thyssenkrupp Materials UK

Powder Metals

Additive Manufacturing

Post Printing Services

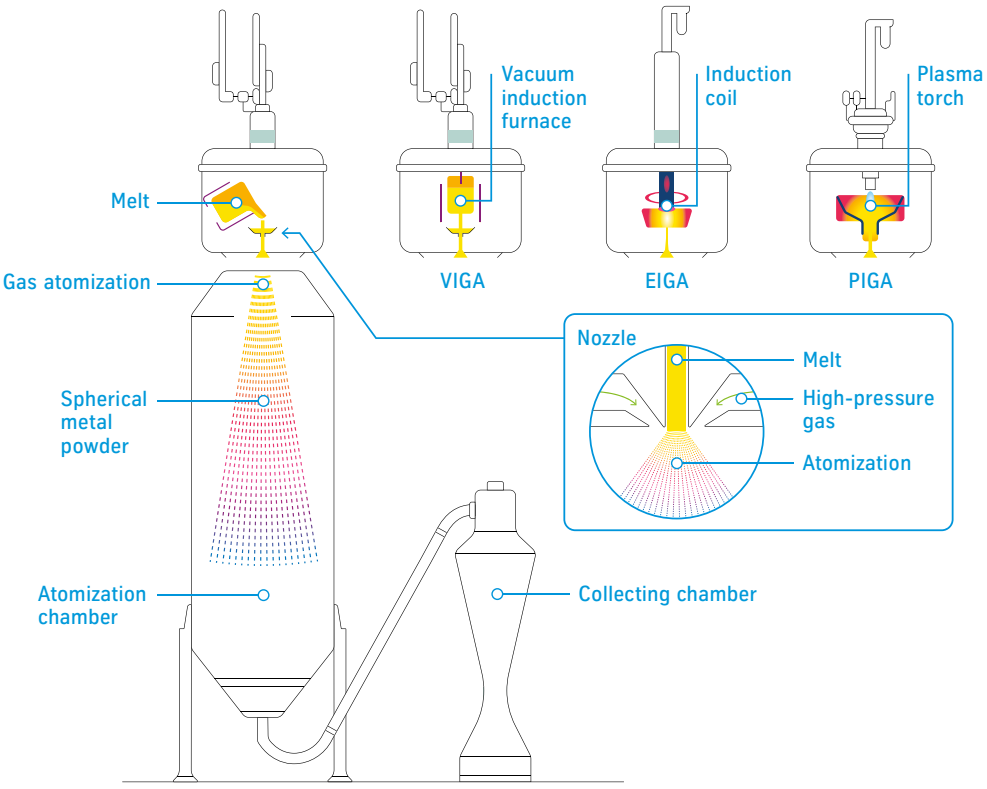
thyssenkrupp

Contents

Cover image: Section though probe head made from material 1.4845

Powder Production

Common methods



Powder production methods

	VIGA	EIGA	PIGA
Method	Vacuum induction furnace	Induction coil	Plasma torch + Cu funnel
Suitable materials	Ni, Cr, Co, Al high alloy steels	Reactive alloys, e.g. Ti	Almost all, incl. low melting metals
Alloying process material	Pre-alloyed or in molten metal bath	• tundish-free melting • Electrodes required as consumables • Alloys only in line with available standard qualities (Ti grades 1- 5, 23)	High purity melting process • No rod material required as consumables
Characteristics	• Spherical particles • Low oxygen content	• Spherical particles • Low oxygen content	• Very spherical particles • Very price intensive
Yield	Size range 0 – 500 µm Yield in range 20 – 150 µm: 10 – 50 % of input quantity	Size range 0 – 250 µm Yield < 45 µm: approx 30 % of input quantity	• Very low impurities • Yield < 45 µm low

The yield, i.e. optimization of the powder fraction in the desired size range, depends to a large extent on factors such as nozzle geometry, gas pressure, nozzle angle, gas type, melt temperature, gas temperature, flow rate etc.

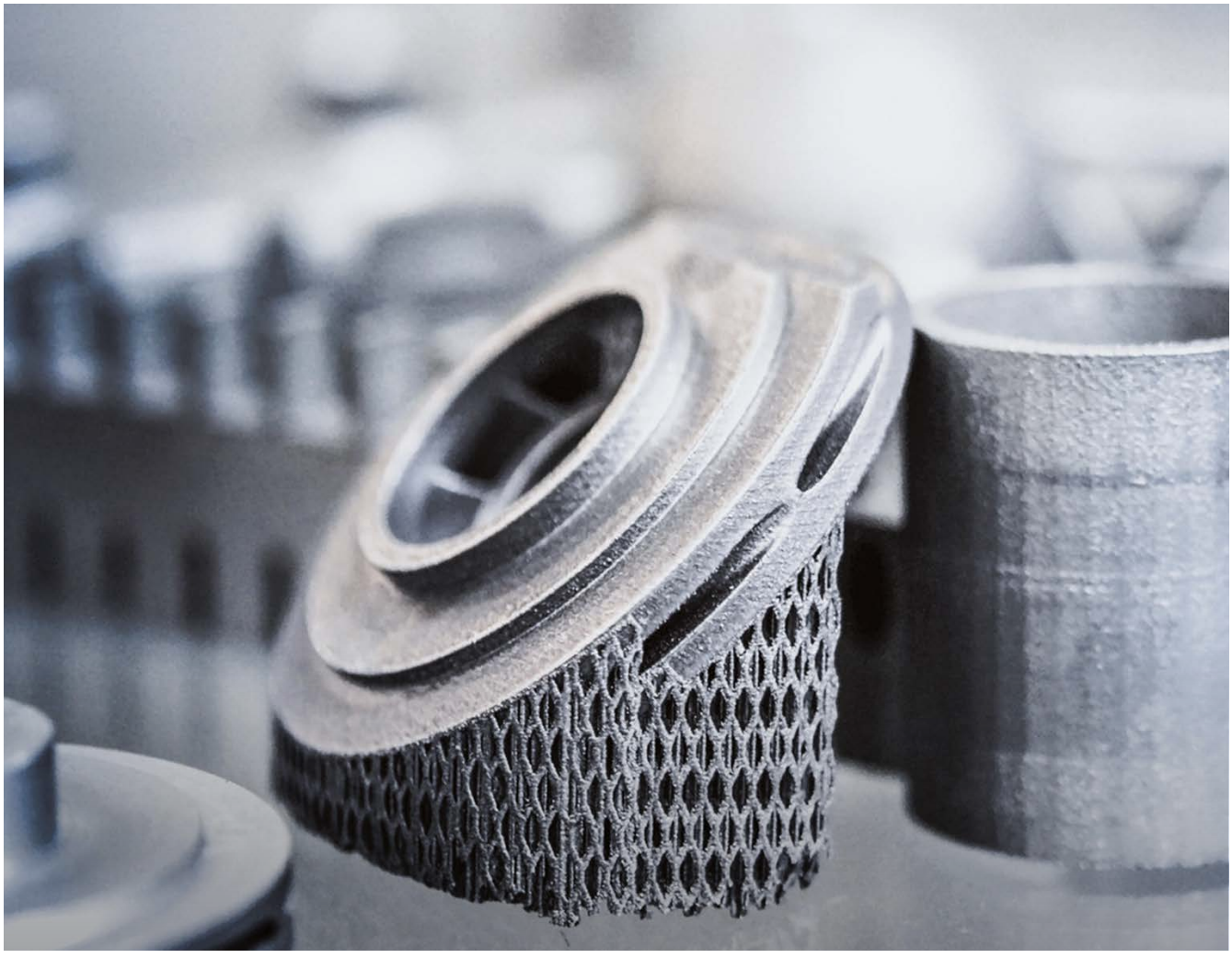
thyssenkrupp and Additive Manufacturing

The rapid development of additive manufacturing processes is placing increasingly diversified demands on machines, powders, handling on the printer and the resultant mechanical properties of the printed parts.

Our advanced metal powders are matched to the different machine types and the underlying processes, enabling us to supply you with the ideal powders for your printing process.

But there are many more advantages to purchasing powders from us:

- highly dependable order execution
- short delivery times
- consistently high and monitored quality
- optimized logistics worldwide
- competitive powder prices

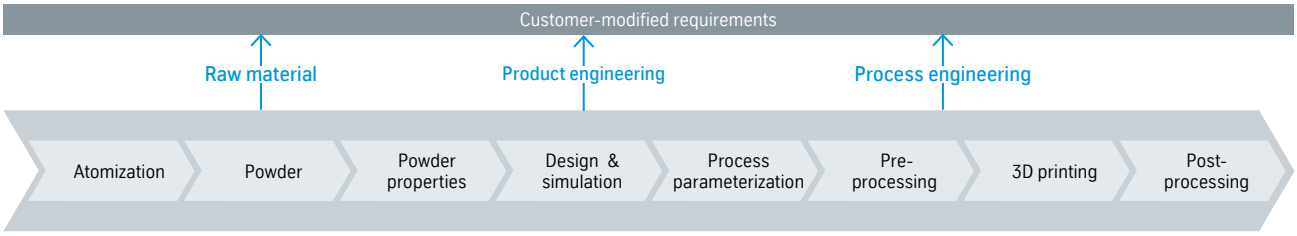


Parts made from TiAl6V4

The AM Value Chain

WVVHQNUSS0DWHULDOV8.VHVVWDWHRIWHDUWWHFQRORWR
EULQFVWRP&1&PDFLQLQWRWHPHWDODGGLWYH
PDQIDFWULQPDUNHW2UQHWRUNRIVLWHVDFURVVWH8.
DOORVVWRRIIHUFDSDFLWDQGFRPSHWLWLYHSULFHV

,WDOVRPHQVWDWHFDQSURGFHERWFRPSOHSURWRWSHVDQG
ORYROPHSURGFWLRQUQVRISULQWHGPHWDOSDUWWPDQ
VU IDFHVILQLVHV



Product Portfolio

Proven standard materials for additive manufacturing that can be used for most powder bed processes without modification:

Standard materials

Name	DIN/EN	Type	Category	Strength range R_m (Mpa) $R_{p0,2}$ (Mpa)	Approximate Vickers hardness (HV 10)
316L	1.4404	Austenitic	stainless	590 – 660 490 – 540	205
17-4PH	1.4542	Ferritic Cr steel	stainless, hardenable	750 – 910 550 – 590	220
1.2709	1.2709	Maraging steel	martensitically hardenable tool steel	970 – 1,050 750 – 900	320
Inconel 625	2.4856	Ni-base alloy	high corrosion resistance	920 – 1,000 660 – 750	285
Inconel 718	2.4668	Ni-base alloy	high corrosion resistance, high-temperature material	950 – 1,030 640 – 770	295
AlSi10Mg	3.2382	Aluminum alloy	lightweight structural material	220 – 420 180 – 220	115
Ti6Al4V	3.7164	Titanium alloy	high-strength lightweighting	830 – 1,100 910 – 1,200	up to 385
Your special materials could be listed here					

Strength and hardness properties strongly depend on heat treated condition of the manufactured part.

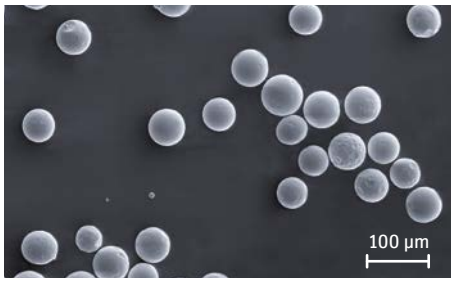
Note:

It is important to note that the anisotropy of properties in additive manufacturing means that strengths may fall significantly short of the values listed here. The properties must be tested on the built part!

Developing Powders to Customer Specifications

In addition to the standard materials commonly used for 3D printing today, thyssenkrupp has a wide range of modification capabilities with regard to alloy structure, atomization and subsequent powder processing that allow us to manufacture and supply custom powders in batches from 50 kg. Ideally modifications of this kind are carried out, tested and approved in close collaboration with the customer.

The close links between the atomization process, thyssenkrupp's laboratories, the TechCenter and thyssenkrupp Materials Trading allows targeted modifications to powders in order to optimize properties and processes.



Ideal spherical particles

Microstructure of a solid AM part

Quality Assurance

thyssenkrupp's central laboratories are certified to DIN EN ISO/IEC L7025:2005 and approved for the following investigations (extract):

"chemical and thermal investigations of steels, ferrous and non-ferrous materials, alloys, crude iron and other metallic materials; chemical investigations and selected determination of reactivity of oxides, ores, sinters, slags, refractory materials and other solid, non-metallic materials; chemical investigations of metallurgical products, petroleum products, refractory materials, polymers, paints and films plus phosphating baths and electrolysis/treatment baths; investigations of sinters, slags and rock materials; mechanical, metallographic and metallurgical investigations of metallic materials; corrosion and resistance investigations, etc."

DAkkS Deutsche Akkreditierungsstelle

All the powders we supply are subject to strict quality controls. The aim is to reduce the batch dependency of the powder properties to a minimum. Certificates of compliance can be included with deliveries.

In cooperation with thyssenkrupp's central laboratories and the thyssenkrupp TechCenter for additive manufacturing we ensure the continuous monitoring and thus the consistently high quality of our AM powders.

Overall Portfolio

In addition to powders for additive manufacturing, thyssenkrupp supplies a wide variety of Fe, Al, Ni and Ti-base metal powders for diverse applications. The range includes:

- Ultrafine powders for metal injection molding
- Powders for thermal and plasma spray processes
- Brazing powders
- Powders for hot isostatic pressing

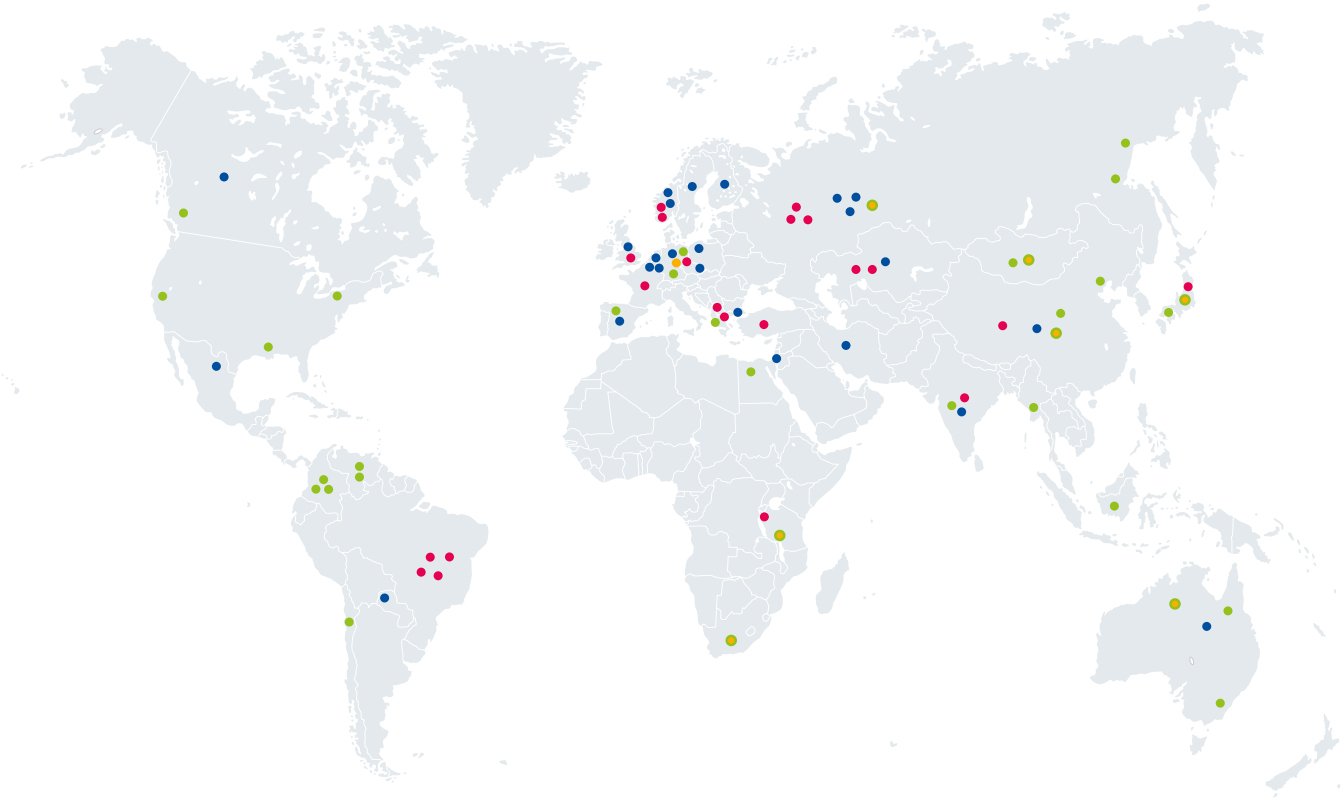
Further powder materials include:

- Ferro alloys
- Carbides
- Nitrides
- Refractory metals
- Soft magnetic alloys
- Ni-base alloys
- Ti alloys
- Al alloys
- Amorphous alloys

On request we can frequently also supply non-standard materials.

Our powders are used in all branches of industry: Welding filler metals for almost all applications, hard coatings, brazing, sintering processes for the automotive and aerospace sectors, medical engineering, plus specific applications requiring special materials, including additive manufacturing.

This broad range is made possible by thyssenkrupp's global presence. We have sources around the world and can manage the raw material flows that are vital for various branches of industry.



thyssenkrupp Materials UK

Coxs Lane, Cradley Heath, B64 5QU
T: +44 (0)1384 563900
www.thyssenkrupp-materials.co.uk

Sale of metal powders, metallurgical advice:

Nigel Evans
Coxs Lane, Cradley Heath, B64 5QU
M: +44(0)7946 290741
nigel.evans@thyssenkrupp-materials.com

engineering. tomorrow. together.