Advanced Ceramic Powders
Introducing H.C. Starck:

Converting knowledge into successful products and applications requires the right materials; H.C. Starck's unique and comprehensive product portfolio offers the best-in-class choices worldwide. H.C. Starck is a leading international developer and manufacturer of high performance metals and ceramic powders, as well as fabricated metal and ceramic products. We serve a diversity of end-markets including electronics, energy, industrial engineering, medical, automotive, and aerospace. H.C. Starck's technology leadership, extensive production process knowledge, and materials expertise benefit our customers from efficient R&D application technology to fully integrated production supply chains.

There are several key aspects which make H.C. Starck a strategic partner for customers. First, our ability to supply a unique combination of essential, and in some instances, rare intermediate materials in defined qualities and volumes, is especially exceptional. Complementing this is our accumulated knowledge and technical expertise in the processing of these materials and combined with H.C. Starck's innovative technology, we deliver product solutions for a full spectrum of applications.

H.C. Starck tailors its products to match the customer's specifications by precisely controlling and adjusting characteristics including particle size, surface area, grain structure and consistency of the materials.

Our technological excellence and well-established record of product innovation includes metal, ceramic and thermal spray powders.

For more information on H.C. Starck, please visit www.hcstarck.com
Introduction

A Partnership of Highest Value

Our Advanced Ceramics product solutions

H.C. Starck is a renowned manufacturer of high-quality ceramic powders for advanced ceramics. We offer one of the most extensive material portfolios for this industry. We specialize in the non-oxide powders that are utilized in high end applications like Technical Ceramics, Pyrotechnics and Clean Energy Technologies. H.C. Starck has a long history of successfully developing and producing advanced ceramic powders in both quantity and quality.

Our in-depth knowledge of ceramic powder production is well accepted by our customers, as we pay attention to their specific requirements regarding controlled chemistry, precisely defined grain forms and morphologies, and adjusted particle size distribution.

With tailored product solutions, we are well prepared to support our customers from powders to finished components: The physical and chemical characteristics of our products can be optimized towards our customers’ needs to improve their processes and final products.

The most important materials are:

- 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

In addition to advanced ceramic powders we offer special metal powders (AMPERSINT™) produced by water- and gas atomization as well as chemical processes for the powder metallurgy market.

Distribution

H.C. Starck is represented by its sales offices and agencies in many different countries throughout the world. A cooperation agreement is in place with the company abcr GmbH specifically for research institutes, universities and other interested parties having small volume requirements in order to offer these customers appropriate support and service. abcr GmbH is responsible for small quantities of ceramic powders from a few grams up to 100 kg. The documentation, i.e. specifications and certificates of analysis are issued by H.C. Starck.

* Limited to beta grades; for alpha powder grades and rtp qualities please refer to H.C. Starck Ceramics, Selb (see back side).
## 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) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lanthanum Hexaboride LaB₆</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade A</td>
<td>Powder for cathodes</td>
<td>O max. 0.3%</td>
<td>8.0 – 12.0</td>
</tr>
<tr>
<td>Grade B</td>
<td>Powder for cathodes</td>
<td>O max. 0.6%</td>
<td>4.0 – 7.0</td>
</tr>
<tr>
<td>Grade C</td>
<td>Powder for cathodes</td>
<td>O max. 1.5%</td>
<td>2.0 – 3.0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th><strong>Chromium Boride CrB</strong></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade K</td>
<td>Grit material for hard face alloys</td>
<td>O max. 0.3%</td>
<td>-400 – 63 μm</td>
</tr>
<tr>
<td>Grade B</td>
<td>Fine sinter powder</td>
<td>O max. 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.

<table>
<thead>
<tr>
<th><strong>Chromium Diboride CrB₂</strong></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade K</td>
<td>Grit material for hard face alloys</td>
<td>O max. 0.6%</td>
<td>-400 – 63 μm</td>
</tr>
<tr>
<td>Grade B</td>
<td>Fine sinter powder</td>
<td>O max. 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.

<table>
<thead>
<tr>
<th><strong>Titanium Diboride TiB₂</strong></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade D&lt;sup&gt;(e)&lt;/sup&gt;</td>
<td>Powder for hot pressing, technical grade</td>
<td>O max. 1.1%</td>
<td>3.5 – 6.0</td>
</tr>
<tr>
<td>Grade F&lt;sup&gt;(e)&lt;/sup&gt;</td>
<td>Powder for sintering, 90% &lt; 4.5 μm</td>
<td>O max. 2.5%</td>
<td>2.5 – 3.5</td>
</tr>
<tr>
<td>Grade SE&lt;sup&gt;(e)&lt;/sup&gt;</td>
<td>Higher N, O, Fe contents</td>
<td>O max. 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 (TiB₂-BN or TiB₂-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 TiB₂ armor plates
- Cutting tools and cermets, used for machining aluminum
- Metal Matrix composites (MMCs)

<table>
<thead>
<tr>
<th><strong>Zirconium Diboride ZrB₂</strong></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade A</td>
<td>Hf min. 0.2%, 90% &lt; 12 μm</td>
<td></td>
<td>3.0 – 5.0</td>
</tr>
<tr>
<td>Grade 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 TiB₂
- Antioxidant in carbon-bonded refractories
- Burnable absorbers for neutrons

### Other Borides

| H.C. Starck | AlB₂, SiB₆ and other borides are available upon request | abcr | AlB₂, HfB₂, MgB₂<sup>16</sup>  <sup>16</sup>, SiB₆ and other borides are available upon request<sup>※</sup> |

<sup>※</sup> This product is under export control. Please contact H.C. Starck for more details.
**Boron | 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) m²/g</th>
</tr>
</thead>
<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>1.0 – 2.0</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>Grade II(e)</td>
<td>Min. 90% Boron, Mg max. 6.0%</td>
<td>1.5 – 3.0</td>
<td>&gt; 18</td>
</tr>
<tr>
<td>Grade III(e)</td>
<td>Min. 86% Boron, Mg max. 12.0%</td>
<td>1.0 – 4.0</td>
<td>&gt; 5</td>
</tr>
</tbody>
</table>

Other specifications are available upon request.

**Typical Applications**
- Automotive (igniter in airbags and belt tensioners)
- 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

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Short Description</th>
<th>Main Particle Size mm</th>
<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crystalline Boron</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade K1</td>
<td>Min. 99.4% Boron, lumpy</td>
<td>1 – 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade K2</td>
<td>Min. 99.4% Boron, lumpy</td>
<td>3 – 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade KT 1</td>
<td>Min. 98.0% Boron, lumpy</td>
<td>1 – 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade P1(e)</td>
<td>Min. 98.0% Boron, fine powder less than 38 μm</td>
<td>25.0</td>
<td>&lt; 2</td>
<td></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
- Metallurgy (deoxidizing agent)

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* 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 H.C. Starck.
For further information please contact: hcestarck@abcr.de

# Carbides | Product Portfolio

## Boron Carbide $B_4C$

<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) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Premium grades:</strong></td>
<td>broad particle size distribution, high green density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade HP Powder for hot-pressing</td>
<td>B:C ratio 3.8 – 3.9</td>
<td>1.5 – 3.5</td>
<td>6 – 9</td>
</tr>
<tr>
<td>Grade HS Powder for sintering</td>
<td>B:C ratio 3.7 – 3.8</td>
<td>0.6 – 1.2</td>
<td>15 – 20</td>
</tr>
<tr>
<td><strong>Industrial grades:</strong></td>
<td>very narrow particle size, reduced green density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade HD 07 Powder for hot-pressing</td>
<td>B:C ratio 3.8 – 4.0</td>
<td>1.0 – 2.0</td>
<td>6 – 9</td>
</tr>
<tr>
<td>Grade HD 15 Powder for sintering</td>
<td>B:C ratio 3.6 – 3.9</td>
<td>0.6 – 0.9</td>
<td>15 – 21</td>
</tr>
<tr>
<td>Grade HD 20 Powder for sintering</td>
<td>B:C ratio 3.7 – 3.9</td>
<td>0.3 – 0.6</td>
<td>22 – 27</td>
</tr>
</tbody>
</table>

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 $Cr_3C_2$

<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) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade A C min. 12.5%, less than 60 μm</td>
<td>15.0 – 25.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 160 C max. 13.3%, less than 1.6 μm</td>
<td>1.5 – 3.0</td>
<td>1.0 – 2.0</td>
<td></td>
</tr>
<tr>
<td>Grade 300 C max. 13.3%, 2.0 – 4.0 μm</td>
<td>5.0 – 6.0</td>
<td>&lt; 2</td>
<td></td>
</tr>
</tbody>
</table>

Other grades are available upon request.

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

## Titanium Carbide $TiC$

<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) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 120 Total C min. 19.2% free C O max. 1.3%</td>
<td>1.0 – 3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard 250 Total C min. 19.2% free C O max. 0.8%</td>
<td>4.5 – 7.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Vacuum 120 Total C min. 19.6% free C O max. 1.0%</td>
<td>1.0 – 3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Vacuum 250 Total C min. 19.6% free C O max. 0.5%</td>
<td>4.5 – 7.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other grades are available upon request.

**Typical Applications**
- Hardmetals (tooling and machining)
- Cermets
- Black ceramics, e.g. $(Al_2O_3 – TiC)$
### Silicon Carbide SiC

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>BF 12</td>
<td>Beta SiC for sintering</td>
<td>0.4 – 0.9</td>
<td>11 – 13</td>
</tr>
<tr>
<td>BF 17</td>
<td>Beta SiC for sintering</td>
<td>0.4 – 0.6</td>
<td>15 – 19</td>
</tr>
<tr>
<td>B-hp</td>
<td>Beta SiC powder, high purity, min. 99.995%</td>
<td>1.0 – 2.5</td>
<td>4 – 6</td>
</tr>
</tbody>
</table>

Other grades, i.e. doped and fine SiC powders, are available upon request.
Limited to beta grades; for alpha powder grades and rtp qualities please refer to H.C. Starck Ceramics (see back side).

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

### Zirconium Carbide ZrC

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Hf &lt; 0.2%</th>
<th>Hf &gt; 0.2 &lt; 2.0%</th>
<th>Hf &gt; 2.0%</th>
<th>5.0 – 13.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade A</td>
<td>90% &lt; 20μm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade B</td>
<td>90% &lt; 8μm</td>
<td>Hf &gt; 0.2</td>
<td></td>
<td></td>
<td>3.0 – 5.0</td>
</tr>
<tr>
<td>Grade AX**(e)**</td>
<td>90% &lt; 20μm</td>
<td>Hf &lt; 0.2%</td>
<td></td>
<td></td>
<td>7.0 – 12.0</td>
</tr>
</tbody>
</table>

Other grades are available upon request.

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

### Other Carbides

<table>
<thead>
<tr>
<th>H.C. Starck</th>
<th>Mo₂C, NbC, TaC, VC, WC and other carbides are available upon request</th>
<th>abcr</th>
<th>Cr₃C₂, HfC, Mo₂C and other carbides are available upon request <strong>(e)</strong></th>
</tr>
</thead>
</table>

**(e)** This product is under export control. Please contact H.C. Starck for more details.

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Nitrides | Product Portfolio

### Aluminum Nitride AlN

<table>
<thead>
<tr>
<th>Grade</th>
<th>Fe ppm</th>
<th>O %</th>
<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt; 50</td>
<td>&lt; 1.0%</td>
<td>7.0 – 11.0</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>B</td>
<td>&lt; 50</td>
<td>&lt; 1.5%</td>
<td>2.0 – 4.5</td>
<td>1 – 3</td>
</tr>
<tr>
<td>C</td>
<td>&lt; 50</td>
<td>&lt; 2.0%</td>
<td>0.8 – 4.5</td>
<td>2 – 4</td>
</tr>
<tr>
<td>AT</td>
<td>&lt; 500</td>
<td>&lt; 1.3%</td>
<td>7.0 – 11.0</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>BT</td>
<td>&lt; 500</td>
<td>&lt; 1.5%</td>
<td>1.0 – 3.0</td>
<td>2 – 4</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 wafer processing (susceptors, chucks, carriers)

### Boron Nitride BN

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>B₂O₃</th>
<th>Average Particle Size / Laser Diffraction $d_{50}$ μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 01</td>
<td>White powder</td>
<td>max. 0.15%</td>
<td>9.0 – 12.0</td>
<td>4 – 8</td>
</tr>
<tr>
<td>B 50</td>
<td>White powder</td>
<td>max. 3.0%</td>
<td>8.0 – 11.0</td>
<td>4 – 7</td>
</tr>
<tr>
<td>C</td>
<td>White powder for hot-pressing (min. lot size 100 kg)</td>
<td>max. 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>max. 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

#### Ceramic Grades

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Average Particle Size / Laser Diffraction d₅₀ μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>B7</td>
<td>Alpha-phase &gt; 90%, industrial grade</td>
<td>0.9 – 1.3</td>
<td>&gt; 4</td>
</tr>
<tr>
<td>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>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</th>
<th>Description</th>
<th>Average Particle Size / Laser Diffraction d₅₀ μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 11 HP coarse</td>
<td>Higher purity &gt; 99.95%, reduced metal impurities</td>
<td>0.7 – 0.9</td>
<td>9 – 12</td>
</tr>
<tr>
<td>Grade HP for PV</td>
<td>High purity &gt; 99.995%, very low metal impurities</td>
<td>0.8 – 1.0</td>
<td>8 – 10</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 Ti(C, N) 50/50 TiC : TiN = 50:50 (weight)

<table>
<thead>
<tr>
<th>Grade</th>
<th>C total</th>
<th>N₂</th>
<th>N₂</th>
<th>Average Particle Size / Laser Diffraction d₅₀ μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9.5 – 10.5%</td>
<td>10.5 – 11.5%</td>
<td>7.0 – 10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>9.5 – 10.5%</td>
<td>10.5 – 11.5%</td>
<td>2.0 – 4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>9.3 – 10.3%</td>
<td>10.3 – 11.3%</td>
<td>1.0 – 2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Narrow grain size distribution and low oxygen content</td>
<td>1.5 – 4.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Grade</th>
<th>N₂ min. 20%, O max. 0.6%</th>
<th>Average Particle Size / Laser Diffraction d₅₀ μm</th>
<th>Specific Surface Area (BET) m²/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7.0 – 10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>2.0 – 4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1.0 – 2.0</td>
<td></td>
<td></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

**H.C. Starck**
- CrN₁₋ₓ, CrₓN, TaN and other nitrides are available upon request

**abcr**
- CrN₁₋ₓ, CrₓN, TaN and other nitrides 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 H.C. Starck.

For further information please contact: hcstarck@abcr.de
## Oxides, Silicon & Silicides | Product Portfolio

### Yttrium Oxide Y$_2$O$_3$

<table>
<thead>
<tr>
<th>Grade</th>
<th>Y$_2$O$_3$/TREO* &gt; 99.9%</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>Grade A</td>
<td>$1.5 – 3.0$</td>
<td></td>
<td>$4 – 9$</td>
</tr>
<tr>
<td>Grade B</td>
<td>$0.9 – 1.7$</td>
<td></td>
<td>$4 – 12$</td>
</tr>
<tr>
<td>Grade C</td>
<td>$0.6 – 0.9$</td>
<td></td>
<td>$10 – 16$</td>
</tr>
<tr>
<td>Grade AT</td>
<td>$1.5 – 3.0$</td>
<td></td>
<td>$1 – 7$</td>
</tr>
</tbody>
</table>

Other grades are available upon request.

*TREO = Total Rare Earth Oxides

**Typical Applications**

- Sintering additive for Si$_3$N$_4$, AIN 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 |
| Grade AX 10 | Typically less than 10 μm, high purity min. 99.995% | 4.5 |
| Grade AX 05 | Typically less than 8 μm, high purity min. 99.995% | 3.5 |

**Typical Applications**

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

### Molybdenum Disilicide MoSi$_2$

<table>
<thead>
<tr>
<th>Grade</th>
<th>Si 36.3 – 36.9%, O max. 0.5%</th>
<th>5.5 – 7.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

- H.C. Starck: WSi$_2$, ZrSi$_2$ 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 H.C. Starck.
For further information please contact: hcstarck@abcr.de

All datasheets within this brochure are available for download at www.hcstarck.com
Amorphous Boron is used for the production of airbag igniters. Amorphous Boron 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.

The purity of Silicon ingots is one of the key parameters for high-quality wafers, which are the main components of any solar cell. Silicon Nitride plays a very important role in the crystallization process as a functional coating in Silica crucibles for multicrystalline Silicon ingot production.

Based on its thermal conductivity, electrical insulation, and favorable Coefficient of Thermal Expansion (CTE), Aluminum Nitride (AlN) was identified as a material of choice for substrates, ceramic parts and filler applications in heat-releasing environments. AlN is superior to Alumina (Al₂O₃) and Silicon Carbide (SiC) for the relevant applications.
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