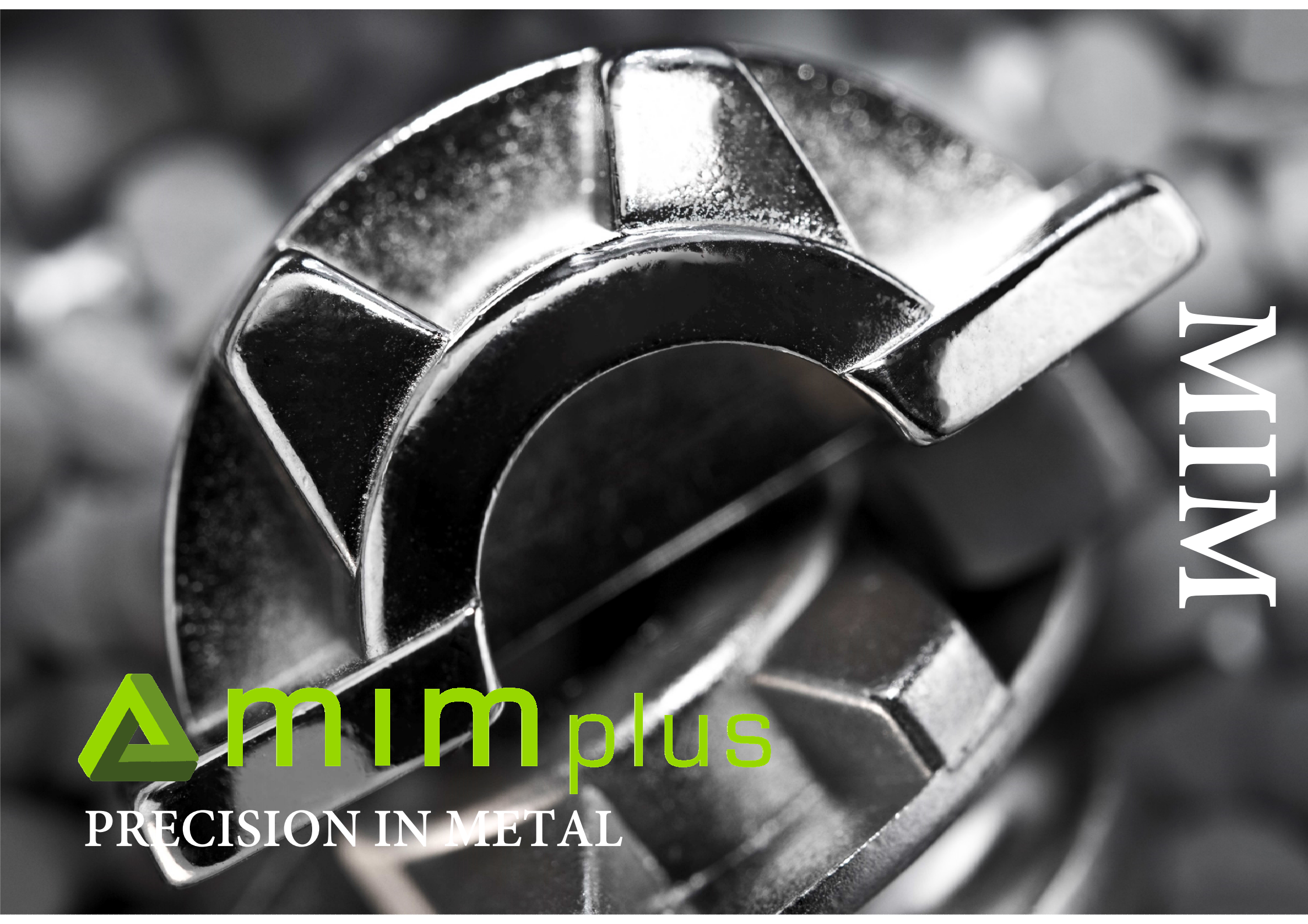

MIM
mim plus
PRECISION IN METAL

MIM

MIMplus Technologies offers the production of complex shaped metal parts using sinter-based metal powder injection molding (MIM).

The processes initially produce so-called "green parts", which are then converted into purely metal parts in the subsequent process steps, debinding and sintering.

In contrast to melt-based processes, the components from the sinter-based process have a homogeneous microstructure and are free of internal stresses. Typically, densities> 96% are achieved.

The MIM technology is an extremely resource-efficient and is therefore also referred to as a “green technology”.

raw material
metal powder, binder

shaping
MIM

debinding
solvent, catalytic

sintering
sintering furnace

metal part

1 — 2 — 3 — 4 — 5

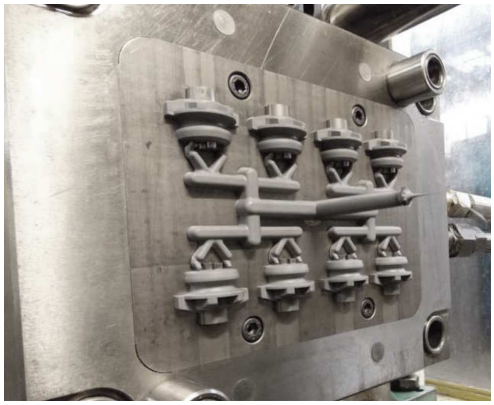
METAL INJECTION MOLDING

Feedstock production:
A metal powder of the desired composition is mixed with a thermoplastic binder and a small quantity of a lubricant (e.g. paraffin) and granulated to become a feedstock. The compound increases the injection capacity of the metal powder and guarantees the shape retention of the blanks.

Injection molding:
The feedstock is formed and demoulded in a mould using conventional injection moulding machines. Blanks produced like this are called “green parts”. They are up to 20% larger than the finished product as a result of the volume quantity of binder, but still however exhibit all the typical geometrical characteristics of the finished component. The sprues can be removed and directly regranulated for the next injection moulding process.

Debinding:
Debinding can be carried out catalytically, thermally or via water depending on the type of feedstock. The binder is hereby removed from the component until a residual binder content of 2-3 % remains. This backbone guarantees the stability of the “brown part” for the subsequent process.

Sintering:
The components are sintered at temperatures of between 1200°C und 1400°C in the last processing step. The remaining binder content is completely removed in special sintering ovens in an inert gas atmosphere. The shrinkage of the component as a result of the sintering is already calculated as a dimensional feature of the mould.



ADVANTAGES OF MIM

- Design freedom for complex geometries
- Ideal technology for mass production & automation
- Highly efficient use of materials
- Large variety of materials
- Density values of almost 100 %
- Similar characteristics to e.g. machined components

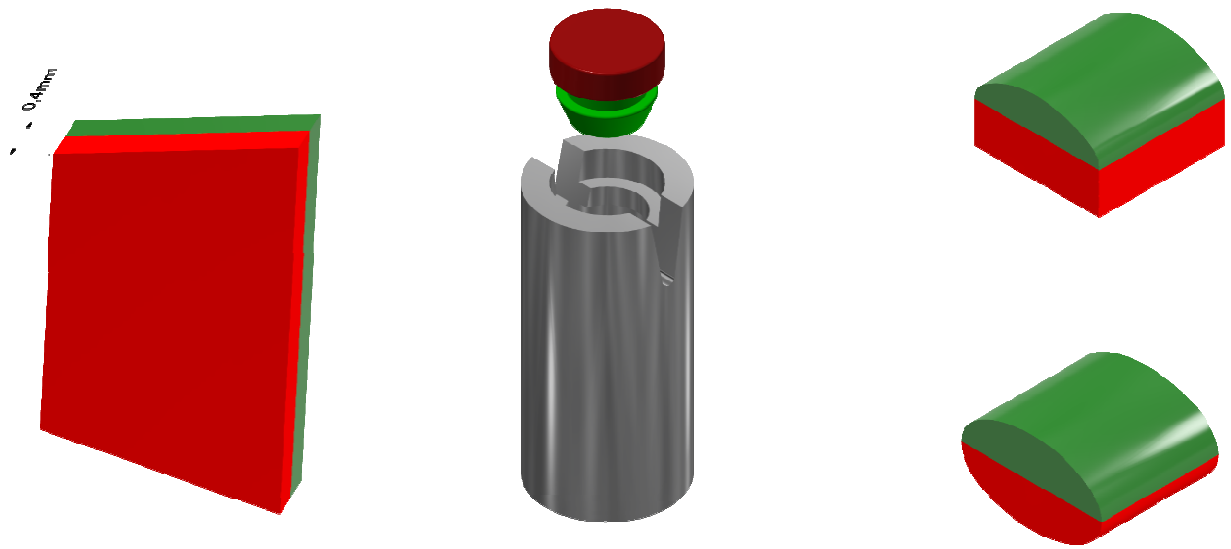
MATERIALS FOR METAL INJECTION MOLDING

Material	Condition	Equivalent material designation	Density g/cm³	Yield point Rp 0,2 MPa	Tensile strength Rm MPa	Breaking strain A %	Hardness	Notes
Low alloyed steels for heat treatment								
FN02	sintered	Fe-2Ni	≥7,50	≥120	≥260	≥25	80-110 HV10	case-hardenable
	surface hardened			-	-	-	≥600 HV 0,2	
100Cr6	sintered	DIN 1.3505	≥7,50	≥500	≥900	≥5	230-290 HV10	heat treatable, wear-resistant
	heat treated			-	-	-	635-720 HV10	
42CrMo4	sintered	DIN 1.7225	≥7,40	≥400	≥700	≥3	130-230 HV10	temperable, surface hardenable, conditionally weldable
	heat treated			≥700	≥1000	≥2	28-36 HRC	
	surface hardened			-	-	-	> 600 HV1	
Tool steels								
M2	sintered	DIN 1.3342	≥7.90	≥800	≥1050	≥1	50-58 HRC	age-hardenable, wear-resistant
	heat treated			-	-	-	60-66 HRC	
Stainless steels								
Nitronic 50	sintered	DIN 1.4565	≥7.80	≥340	≥570	≥16	180-240 HV10	austenitic, non-magnetic
316L	sintered	DIN 1.4404	≥7.75	≥150	≥450	≥40	100-150 HV10	austenitic, non-magnetic, can be polished
17-4-PH	sintered	DIN 1.4542	≥7.60	≥660	≥800	≥3	290-340 HV10	martensitic precipitation, hardening, ferromagnetic, can be polished
	heat treated			-	-	-	36-40 HRC	
420W	sintered	DIN 1.4028	≥7.60	≥600	≥800	≥0.2	≥380 HV10	martensitic, hardenable, corrosion resistant
430	sintered	DIN 1.4016	≥7.60	≥200	≥350	≥30	100-150 HV10	heat-resistant, ferromagnetic
440C	sintered	DIN 1.4125	≥7.54	≥600	≥780	≥1.5	39 HRC	martensitic, hardenable, heat-resistant, ferromagnetic
	heat treated			-	-	-	61 HRC	
Titanium								
Ti Grade2	sintered	DIN 3.7035	≥4.30	≥270	≥340	≥20	≥170 HV10	non-magnetic, corrosion-resistant, light
Ti Grade4	Sintered	DIN 3.7065	≥4.20	≥480	≥550	≥5	160-240 HV10	non-magnetic, corrosion-resistant, light
Ti Grade5	Sintered	DIN 3.7164	≥4.30	-	-	-	330-355 HV10	non-magnetic, corrosion-resistant, light
Other alloys								
FN50	Sintered	DIN 1.3926	≥7.60	≥150	≥400	≥20	90-120 HV10	magnetically soft alloy
FeSi3	Sintered	DIN 1.0884	≥7.50	≥280	≥440	≥20	140-170 HV10	magnetically soft alloy
Inconel 601	Sintered	DIN 2.4851	≥7,6	≥210	≥620	≥30	135-160 HV10	nickel based alloy
Cu 99.9	Sintered	DIN 2.0060	≥8.50	≥40	≥200	≥40	36-38 HV10	electric conductivity 50 MS/m, good thermal conductivity

MAGNETS IN MIM – UNIQUE DESIGN FREEDOM

The innovative and unique production technology of MIMplus Technologies allows the production of sintered NdFeB magnets with highest complexity and energy product Bh_{max}.

Freeform NdFeB permanent magnets can be produced via Metal Injection Molding. With newest developments the MIM process can be combined with a resource efficient recycling approach. MIMplus Technologies NdFeB magnets show magnetic properties, that are competitive to the world's stronges permanent magnets



ADVANTAGES OF MIMPLUS MAGNETS

- Sintered magnets with highest shape complexity
- Complex magnetization fields
- No post processing
- MIMplus globally only capable supplier of MIM NdFeB magnets at industrial scale

COMPLEMENTARY TECHNOLOGIES

In addition to our core technologies Metal Injection Molding and sinter-based Additive Manufacturing we also offer conventional manufacturing technologies like CNC precision machining. For customers who want to purchase complete assemblies from MIMplus Technologies we also have a large network of leading subcontractors for different technologies in order to be able to offer the most suitable process for every component.

Furthermore we offer different joining technologies like laser welding, soldering, special gluing as well as solvable connections. With these technologies we are able to deliver complete assemblies to our customers.

POST PROCESSING

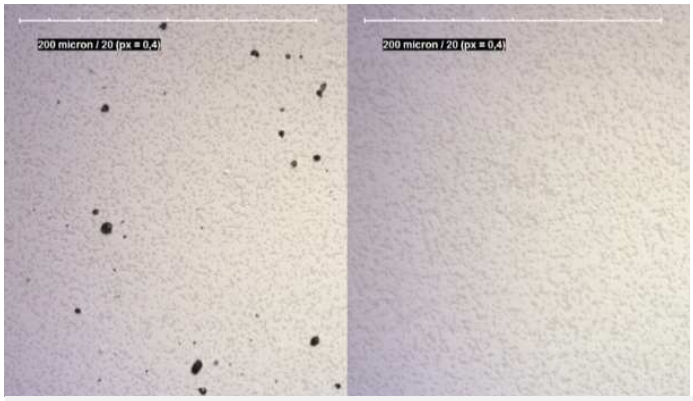
Parts produced by MIMplus Technologies can be refined through further process steps to fulfil special requirements. With our large range of post processing technologies either in-house or at specialised sub suppliers MIMplus Technologies is able to meet many customer demands.

Electroplating

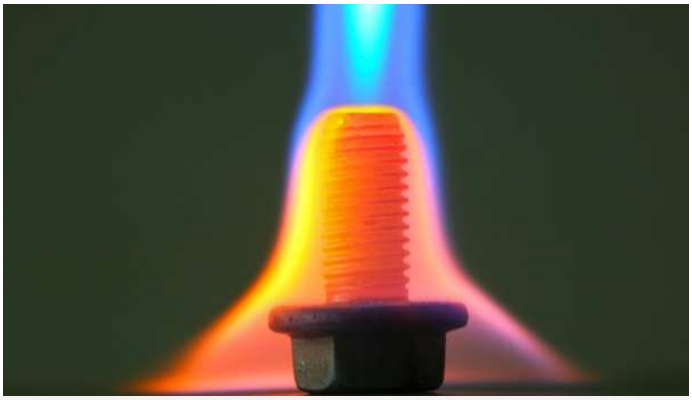
Tumbling & polishing

Surface grinding

PVC & DLC coating



Hot isostatic pressing (HIP)



Heat treatment

OUR INDUSTRIES

MEDICAL

Medical technology demands maximum precision and reliability. Single use is becoming increasingly important which leads to higher quantities for which MIM technology has the ideal prerequisites. For lower quantities and complex geometries Additive Manufacturing is the perfect choice.

CONSUMER & LUXURY

No matter whether your watch, glasses or handbag, they all have one thing in common. High precision metal components determine their appearance and performance. Through longstanding partnerships, MIMplus Technologies supplies these industries.

OUR INDUSTRIES

AEROSPACE

Our components are used in the aerospace industry at high altitudes. At such heights, our components are exposed to the toughest conditions. It hardly needs to be mentioned that enormous resistance, reliability, lightweight and high temperature resistance are required here.

AUTOMOTIVE

Wherever metal parts in high quality are needed MIMplus is the right partner. Well known car manufacturers have trusted our products for decades already and we deliver solutions for cars with combustion engines as well as with electric drives.