Advanced Ceramic Powders
Expertise, Quality and Care for Customers – Welcome to Höganäs

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.

Höganäs offers a valuable product portfolio consisting out of high quality surface coating, ceramic and metal powders. We 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 are constantly on track with latest market and product developments

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 TiB₂, ZrB₂ or LaB₆
- Carbides, such as B₄C, SiC or TiC, for sintering applications
- Nitrides, such as Si₃N₄, AlN, BN, TiN
- Oxides, Silicon & Silicides
- Special carbides, such as Cr₃C₂, VC, Mo₂C and WTiC, for the hard metal industry

For samples and small quantity orders (a few grams up to 100 kg) 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 Germany.
## Borides | Product Portfolio

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Short Description</th>
<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m$^2$/g</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lanthanum Hexaboride LaB$_6$</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade A</td>
<td>Powder for cathodes</td>
<td>$0.3%$</td>
<td>$8.0 – 12.0$</td>
</tr>
<tr>
<td>Grade B</td>
<td>Powder for cathodes</td>
<td>$0.6%$</td>
<td>$4.0 – 7.0$</td>
</tr>
<tr>
<td>Grade C</td>
<td>Powder for cathodes</td>
<td>$1.5%$</td>
<td>$2.0 – 3.0$</td>
</tr>
</tbody>
</table>

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

## Chromium Boride CrB

<table>
<thead>
<tr>
<th>Grade</th>
<th>Short Description</th>
<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m$^2$/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Grit material for hard face alloys</td>
<td>$0.3%$</td>
<td>$+400 \mu m$ max. $2%$ / $-63 \mu m$ max. $5%$</td>
</tr>
<tr>
<td>B</td>
<td>Fine sinter powder</td>
<td>$0.3%$</td>
<td>FSSS &lt; 2.5 μm</td>
</tr>
</tbody>
</table>

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

## Chromium Diboride CrB$_2$

<table>
<thead>
<tr>
<th>Grade</th>
<th>Short Description</th>
<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m$^2$/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Grit material for hard face alloys</td>
<td>$0.6%$</td>
<td>$+400 \mu m$ max. $2%$ / $-63 \mu m$ max. $5%$</td>
</tr>
<tr>
<td>B</td>
<td>Fine sinter powder</td>
<td>$0.6%$</td>
<td>FSSS &lt; 2.5 μm</td>
</tr>
</tbody>
</table>

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

## Titanium Diboride TiB$_2$

<table>
<thead>
<tr>
<th>Grade</th>
<th>Short Description</th>
<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m$^2$/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(e)</td>
<td>Powder for hot pressing, technical grade</td>
<td>$1.1%$</td>
<td>$3.5 – 6.0$</td>
</tr>
<tr>
<td>P(e)</td>
<td>Powder for sintering, 90% &lt; 4.5 μm</td>
<td>$2.5%$</td>
<td>$2.5 – 3.5$</td>
</tr>
<tr>
<td>SE(e)</td>
<td>Higher N, O, Fe contents</td>
<td>$1.5%$</td>
<td>$3.5 – 6.0$</td>
</tr>
</tbody>
</table>

High purity powders, coarse and doped powders are available upon request.

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$_2$

<table>
<thead>
<tr>
<th>Grade</th>
<th>Short Description</th>
<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m$^2$/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Hf min. 0.2%, 90% &lt; 12 μm</td>
<td></td>
<td>$3.0 – 5.0$</td>
</tr>
<tr>
<td>B</td>
<td>Hf min. 0.2%, 90% &lt; 6 μm</td>
<td></td>
<td>$1.5 – 3.0$</td>
</tr>
</tbody>
</table>

Coarse powders are available upon request.

Typical Applications
- See TiB$_2$
- Antioxidant in carbon-bonded refractories
- Burnable absorbers for neutrons

### Other Borides

<table>
<thead>
<tr>
<th>Other Borides</th>
<th>Höganäs</th>
<th>abcr</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiB$_6$ and other borides are available upon request</td>
<td></td>
<td><strong>Höganäs</strong></td>
</tr>
</tbody>
</table>

## Boron | Product Portfolio

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Amorphous Boron</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade I(e)</td>
<td>Min. 95% Boron, Mg max. 0.8%</td>
<td></td>
<td>$1.0 – 2.0$</td>
</tr>
<tr>
<td>Grade II(e)</td>
<td>Min. 90% Boron, Mg max. 6.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade III(e)</td>
<td>Min. 85% Boron, Mg max. 12.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other specifications are available upon request.

Typical Applications
- Automotive (igniter in airbags and belt tighteningers)
- 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

## Crystalline Boron

<table>
<thead>
<tr>
<th>Grade</th>
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<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m$^2$/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>Min. 99.4% Boron, lumpy</td>
<td>$1 – 20$</td>
<td>N/A</td>
</tr>
<tr>
<td>K2</td>
<td>Min. 99.4% Boron, lumpy</td>
<td>$3 – 8$</td>
<td>N/A</td>
</tr>
<tr>
<td>KT 1</td>
<td>Min. 98.0% Boron, lumpy</td>
<td>$1 – 20$</td>
<td>N/A</td>
</tr>
<tr>
<td>P1(e)</td>
<td>Min. 98.0% Boron, fine powder less than 38 μm</td>
<td></td>
<td>$25.0$</td>
</tr>
</tbody>
</table>

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

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

* abcr is responsible for small quantities of ceramic powders from a few grams up to 100 kg. The documentation, i.e. certificates of analysis (COA) are issued by Höganäs Germany GmbH. For further information please contact: hoganas@abcr.de

**Carbides | Product Portfolio**

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**Boron Carbide B₄C**

- **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 thermocouples
- Sintering additive for SiC advanced ceramics
- Neutron shielding material

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</table>

**Chromium Carbide Cr₃C₂**

- **Grade A** C min. 12.5%, less than 60 μm
  - 15.0 – 25.0
  - N/S
- **Grade 160** C max. 13.3%, less than 1.6 μm
  - 1.5 – 3.0
  - 1.0 – 2.0
- **Grade 300** C max. 13.3%, 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**

- **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 13.2 - 13.9% O max. 0.8%
  - 4.0 – 7.0
  - N/S
- **HV 100** 50/50 Total C 13.7 - 13.9% O max. 0.5%
  - 1.0 – 3.0
  - N/S
- **HV 300** 50/50 Total C 13.7 - 13.9% 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

Other grades are available upon request.

**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** 90% < 20μm Hf > 0.2 < 2.0%
  - 7.0 – 12.0
  - N/S

Other grades are available upon request.

**Other Carbides**
- **Höganäs** Mo₂C, NbC, TaC, VC, WC and other carbides are available upon request
- **abcr** Alpha SiC, Cr₃C₂, HfC, Mo₂C and other carbides are available upon request

<table>
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<tr>
<th>Product Type</th>
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</tr>
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</table>

**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. 99.999%
  - 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 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

Other grades are available upon request.

**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

Other grades are available upon request.

- 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

Höganäs Other Carbides
- M₉C₃, NiBC, TaC, VC, WC and other carbides are available upon request
- abcr Alpha SiC, Cr₃C₂, HfC, Mo₂C and other carbides are available upon request

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**Nitrides | Product Portfolio**

### Aluminum Nitride AlN

<table>
<thead>
<tr>
<th>Grade</th>
<th>Fe &lt; 50 ppm</th>
<th>O &lt; 1.0%</th>
<th>(d_{50}) μm</th>
<th>(BET) m²/g</th>
<th>d50 μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7.0 – 11.0</td>
<td>&lt; 2</td>
<td>Grade B</td>
<td>2.0 – 4.5</td>
<td>1 – 3</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.8 – 2.0</td>
<td>2 – 4</td>
<td>Grade AT</td>
<td>7.0 – 11.0</td>
<td>&lt; 2</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>1.6 – 3.0</td>
<td>2 – 4</td>
<td>Grade BT</td>
<td>2.0 – 4.5</td>
<td>1 – 3</td>
<td></td>
</tr>
</tbody>
</table>

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 water processing (susceptors, chucks, carriers)

### Baron Nitride BN

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>B₂O₃ max.</th>
<th>(d_{50}) μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>A D1</td>
<td>White powder</td>
<td>0.15%</td>
<td>9.0 – 12.0</td>
<td>4 – 8</td>
</tr>
<tr>
<td>B 50</td>
<td>White powder</td>
<td>3.0%</td>
<td>8.0 – 11.0</td>
<td>4 – 7</td>
</tr>
<tr>
<td>C</td>
<td>White powder for hot-pressing</td>
<td>3.0%</td>
<td>3.0 – 4.0</td>
<td>10 – 20</td>
</tr>
<tr>
<td>F 15</td>
<td>Very fine white powder</td>
<td>0.3%</td>
<td>4.0 – 6.0</td>
<td>10 – 20</td>
</tr>
</tbody>
</table>

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

### Silicon Nitride Si₃N₄

<table>
<thead>
<tr>
<th>Ceramic Grades</th>
<th>Description</th>
<th>(d_{50}) μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade B7</td>
<td>Alpha-phase &gt; 90%, industrial grade</td>
<td>0.9 – 1.3</td>
<td>&gt; 4</td>
</tr>
<tr>
<td>Grade M 9</td>
<td>Alpha-phase &gt; 90%, very narrow particle size distribution</td>
<td>0.7 – 0.9</td>
<td>8 – 10</td>
</tr>
<tr>
<td>Grade M 11</td>
<td>Alpha-phase &gt; 90%, very narrow particle size distribution</td>
<td>0.5 – 0.7</td>
<td>12 – 15</td>
</tr>
</tbody>
</table>

**PV Grades**

<table>
<thead>
<tr>
<th>Grade M 11 HP</th>
<th>Description</th>
<th>(d_{50}) μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>High purity &gt; 99.95%, reduced metal impurities</td>
<td>0.7 – 0.9</td>
<td>9 – 12</td>
<td></td>
</tr>
<tr>
<td>High purity &gt; 99.965%, very low metal impurities</td>
<td>0.8 – 1.0</td>
<td>8 – 10</td>
<td></td>
</tr>
</tbody>
</table>

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 Ti₃C₆N₆

<table>
<thead>
<tr>
<th>Description</th>
<th>(d_{50}) μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade A</td>
<td>9.5 – 10.5% N₆</td>
<td>7.0 – 10.0</td>
</tr>
<tr>
<td>Grade B</td>
<td>9.5 – 10.5% N₆</td>
<td>2.0 – 4.0</td>
</tr>
<tr>
<td>Grade C</td>
<td>9.3 – 10.3% N₆</td>
<td>1.0 – 2.0</td>
</tr>
</tbody>
</table>

Ti₃C₆N₈ 70/30 is available upon request. Mixed carbides are available upon request.

### Typical Applications
- Hardmetals (tooling and machining)
- Cermets, black ceramics
- SiAlONs
- Additive for ceramic parts to increase electrical conductivity
- Constituent of cermets and black ceramics
- Raw material for TiN sputter targets (PVD)
- Recrystallization of TiN sputter targets (PVD)
- Constituent of cermets and black ceramics
- Raw material for TiN sputter targets (PVD)

### Titanium Nitride TiN

<table>
<thead>
<tr>
<th>Description</th>
<th>(d_{50}) μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade A</td>
<td>N₆ min. 20%, O max. 0.6%</td>
<td>7.0 – 10.0</td>
</tr>
<tr>
<td>Grade B</td>
<td>N₆ min. 20%, O max. 1.1%</td>
<td>2.0 – 4.0</td>
</tr>
<tr>
<td>Grade C</td>
<td>N₆ min. 20%, O max. 1.5%</td>
<td>1.0 – 2.0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Description</th>
<th>(d_{50}) μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>CrN₁₋ₓ, Cr₂N, TaN and other nitrides are available upon request</td>
<td>N/S</td>
<td>N/S</td>
</tr>
</tbody>
</table>

Höganäs | abcr

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**Oxides, Silicon & Silicides** | Product Portfolio

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<tbody>
<tr>
<td><strong>Yttrium Oxide (Y_2O_3)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade A</td>
<td>(Y_2O_3/\text{TREO}^* &gt; 99.9%)</td>
<td>1.5 – 3.0</td>
<td>4 – 9</td>
</tr>
<tr>
<td>Grade B</td>
<td>(Y_2O_3/\text{TREO}^* &gt; 99.9%)</td>
<td>0.9 – 1.7</td>
<td>4 – 12</td>
</tr>
<tr>
<td>Grade C</td>
<td>(Y_2O_3/\text{TREO}^* &gt; 99.95%)</td>
<td>0.6 – 0.9</td>
<td>10 – 16</td>
</tr>
<tr>
<td>Grade AT</td>
<td>(Y_2O_3/\text{TREO}^* &gt; 99.9%)</td>
<td>1.5 – 3.0</td>
<td>1 – 7</td>
</tr>
<tr>
<td><em>Other grades are available upon request.</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(^\ast\text{TREO} = \text{Total Rare Earth Oxides})</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Typical Applications**
- Sintering additive for \(Si_N_x\), \(AlN\) 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 |

**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\(_2\), HfO\(_2\) are available upon request |
| abcr | WSi\(_2\), ZrSi\(_2\), HfO\(_2\) are available upon request |

* *abcr* is responsible for small quantities of ceramic powders from a few grams up to 100 kg.
The documentation, i.e. certificates of analysis (COA) are issued by Höganäs Germany GmbH.
For further information please contact: hoganas@abcr.de

Datasheets for all products in this brochure are available for download at www.hoganas.com

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

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 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.

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

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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

<table>
<thead>
<tr>
<th>Powder</th>
<th>Powder Type</th>
<th>BET m²/g</th>
<th>Typical Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSM30</td>
<td>La₃Sr₂Mn₅O₁₂</td>
<td>4.0 – 6.0</td>
<td>Screen Printing, For SOFC Cathode</td>
</tr>
<tr>
<td>LSM20</td>
<td>La₃Sr₂Mn₅O₁₂</td>
<td>1.5 – 3.5</td>
<td>Screen Printing, For SOFC Cathode</td>
</tr>
<tr>
<td>LSCF</td>
<td>La₀.₆₀Sr₀.₄₀Co₀.₂₀Fe₀.₈₀O₃</td>
<td>4.0 – 11.0</td>
<td>Screen Printing, For SOFC Cathode</td>
</tr>
<tr>
<td>LSCF/GCO</td>
<td>La₀.₆₀Sr₀.₄₀Co₀.₂₀Fe₀.₈₀O₃ / Gd₀.₅₀Ce₀.₅₀O₂</td>
<td>4.0 – 11.0</td>
<td>Screen Printing, For SOFC Cathode, Also for SOEC mode</td>
</tr>
<tr>
<td>LSCM</td>
<td>La₀.₈₀Sr₀.₂₀Co₀.₁₀Mn₀.₉₀O₃</td>
<td>1.5 – 3.5</td>
<td>Screen Printing, Contact layer SOFC Cathode</td>
</tr>
<tr>
<td>LSC</td>
<td>La₀.₉₀Sr₀.₁₀Co₀.₁₀O₃</td>
<td>4.0 – 6.0</td>
<td>Screen Printing, Contact layer SOFC Cathode</td>
</tr>
<tr>
<td>MCF</td>
<td>Mn₁₂Co₁₂Fe₆O₃₂</td>
<td>2.0 – 4.0</td>
<td>As protective coating on Cr-containing interconnectors</td>
</tr>
</tbody>
</table>

### 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

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.

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.

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.

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 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

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### Pastes for Solid Oxide Fuel Cells

<table>
<thead>
<tr>
<th>Powder</th>
<th>Powder Type</th>
<th>Typical Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSM30</td>
<td>La$<em>{0.65}$Sr$</em>{0.30}$Mn$_{1.0}$O$_3$</td>
<td>SOFC Cathode</td>
</tr>
<tr>
<td>LSM20</td>
<td>La$<em>{0.75}$Sr$</em>{0.20}$Mn$_{1.0}$O$_3$</td>
<td>SOFC Cathode</td>
</tr>
<tr>
<td>LSCF</td>
<td>La$<em>{0.60}$Sr$</em>{0.40}$Co$<em>{0.20}$Fe$</em>{0.80}$O$_3$</td>
<td>SOFC Cathode. Also for SOEC mode</td>
</tr>
<tr>
<td>LSCF/GCO</td>
<td>La$<em>{0.60}$Sr$</em>{0.40}$Co$<em>{0.20}$Fe$</em>{0.80}$O$<em>3$ /Gd$</em>{0.1}$Ce$_{0.9}$O$_2$</td>
<td>SOFC Cathode. Also for SOEC mode</td>
</tr>
<tr>
<td>LSMG</td>
<td>La$<em>{0.80}$Sr$</em>{0.20}$Co$<em>{0.10}$Mn$</em>{0.90}$O$_3$</td>
<td>Contact layer SOFC Cathode</td>
</tr>
<tr>
<td>MCF</td>
<td>Mn$<em>{1.0}$Co$</em>{1.9}$Fe$_{0.1}$O$_4$</td>
<td>As protective coating on Cr containing interconnectors</td>
</tr>
<tr>
<td>10GCO</td>
<td>Gd$<em>{0.1}$Ce$</em>{0.9}$O$_2$</td>
<td>SOFC Cathode and Anode</td>
</tr>
<tr>
<td>20GCO</td>
<td>Gd$<em>{0.2}$Ce$</em>{0.8}$O$_2$</td>
<td>SOFC Cathode and Anode</td>
</tr>
<tr>
<td>40GCO</td>
<td>Gd$<em>{0.4}$Ce$</em>{0.6}$O$_2$</td>
<td>SOFC Cathode and Anode</td>
</tr>
<tr>
<td>NIO</td>
<td>NiO</td>
<td>SOFC Anode</td>
</tr>
</tbody>
</table>

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### Pastes

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**

<table>
<thead>
<tr>
<th>Binder alloy</th>
<th>Hard metal application</th>
</tr>
</thead>
<tbody>
<tr>
<td>A6050/A6050HT</td>
<td>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</td>
</tr>
<tr>
<td>M1500/1800</td>
<td>For round tools with cooling channels, wood and stone cutting tools, wear parts, For binder content &gt;10%, Austenitic at high carbon content, Very shock and fatigue resistant</td>
</tr>
<tr>
<td>A8500</td>
<td>Universal, Property profile like cobalt, High hot hardness and high K1C</td>
</tr>
</tbody>
</table>

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