Advanced Ceramic Powders

Höganäs

Welcome to Höganäs

Expertise, Quality and Care for Customers

Whenever ideas are to be turned into successful products or applications, the first step is to find the right material supplier. Höganäs is just that supplier.

Höganäs is the undisputable world leader in iron and metal powders. Ever since our beginning in 1797, we have been at the forefront of what has been technically possible at the time.

By acquiring Höganäs Surface Technology & Ceramic Powders division, Höganäs has gained access to a valuable product portfolio consisting out of high quality surface coating, ceramic and metal powders.

Together, we will continue to invest and develop state-of-the-art powders and processes for a myriad of applications. We are proud to be a strategic partner with our customers for many reasons including:

- **We produce powders of consistent high quality**
- **We recognize and respond to our customers' unique requirements**
- **We tailor powders to customers' unique specifications**
- **We track market and application trends and align our new product developments with those trends**

For more information,
please visit www.hoganas.com

High Quality Partnerships

Our advanced ceramic powder solutions

We are a renowned manufacturer of high-quality ceramic powders for a diverse range of applications. We offer one of the most extensive material portfolios in non-oxide ceramic powders, specializing in boron, boride, carbide and nitride powders. Our high-quality products are utilized in applications such as clean energy technologies, technical ceramics, thermal management, and pyrotechnics.

Our business is defined by our customer focus and customer partnerships, which have made us one of the most successful ceramic powder manufacturers worldwide. Our experts continuously provide customers with technical support as well as with a wealth of material knowledge.

In addition to our vast portfolio of standard grades, we also engineer ceramic and metal powders on a customer-specific basis, aligning various factors such as chemical composition, particle size distribution and morphology to meet our customers' exact requirements.

Our extensive portfolio includes the following material groups:

- **Boron (amorphous and crystalline)**
- **Borides, such as TiB_2, ZrB_2 and LaB_6**
- **Carbides, such as B_4C, SiC and TiC**
- **Nitrides, such as Si_3N_4, AlN, BN, TiN**
- **Oxides, Silicon & Silicides**
- **Special carbides, such as Cr_3C_2, VC, Mo_2C and WTiC, for the hard metal industry**

Our distribution network

Throughout the world, Höganäs is represented by its sales offices and agencies. We offer regional technical support and short response times. This is the key in providing an individualized, highly flexible service.

For samples and small quantity orders (a few grams up to 100 kgs) our longtime distribution partner abcr GmbH is the ideal partner for customers, research institutes or universities having small volume requirements. Of course, all documentation, i.e. specifications and certificates of analysis are issued by Höganäs.

Gute Chemie abcr

Borides | Product Portfolio

Product Type	Short Description		Average Particle Size / Laser Diffraction d_{50} µm
Lanthanum Hexaboride LaB_6			
Grade A	Powder for cathodes	O max. 0.3%	8.0-12.0
Grade B	Powder for cathodes	O max. 0.6%	4.0-7.0
Grade C	Powder for cathodes	O max. 1.5%	2.0-3.0

Other grades, i.e. coarse and fine powders are available upon request.

Chromium Boride CrB			
Grade K	Grit material for hard face alloys	O max. 0.3%	+400 µm max. 2% / -63 µm max. 5%
Grade B	Fine sinter powder	O max. 0.3%	FSSS < 2.5 µm

Other grades, i.e. coarse and fine powders are available upon request.

Chromium Diboride CrB_2			
Grade K	Grit material for hard face alloys	O max. 0.6%	+400 µm max. 2% / -63 µm max. 5%
Grade B	Fine sinter powder	O max. 0.6%	FSSS < 2.5 µm

Other grades, i.e. coarse and fine powders are available upon request.

Titanium Diboride TiB_2			
Grade D[e]	Powder for hot pressing, technical grade	O max. 1.1%	3.5-6.0
Grade F[e]	Powder for sintering, 90% < 4.5 µm	O max. 2.5%	2.5-3.5
Grade SE[e]	Higher N, O, Fe contents	O max. 1.5%	3.5-6.0

High purity powders, coarse and doped powders are available upon request.
[e] This product is under export control. Please contact us for more details.

Typical Applications

- Hot-pressed composites of excellent electrical conductivity, e.g. evaporation boats (TiB_2-BN or TiB_2-BN-AlN) for continuous aluminum metallizing
- Crucible material for non-ferrous metals (Al, Cu, Mg, Zn, etc.)
- Ceramic shapes to be used in production of Al in Hall-Héroult cells
- Hot-pressed TiB_2 armor plates
- Cutting tools and cermets, used for machining aluminum
- Metal Matrix composites (MMCs)

Zirconium Diboride ZrB_2		
Grade A	Hf min. 0.2%, 90% < 12 µm	3.0-5.0
Grade B	Hf min. 0.2%, 90% < 6 µm	1.5-3.0

Coarse powders are available upon request.

Typical Applications

- See TiB_2
- Antioxidant in carbon-bonded refractories
- Burnable absorbers for neutrons

Boron | Product Portfolio

Product Type	Short Description	Average Particle Size / Laser Diffraction d_{50} µm	Specific Surface Area (BET) m^2/g
Amorphous Boron			
Grade I[e]	Min. 95% Boron, Mg max. 0.8%	1.0-2.0	> 10
Grade II[e]	Min. 90% Boron, Mg max. 6.0%	1.5-3.0	> 18
Grade III[e]	Min. 86% Boron, Mg max. 12.0%	1.0-4.0	> 5

Other specifications are available upon request.
[e] This product is under export control. Please contact us for more details.

Typical Applications

- Automotive (igniter in airbags and belt tighteners)
- Additive in pyrotechnic mixtures (flares, igniters and delay compositions)
- Additive in solid rocket propellant fuels and explosives
- Preparation of refractory metal borides
- Sintering additive for SiC advanced ceramics
- Reducing additive in fluxes for soldering stainless steel
- Neutron absorber in nuclear technology

Product type	Short Description	Main Particle Size mm	Average Particle Size / Laser Diffraction d_{50} µm	Specific Surface Area (BET) m^2/g
Crystalline Boron				
Grade K1	Min. 99.4% Boron, lumpy	1-20		N/A
Grade K2	Min. 99.4% Boron, lumpy	3-8		N/A
Grade KT 1	Min. 98.0% Boron, lumpy	1-20		N/A
Grade P1[e]	Min. 98.0% Boron, fine powder less than 38 µm		25.0	< 2

Other grades, i.e. fine and coarse powders are available upon request.
[e] This product is under export control. Please contact us for more details.

Typical Applications

- Neutron shields and absorbers in nuclear reactors
- Thermistors
- Filaments
- Preparation of high-purity metal borides
- Metallurgy (deoxidizing agent)

* Small quantities from a few grams up to a 100kgs may be purchased through **abcr**.
For further information please contact: hoganas@abcr.de
Hazards identification in Advertising (Directive 67/548/EEC Article 26 and Directive 1999/45/EC Article 13): [4] highly flammable, [8] harmful.

Carbides | Product Portfolio

Product Type	Short Description		Average Particle Size / Laser Diffraction d_{50} µm	Specific Surface Area (BET) m^2/g
Boron Carbide B_4C				
Premium Grades:	**Broad particle size distribution, high green density**			
Grade HP	Powder for hot-pressing	B:C ratio 3.8-3.9	1.5-3.5	6-9
Grade HS	Powder for sintering	B:C ratio 3.7-3.8	0.6-1.2	15-20
Industrial Grades:	**Very narrow particle size, reduced green density**			
Grade HD 07	Powder for hot-pressing	B:C ratio 3.8-4.0	1.0-2.0	6-9
Grade HD 15	Powder for sintering	B:C ratio 3.6-3.9	0.6-0.9	15-21
Grade HD 20	Powder for sintering	B:C ratio 3.7-3.9	0.3-0.6	22-27

Other grades are available upon request.

Typical Applications

- Abrasive grit or powder (grinding, lapping, polishing)
- Wear resistant engineering components (e.g. sand-blasting and water jet nozzles)
- Light weight ceramic armor
- Metal infiltration
- Boron source to produce other boron compounds
- High-temperature thermoelements
- Sintering additive for SiC advanced ceramics
- Neutron shielding material

Chromium Carbide Cr_3C_2				
Grade A	C min. 12.5%	d100 < 60 µm	15.0-25.0	N/S
Grade 160	C max. 13.3%	FSSS < 1.6 µm	1.5-3.0	1.0-2.0
Grade 300	C max. 13.3%	FSSS 2.0-4.0 µm	5.0-6.0	< 2

Other grades are available upon request.

Typical Applications

- Brake pad formulations
- Corrosion resistance parts
- Hot working tools
- Grain growth inhibitor

Titanium Carbide TiC					
Standard 120	Total C min. 19.2%	free C max. 0.5%	O max. 1.3%	1.0-3.0	N/S
Standard 250	Total C min. 19.2%	free C max. 0.5%	O max. 0.8%	4.5-7.0	N/S
High Vacuum 120	Total C min. 19.6%	free C max. 0.15%	O max. 1.0%	1.0-3.0	N/S
High Vacuum 250	Total C min. 19.6%	free C max. 0.15%	O max. 0.5%	4.5-7.0	N/S

Other grades are available upon request.

Typical Applications

- Hardmetals (tooling and machining)
- Cermets
- Black ceramics, e.g. (Al_2O_3-TiC)

Product Type	Short Description	Average Particle Size / Laser Diffraction d_{50} µm	Specific Surface Area (BET) m^2/g
Silicon Carbide SiC			
Grade BF 12	Beta SiC for sintering	0.4-0.9	11-13
Grade BF 17	Beta SiC for sintering	0.4-0.6	15-19
Grade B-hp	Beta SiC powder, high purity, min. 99.995 %	1.0-2.5	4-6

Other grades, i.e. doped and fine SiC powders, are available upon request.

Typical Applications

- Sliding bearings
- Seal rings
- Wear parts
- Kiln furniture, crucibles, heating elements, burner nozzles, heat exchangers

Tungsten Titanium Carbide WTiC					
STD 100	50/50 (W,Ti)C	Total C 12.5-12.9%	O max. 0.8%	1.0-3.0	N/S
STD 300	50/50	Total C 12.5-12.9%	O max. 0.6%	4.0-7.0	N/S
HV 100	50/50	Total C 12.7-13.1%	O max. 0.5%	1.0-3.0	N/S
HV 300	50/50	Total C 12.7-13.1%	O max. 0.2%	4.0-7.0	N/S
HV 100	70/30	Total C 9.8-10.2%	O max. 0.5%	1.0-3.0	N/S
HV 300	70/30	Total C 9.8-10.2%	O max. 0.2%	4.0-7.0	N/S

Typical Applications

- Mixed carbide additive for cutting tool and wear part products
- Additive for WC based cemented carbide manufacturing
- Special carbide additive to improve hardness and HT strength

Zirconium Carbide ZrC				
Grade A	90% < 20µm	Hf > 0.2 < 2.0%	5.0-13.0	N/S
Grade B	90% < 8µm	Hf > 0.2 < 2.0%	3.0-5.0	N/S
Grade AX[e]	90% < 20µm	Hf < 0.2%	7.0-12.0	N/S

Other grades are available upon request.
[e] This product is under export control. Please contact us for more details.

Typical Applications

- Additive for hardmetals
- Additive in powder metallurgy (TZM Titanium-Zirconium-Molybdenum)
- Moderator in solid fuel propellant

Other Carbides			
Höganäs	Mo_2C, VC and other carbides are available upon request	**abcr**	Alpha SiC, Cr_3C_2, HfC, Mo_2C and other carbides are available upon request

* Small quantities from a few grams up to a 100kgs may be purchased through **abcr**.
For further information please contact: hoganas@abcr.de
Hazards identification in Advertising (Directive 67/548/EEC Article 26 and Directive 1999/45/EC Article 13): [4] highly flammable.

Nitrides | Product Portfolio

Product Type	Short Description		Average Particle Size / Laser Diffraction d_{50} µm	Specific Surface Area (BET) m^2/g
Aluminum Nitride AlN				
Grade A	Fe < 50 ppm	O < 1.0%	7.0-11.0	< 2
Grade B	Fe < 50 ppm	O < 1.5%	2.0-4.5	1-3
Grade C	Fe < 50 ppm	O < 2.0%	0.8-2.0	2-4
Grade AT	Fe < 500 ppm	O < 1.3%	7.0-11.0	< 2
Grade BT	Fe < 500 ppm	O < 1.5%	1.0-3.0	2-4

Coarse and fine powders and experimental grades are available upon request.

Typical Applications

- High thermally conductive ceramics
- Composite ceramics, e.g. evaporation boats
- SiAlONs
- Heat sinks
- Electrically insulating packages for electronics
- Crucibles for metals and salt melts
- Thermally conductive filler for polymers
- Components for wafer processing (susceptors, chucks, carriers)

Boron Nitride BN				
Grade A 01	White powder	B_2O_3 max. 0.15%	9.0-12.0	4-8
Grade B 50	White powder	B_2O_3 max. 3.0%	8.0-11.0	4-7
Grade C	White powder for hot-pressing (min. lot size 100 kg)	B_2O_3 max. 3.0%	3.0-4.0	10-20
Grade F 15	Very fine white powder	B_2O_3 max. 0.3%	4.0-6.0	10-20

Coarse and fine powders and experimental grades are available upon request.

Typical Applications

- Solid lubricant for high-temperature applications
- Mold release for die casting and injection molding
- Raw material for cubic BN
- Thermally conductive filler for polymers
- Composite ceramics, e.g. evaporation boats
- Starting material for hot-pressed BN parts
- Refractories

Consistently high product quality
– from batch to batch, from order to order

Product Type	Short Description	Average Particle Size / Laser Diffraction d_{50} µm	Specific Surface Area (BET) m^2/g
Silicon Nitride Si_3N_4			
Ceramic Grades			
Grade B7	Alpha-phase > 90%, industrial grade	0.9-1.3	> 4
Grade M 9	Alpha-phase > 90%, very narrow particle size distribution	0.7-0.9	8-10
Grade M 11	Alpha-phase > 90%, very narrow particle size distribution	0.5-0.7	12-15
PV Grades			
Grade M 11 HP coarse	Higher purity > 99.95%, reduced metal impurities	0.7-0.9	9-12
Grade HP for PV	High purity > 99.995%, very low metal impurities	0.8-1.0	8-10

Other qualities are available upon request.

Typical Applications

- Ceramic cutting tools
- Heavy duty components in automotive engines
- High-performance parts for mechanical engineering
- Bearing components, like high precision balls
- SiAlONs
- Metallurgy (thermocouple protection tubes, stalk tubes, crucibles)
- Chemical engineering, e.g. heat exchangers
- Functional parts in textile machinery
- Releasing agent in Silicon ingot production

Titanium Carbonitride Ti(C, N) 50/50 TiC : TiN = 50:50 (weight)				
Grade A	C total 9.5-10.5%	N_2 10.5-11.5%	7.0-10.0	N/S
Grade B	C total 9.5-10.5%	N_2 10.5-11.5%	2.0-4.0	N/S
Grade C	C total 9.3-10.3%	N_2 10.3-11.3%	1.0-2.0	N/S
Grade D	Narrow grain size distribution and low oxygen content		1.5-4.0	N/S

Ti(C,N) 70/30 is available upon request. Mixed carbides are available upon request.

Typical Applications

- Hardmetals (tooling and machining)
- Cermets, black ceramics

Titanium Nitride TiN				
Grade A	N_2 min. 20%	O max. 0.6%	7.0-10.0	N/S
Grade B	N_2 min. 20%	O max. 1.1%	2.0-4.0	N/S
Grade C	N_2 min. 20%	O max. 1.5%	1.0-2.0	N/S

Coarse powders are available upon request.

Typical Applications

- Additive for ceramic parts to increase electrical conductivity
- Constituent of cermets and black ceramics
- Raw material for TiN sputter targets (PVD)

Other Nitrides			
Höganäs	CrN_{1-x}, Cr_2N, TaN and other nitrides are available upon request	**abcr**	CrN_{1-x}, Cr_2N, TaN and other nitrides are available upon request*

* Small quantities from a few grams up to a 100kgs may be purchased through **abcr**.
For further information please contact: hoganas@abcr.de

Oxides, Silicon & Silicides | Product Portfolio

Product Type	Short Description	Average Particle Size / Laser Diffraction d_{50} µm	Specific Surface Area (BET) m^2/g
Yttrium Oxide Y_2O_3			
Grade A	Y_2O_3/TREO* > 99.9%	1.5-3.0	4-9
Grade B	Y_2O_3/TREO* > 99.9%	0.9-1.7	4-12
Grade C	Y_2O_3/TREO* > 99.95%	0.6-0.9	10-16
Grade AT	Y_2O_3/TREO* > 99.9%	1.5-3.0	1-7

Other grades are available upon request.

*TREO = Total Rare Earth Oxides

Typical Applications

- Sintering additive for Si_3N_4, AlN and SiC
- Stabilizer for Zirconias – e.g. YSZ coatings (TBCs); YSZ electrolytes for solid oxide fuel cells (SOFC)
- Catalyst carrier
- Luminescent materials (phosphors)
- Constituent of high-temperature superalloys and ODS materials
- Additive in special glass (Yttralox)
- Dopants for Barium Titanates in electro ceramics

Silicon Metal Powder Si			
Grade AX 20	Typically less than 20 µm, high purity min. 99.995%	7.5	N/S
Grade AX 10	Typically less than 10 µm, high purity min. 99.995%	4.5	N/S
Grade AX 05	Typically less than 8 µm, high purity min. 99.995%	3.5	N/S

Typical Applications

- Raw material for reaction bonded Silicon Nitride (RBSN)
- Silicon metal infiltration for SiC (SiSiC)

Molybdenum Disilicide $MoSi_2$				
Grade A	Si 36.3-36.9%	O max. 0.5%	5.5-7.5	N/S
Grade B	Si 36.1-36.9%	O max. 1.5%	3.5-5.0	N/S
Grade C	Si 35.9-36.9%	O max. 2.0%	2.0-3.0	N/S

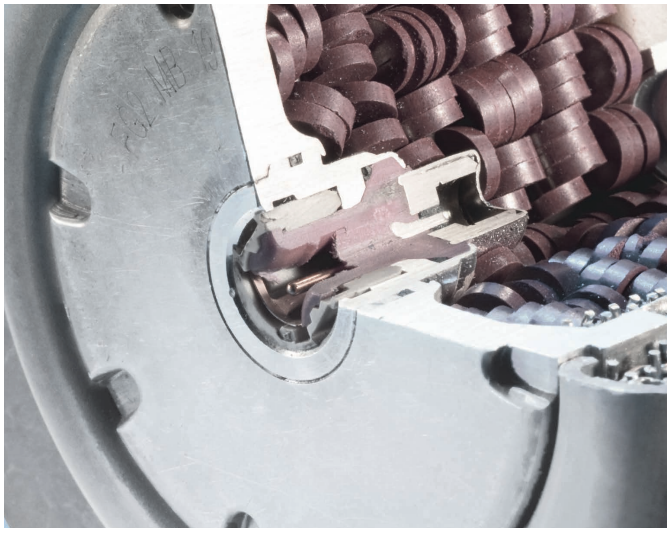
Fine powders are available upon request.

Typical Applications

- Composite ceramics
- Heating elements
- Constituent of glow plugs for engines
- Raw material for $MoSi_2$ sputter targets (PVD)

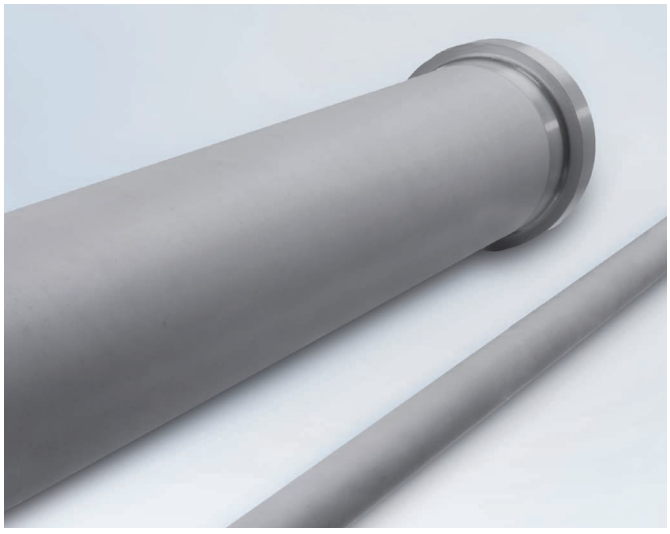
Other Oxides and Silicides			
Höganäs	WSi_2, $ZrSi_2$ are available upon request	**abcr**	WSi_2, $ZrSi_2$, HfO_2 are available upon request*

* Small quantities from a few grams up to a 100kgs may be purchased through **abcr**.
For further information please contact: hoganas@abcr.de



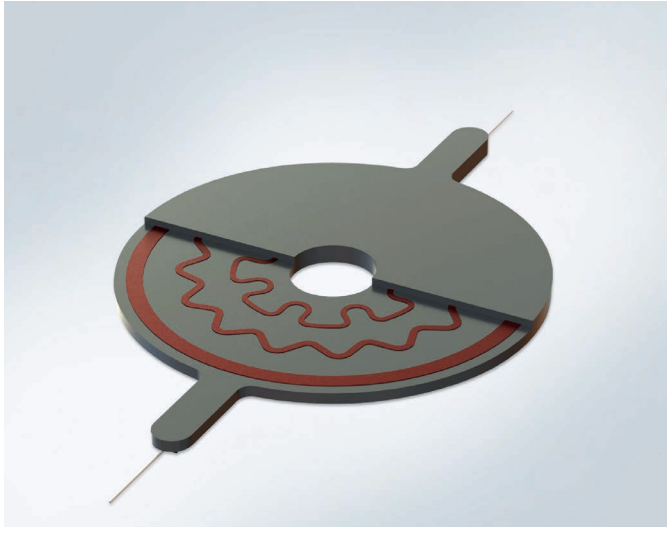
Boron for airbag igniters

Amorphous Boron is used for the production of airbag igniters. It is also used in propellant additives for pyrotechnics.



Silicon nitride for casting industry

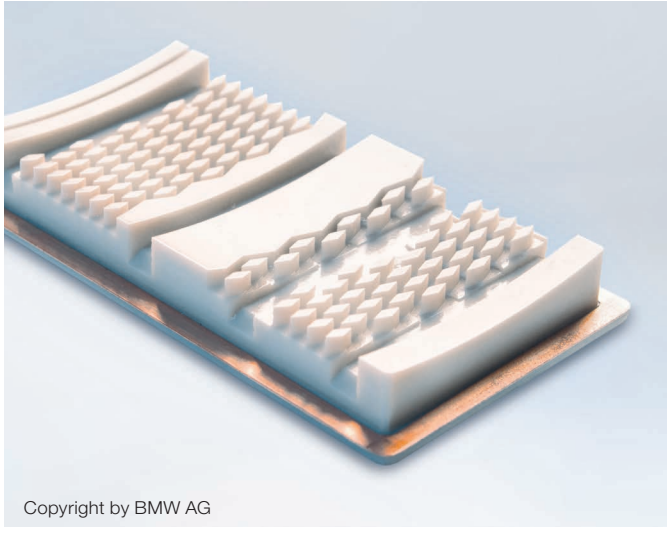
Casting industries are using Silicon Nitride for foundry applications like feeders and riser tubes for pneumatically conveying furnaces. The materials are characterized by extraordinary thermal shock resistance as well as by high corrosion and wear resistance.



Nitrides for heating elements

Nitrides are known for their excellent wear and oxidation resistance. Demanding technical applications require the combination of outstanding properties waiting for very precise and reliable components.

Fully ceramic heating elements made of Silicon Nitride (Si_3N_4) and Aluminium Nitride (AlN) with an integrated ceramic heating conductor represent such trends.



Nitrides for thermal management

Based on its thermal conductivity, electrical insulation, and favorable Coefficient of Thermal Expansion (CTE), Aluminum Nitride (AlN) is a material of choice for substrates, ceramic parts and filler applications in heat-releasing environments. AlN is superior to Alumina (Al_2O_3) and Silicon Carbide (SiC) for the relevant applications.

Powders for Solid Oxide Fuel Cells

Based on a long history in the development and production of advanced ceramic powders Höganäs offers a wide range of AMPERGY® cathode and anode powders for solid oxide fuel cells (SOFCs) and other advanced energy applications, like solid oxide electrolyze cells (SOECs). Moreover, Höganäs has established its own paste production technology, which can be utilized for the development and fabrication of tailor-made and customized ceramic pastes.

We use our 15 plus years of experience in these application areas to meet our customers' needs and requirements.

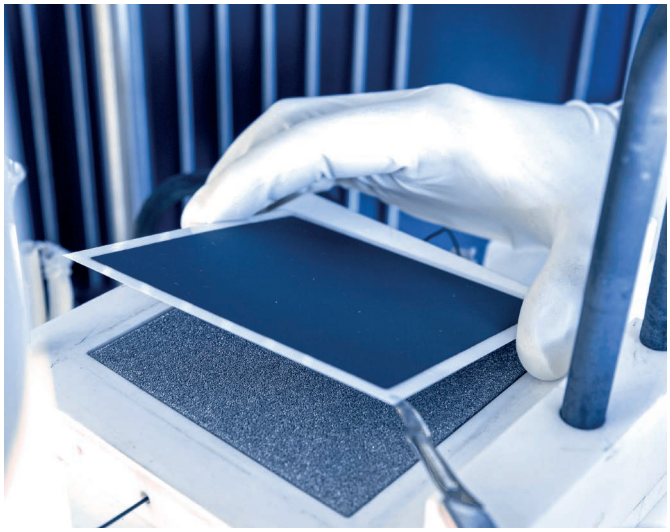
Powders

Powder	Powder type	BET m²/g	Typical applications
LSM20	$La_{0.75}$ $Sr_{0.20}$ MnO_3	4.0-6.0	• Screen Printing • For SOFC Cathode
LSM30	$La_{0.65}$ $Sr_{0.30}$ MnO_3	1.5-3.5	• Screen Printing • For SOFC Cathode
LSCF	$La_{0.6}$ $Sr_{0.4}$ $Co_{0.2}$ $Fe_{0.8}$ O_3	7.5-10.0	• Screen Printing • For SOFC Cathode
LSMC	$La_{0.8}$ $Sr_{0.2}$ $Co_{0.1}$ $Mn_{0.9}$ O_3	1.5-3.5	• Screen Printing • Contact layer SOFC Cathode
LSC10	$La_{0.9}$ $Sr_{0.1}$ CoO_3	4.0-6.0	• Screen Printing • Contact layer SOFC Cathode
LSC40	$La_{0.6}$ $Sr_{0.4}$ CoO_3	4.0-6.0	• Screen Printing • Contact layer SOFC Cathode
LSC50	$La_{0.5}$ $Sr_{0.5}$ CoO_3	4.0-6.0	• Screen Printing • Contact layer SOFC Cathode
MCF	$Fe_{0.1}$ $Co_{1.9}$ MnO_4	2.0-4.0	• Protective coating on Cr containing interconnectors
10GCO	$Gd_{0.1}$ $Ce_{0.9}$ O_2	6.0-9.0	• Screen Printing • For SOFC Cathode and Anode
10GCO fine Grade	$Gd_{0.1}$ $Ce_{0.9}$ O_2	10.0-13.0	• Screen Printing • For SOFC Cathode and Anode
20GCO	$Gd_{0.2}$ $Ce_{0.8}$ O_2	6.0-9.0	• Screen Printing • For SOFC Cathode and Anode
20GCO fine Grade	$Gd_{0.2}$ $Ce_{0.8}$ O_2	10.0-13.0	• Screen Printing • For SOFC Cathode and Anode
40GCO	$Gd_{0.4}$ $Ce_{0.6}$ O_2	10.0-13.0	• Screen Printing • For SOFC Cathode and Anode

Customer benefits

- Quality advantage because all products are fine and micron sized powders, offering high homogeneity and high purity along with a precise stoichiometry
- We offer customizable solutions and adjust particle size, powder BET and chemistry according to customer requirements
- Exactly specified powder properties enable setting of a defined sinter shrinkage matching the system
- Mixed powders (e.g. LSCF / GCO) are available in different, homogeneously mixed ratios

We support you in finding the right powder and paste for your specific application



In-house development capabilities

Due to our in-house development capabilities, we can meet our customers' requirements for a variety of applications, such as ASCs (anode supported cells), ESCs (electrolyte supported cells) and various kinds of electrolyze cells.

Customer specific development

As a leading producer for advanced ceramic powders, we are capable to produce highly homogenous powder mixes. Moreover, the individual powder components can be refined and adjusted according to very specific customer requirements.

Continous high quality

High end equipment like a three-roll-mill as well as in-house developed proprietary processes have been implemented to secure a save and reproducible AMPERGY® production. Our individual set-up has proven to facilitate the manufacturing of homogenous and stable pastes, thus meeting the increasingly demanding requirements of our customers.

High-end equipment

Our state-of-the art powder technology supplemented by our paste production capabilities enable us to meet specific customer requirements for challenging tasks in various applications.

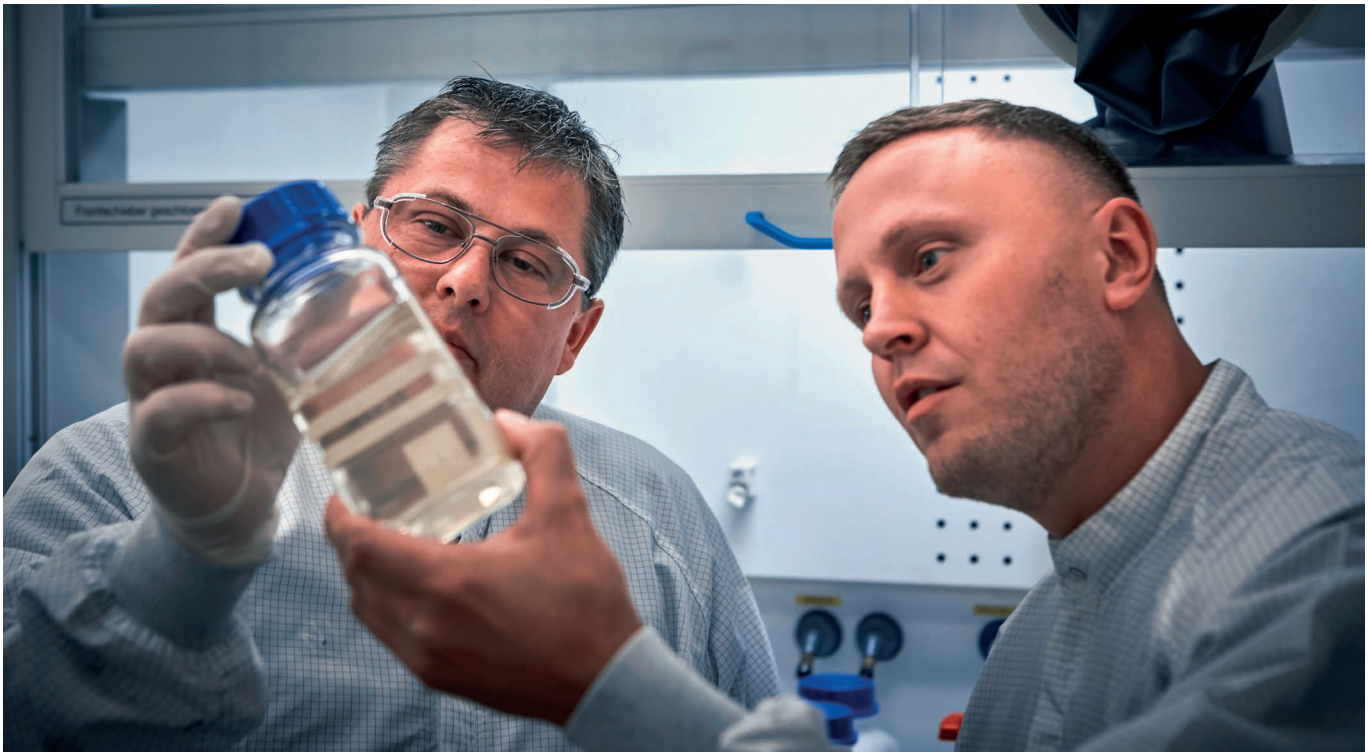
Pastes for Solid Oxide Fuel Cells

Pastes

Powder	Powder type	Typical applications
LSM	$La_{0.75}Sr_{0.20}MnO_3$ $La_{0.65}Sr_{0.30}MnO_3$	• Viscosity 10 Pas-80 Pas (customer defined) • Solid content up to 80w% possible • Particle size defined by customer
LSCF	$La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_3$	• Viscosity 10 Pas-100 Pas (customer defined) • Solid content up to 75w% possible • Particle size defined by customer
LSMC	$La_{0.8}Sr_{0.2}Co_{0.1}Mn_{0.9}O_3$	• Viscosity 10 Pas-80 Pas (customer defined) • Solid content up to 80w% possible • Particle size defined by customer
LSC	$La_{0.9}Sr_{0.1}CoO_3$ $La_{0.6}Sr_{0.4}CoO_3$ $La_{0.6}Sr_{0.4}CoO_3$	• Viscosity 10 Pas-100 Pas (customer defined) • Solid content up to 85w% possible • Particle size defined by customer
MCF	$Fe_{0.1}Co_{1.9}MnO_4$	• Viscosity 10 Pas-100 Pas (customer defined) • Solid content up to 85w% possible • Particle size defined by customer
GCO	$Gd_{0.1}Ce_{0.9}O^2$ $Gd_{0.2}Ce_{0.8}O_2$ $Gd_{0.4}Ce_{0.6}O_2$	• Viscosity 5 Pas-50 Pas (customer defined) • Solid content up to 70w% possible • Particle size defined by customer
NiO	NiO	• Viscosity 10 Pas-60 Pas (customer defined) • Solid content up to 75w% possible • Particle size defined by customer

Customer benefits

- Exactly specified paste properties enable defined sinter shrinkage settings to match the customer's system
- We offer customizable solutions and adjust viscosity, solid content, particle size, powder BET and chemistry according to customer requirements
- Binder systems: according to customer specifications or developed by Höganäs
- Mixed pastes (e.g. LSCF/GCO) can be offered in different, homogeneously mixed ratios



Pre-alloyed Powders for Hard Metals

Höganäs offers unique pre-alloyed iron (Fe) based binder alloys under the brand name of AMPERSINT® MAP. The novel binder systems are designed for the specific requirements of the hard metal production and represent an economically as well as environmentally viable alternative to conventional WC/Co with identical and even improved material properties. The carbon content can be individually adjusted to cater to specific hard metal applications, which enables the customization of materials and processes.

Main advantages of AMPERSINT® MAP binder systems

- Identical and even improved material properties
- Individual carbon content
- Customization of material and processing
- Can be processed in the same manner as a conventional Co binder
- Lower inhalation toxicity of hard metal powders or grinding dust
- Effectively bind with other mixture components
- No precipitation, phase transitions and grain growth

Höganäs' binder alloys are suitable for hard metal applications like

- Wood cutting tools
- Stone cutting tools
- Round tools (drilling, milling)
- Inserts (turning, milling)
- Hot rolling
- Wear parts

Examples of AMPERSINT® map pre-alloyed iron based binder alloys

Binder alloy	Hard metal application
A6050/A6050HT	• Universal • Especially G (forming, wear, stone and construction materials) • Suitable for less demanding metal cutting applications (milling, finishing) • For low to very high binder contents • Processing and properties very similar to Co • HT version offers improved hot hardness and high strength at room temperature
M1500/1800	• For round tools with cooling channels, wood and stone cutting tools, wear parts • For binder content >10% • Austenitic at high carbon content • Very shock and fatigue resistant
A8500	• Universal • Property profile like cobalt • High hot hardness and high K1C

Please find further specialty carbides for the hard metal industry in the carbide section of this brochure.

Datasheets for our products are available for download at **www.hoganas.com**

Inspire industry to make more with less

Höganäs vision is to inspire industry to make more with less. Powder technology provides endless opportunities; not only does it enable our customers to reduce their material and energy consumption, but it also helps them use new and better techniques that make final products more efficient and less expensive. In short, powders are a resource-efficient alternative, suitable for many industries – that's one of our contributions to a sustainable world.

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