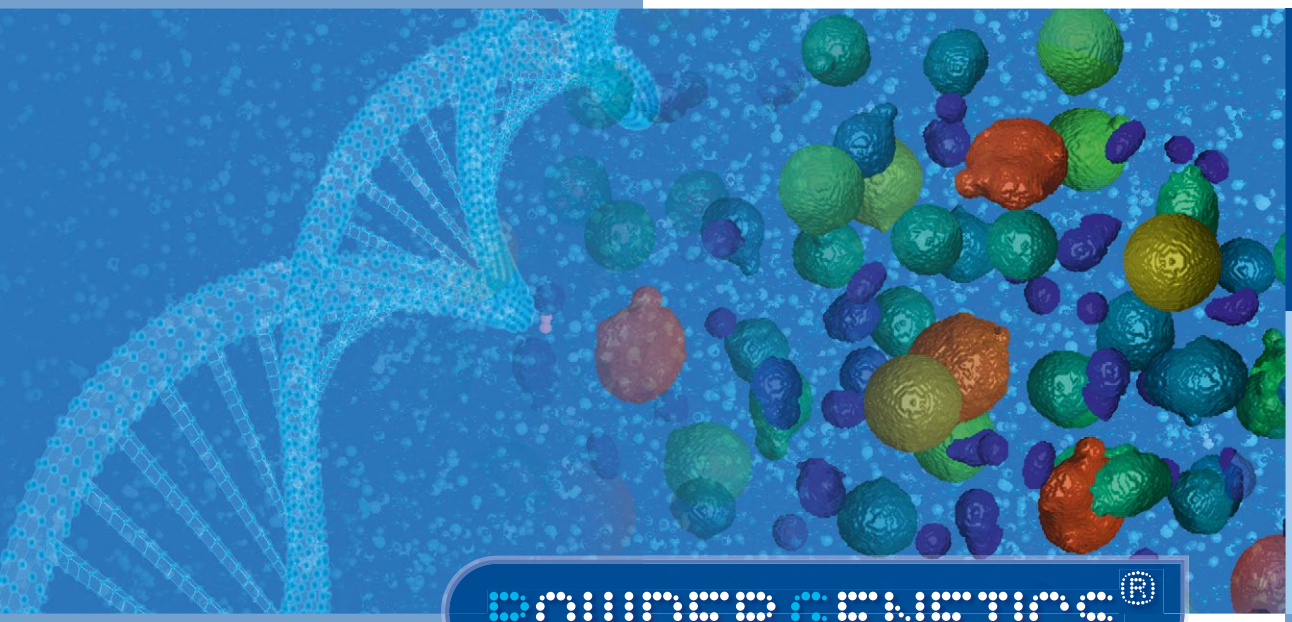
Genetic information of powder material



POWDERGENETICS®

The essential fingerprint
of additive manufacturing

IABG

POWDERGENETICS®

The essential fingerprint of additive manufacturing

Powder Genetics® is an IABG invented powder characterization procedure for metal and ceramic powder material. With the performance of four investigation methods at a small amount of powder (20 – 50g), elementary powder properties are both qualitatively and quantitatively obtained.

All methods are interdependent which allows cross connections of characteristic properties for correlation purposes.

Powder Genetics® is the holistic approach of a sustainable powder characterization due to the reliability of the results and the transferability to the manufacturing process. Included within an AM data base, Powder Genetics® is the foundation for optimization, correlation and stabilization purposes within the value chain of additive manufacturing.

Method	Characteristics	Description	Remark
Macroscopic investigation	Rough estimation of non-acceptable features as obvious discolouration and humidity	3D-information pure qualitative efficient	Possibility to refuse powder material in an early stage
Chemical analysis			
a) X-ray fluorescence	Chemical composition	Full scale spectra of contained elements, qualitative and quantitative information	Possibility to refuse powder material in an early stage – due to strong acceptance criteria
b) Carrier gas hot extraction	Determination of elements H, N, O, C, S		
c) Colourmetric Karl Fischer titration	Content of water		
SEM-investigation	Topography, Morphology, Contamination	2D-information, qualitative	CT-scan resolution and evaluation criteria for sphericity are gained by the results of SEM investigation
Computed tomography	Particle size and distribution, morphology, surface area, particle volume, hollow spaces, higher dense particle	3D-information of elemental properties, quantitative	Statistically verified due to a high amount of scanned particles (10^5)

POWDERGENETICS®

The DNA of powder material

- Efficient and holistic examination of the elementary parameters
- Reduction of methods and powder amount
- Increasing the depth of information by statistically validated results
- Combination of elementary parameters allows cross-connections

CLASSIFICATION
Weightings and limit values depending on production and material parameters

CORRELATION
Influence on component quality

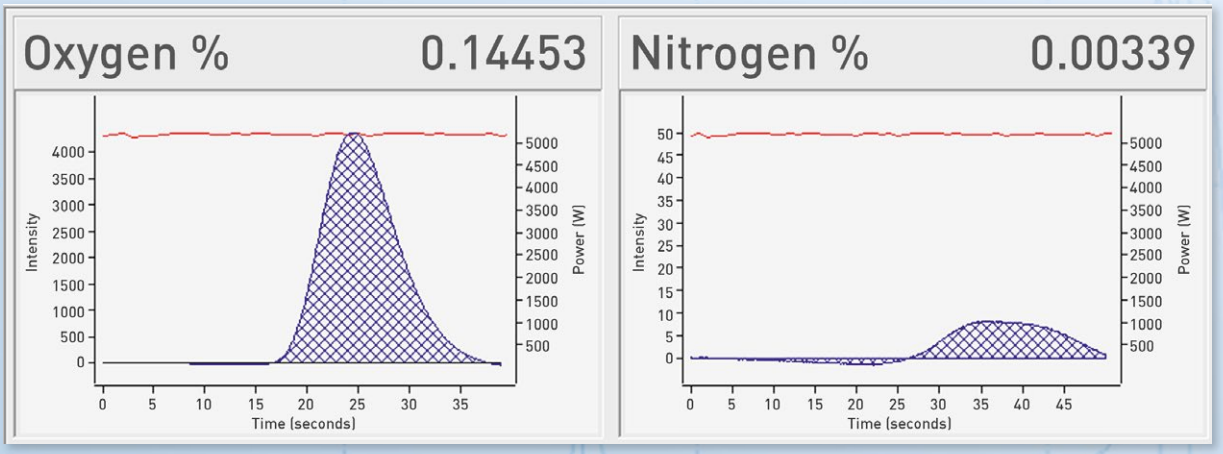
Our seal stands for the quality of our accredited and certified test facilities

Industrieanlagen-Betriebsgesellschaft mbH
geprüft durch IABG tested by
Ottobrunn

Macroscopic investigation

The visual inspection allows a fast and very efficient approach of detecting rough abnormalities within the powder material. Following listed features are compared to specified characteristics for an efficient approach of evaluation.

- Discolouration
- Humidity
- Coarseness of grains
- Contamination

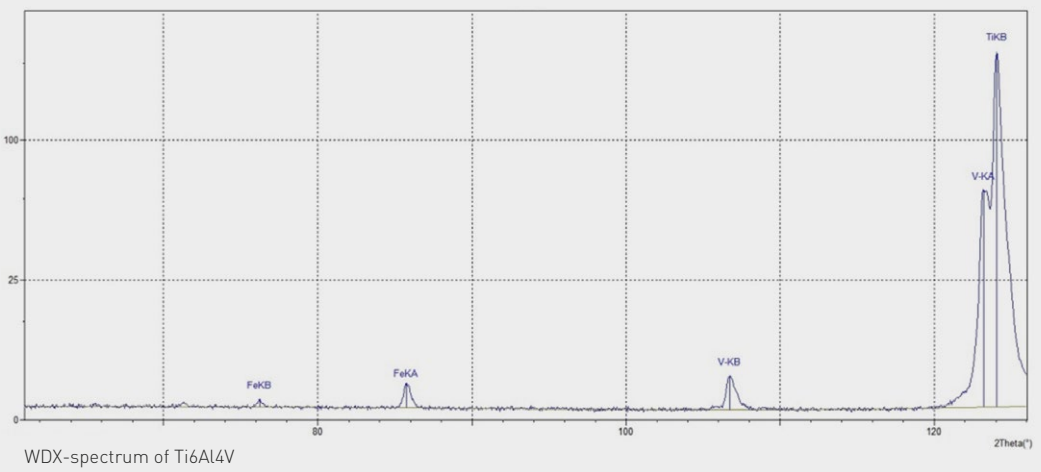


Chemical analysis

The chemical composition of powder material forms an essential aspect of powder characterization. The content of specified elements, impurities, contamination and the content of highly reactive light elements play a decisive role for the usability of a powder material. The results of the investigation are evaluated with a target/actual comparison as a quality assurance measurement.

In case of a non-conformance, the powder material might be refused. Due to cost and time saving this approach is a very efficient procedure. Also for mixed or refurbished powder material the chemical analysis is essential regarding the usability of powder material for distinct purposes.

- Determination of chemical composition for specified elements
- Content of water
- Content of reactive elements as H, N, O, C, S
- Rough contamination



WDX-spectrum of Ti6Al4V

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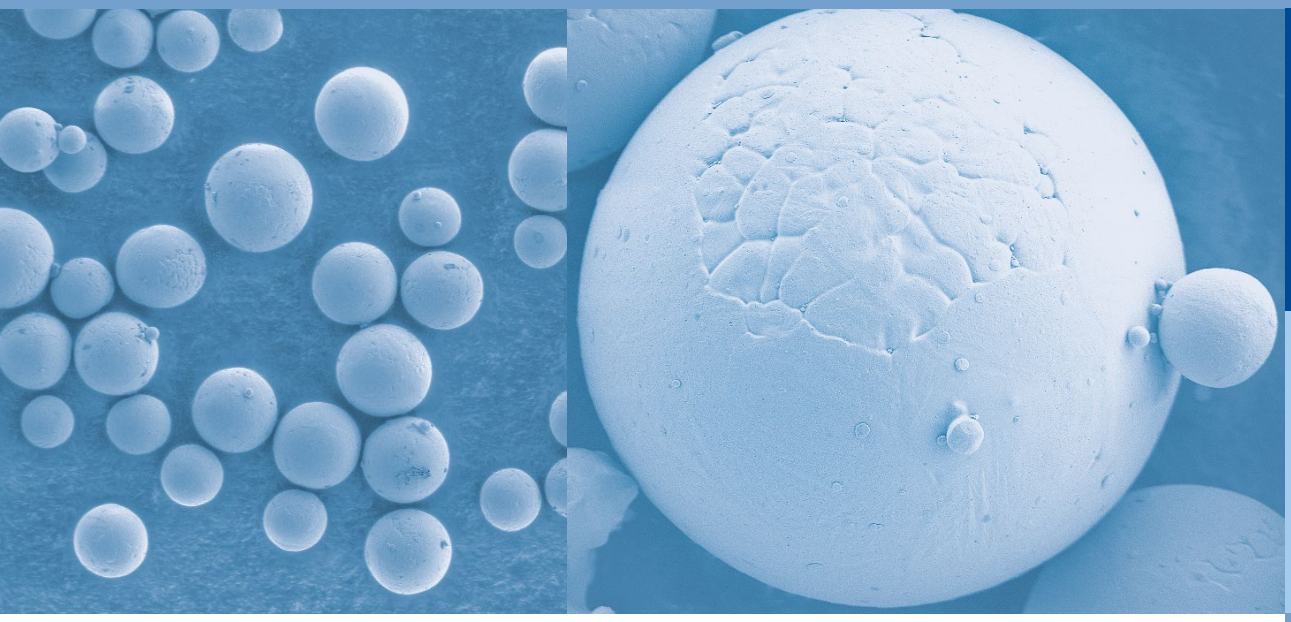

Scanning electron microscopy

By the means of scanning electron microscopy, a sample of about 500 powder particles becomes investigated for gaining qualitative results. The information about surface structures, sub- and de-shaped particles combined with the size distribution are important to estimate the flowability behavior of powder material. Furthermore the qualitative results are evaluated as input and scan data for the computed tomography.

The following features are obtained qualitatively:

- Morphology
- Topography
- Contamination
- Size distribution

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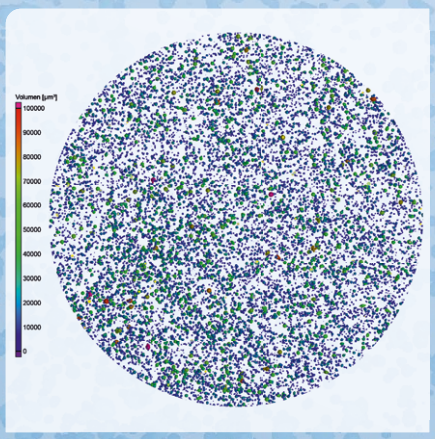

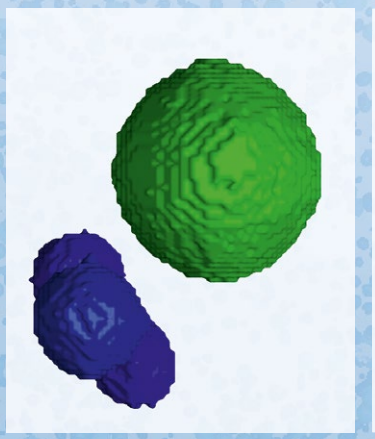

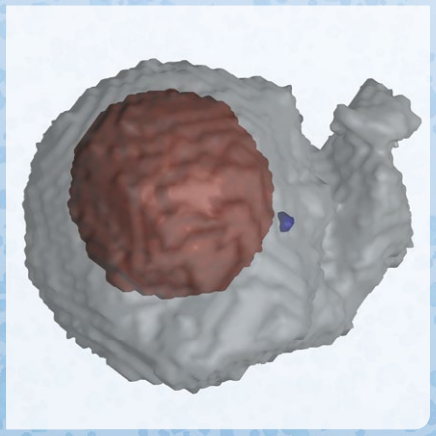

Computed tomography

More than 10e5 particles are separately orientated within a capsule sample. The sample preparation does not exhibit any preparation artefacts like particle agglomerate and conglomerate. A high resolution scan of up to 500 nm voxel sizes allows the 3-dimensional investigation of elementary particle features. According to the SEM analysis results, an evaluation is performed to receive statistically verified particle properties within the highest possible information depth.

The evaluation contains a target/actual comparison according to specified requirements.

- Particle size
- Particle size distribution
- Morphology
- Morphology distribution
- Surface area
- Particle Volume
- Hollow spaces
- Higher dense particle (HDP)

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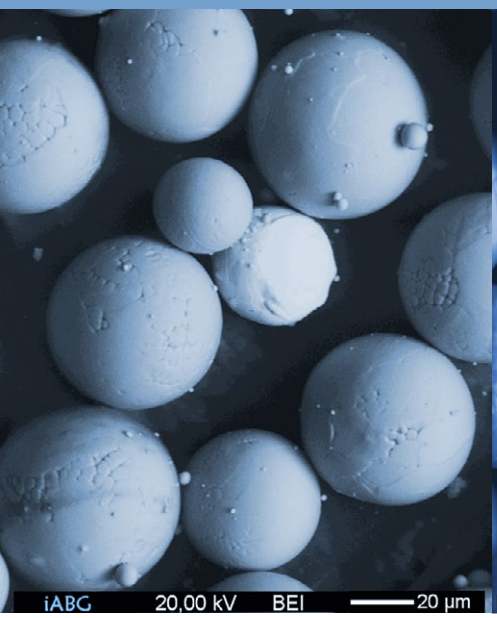
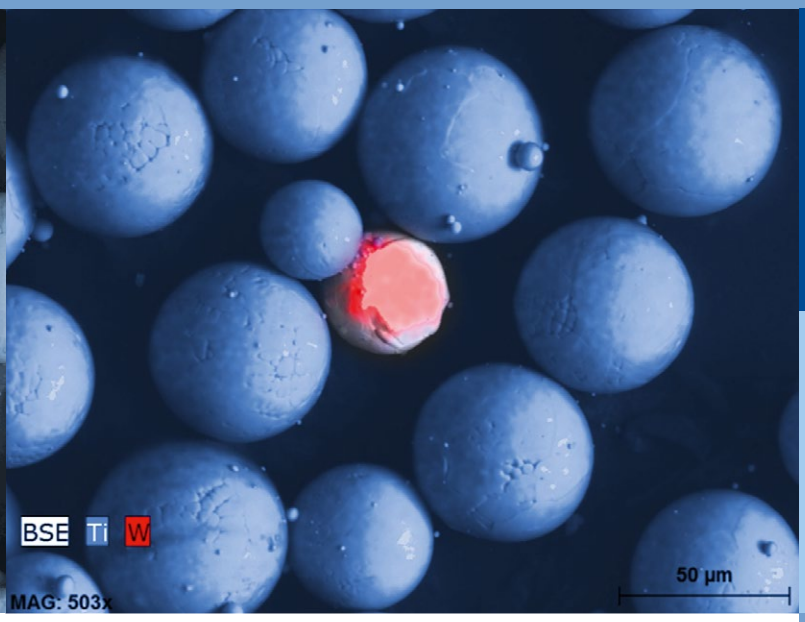
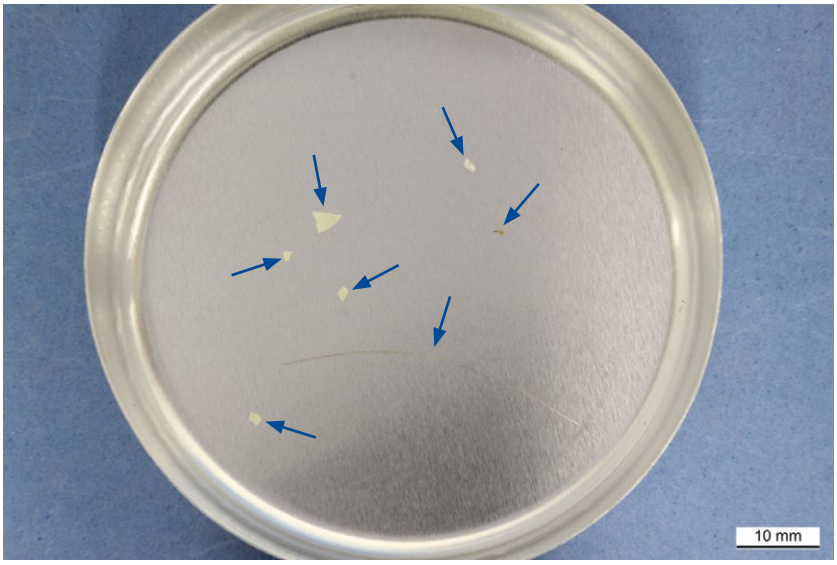




Optional: Contamination analysis

Contaminations of elements below the detection limit of the chemical analysis or which are in the material specification of the powder material can be determined qualitatively and quantitatively in sub-ppm-range.

Plastics, lower and higher dense materials as well as different powders can be analysed. The amount of contamination is determined by computed tomography or gravimetricly. The contamination will be isolated from the powder and analysed by light optical or scanning electron microscopy.



Extracted contamination of lower dense material (organic impurity)

AUTOMOTIVE

INFOCOM

MOBILITY, ENERGY & ENVIRONMENT

AERONAUTICS

SPACE

DEFENCE & SECURITY

About IABG

IABG offers integrated, ground-breaking solutions in the sectors Automotive • InfoCom • Mobility, Energy & Environment • Aeronautics • Space • Defence & Security. We provide independent and competent consulting. We implement with future viability and target orientation. We operate reliably and sustainably. Our success is based on an understanding of market trends and requirements, on our staff's technological excellence and a fair relationship with our customers and business partners.

As a development partner we provide quality control services and develop solutions in the areas of functional efficiency, quality, design, and materials. We offer a broad spectrum of products and services, ranging from numerical analysis to experimental testing to the realisation of turnkey, customised test systems that we operate for the customer.

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