Higher yields. Lower costs.

Advanced technical ceramics for electronics manufacturing

3M Technical Ceramics for Semiconductor Manufacturing
As fab costs continue to rise year over year, finding ways to reduce maintenance, extend equipment life and improve yields has become more critical than ever before.

Device components made from 3M Technical Ceramics can help you achieve these goals – providing dependable performance in the harshest thermal, chemical and structural environments.

Since 1996, technical ceramics from Ceradyne Inc., a 3M company, have been used to produce consistent, high-quality semiconductor processing components that translate to higher yields and lower cost of ownership. Our solutions range from complex ceramic parts as large as 700 mm in diameter to the smallest, most intricate injection molded devices.

We offer fully integrated manufacturing with substantial resources for the design and development of innovative product concepts and applications. Our manufacturing facilities provide advanced ceramic fabrication flexibility and custom engineering services.

Consider 3M Technical Ceramics, when your application calls for:
- High Purity
- High Thermal Conductivity
- Reduced Particulate Generation
- Corrosion/Erosion Resistance
- Controlled Electrical Properties

Hard-working, hard-wearing materials.
Combining materials science with creativity – to solve your toughest challenges.

3M is your trusted source for advanced non-oxide and select oxide ceramics. 3M Semiconductor Grade Ceramics are specially formulated to meet the stringent demands of these extreme processing environments.

Applications include:
- Chamber Liners
- Chucks
- E-chucks
- Edge Rings
- Electrical Dissipation Plugs
- Electrodes
- Electrode Covers
- Focus Rings
- Gas Distribution Plates
- Heaters
- Microwave Windows
- RF Windows
- Vacuum Chucks

Custom ceramic formulations

**3M™ Aluminum Nitride (AIN) 1370 Series**
- Electrical insulator
- High thermal conductivity
- Critical thermal management material

**3M™ Silicon Nitride (Si₃N₄) 147-A**
- Electrical insulator
- Excellent mechanical properties
- Good wear resistance

**3M™ Boron Carbide (B₄C) 146-IS**
- Electrical properties tailored for semi-conductor: Resistivity >10⁶ Ω•cm
- Outstanding high temperature, corrosion and wear properties
- High specific stiffness

**3M™ Silicon Carbide (SiC) 146-4I**
- Electrical conductor
- Very high hardness
- High specific stiffness
- Excellent wear resistance in plasma

**3M Technical Ceramics for Semiconductor Manufacturing**
Typical Properties of 3M Semiconductor Grade Materials
Not for specification purposes

<table>
<thead>
<tr>
<th>Material</th>
<th>3M™ Silicon Nitride</th>
<th>3M™ Silicon Carbide</th>
<th>3M™ Aluminum Nitride</th>
<th>3M™ Boron Carbide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>Si₃N₄</td>
<td>SiC</td>
<td>AlN</td>
<td>B₄C</td>
</tr>
<tr>
<td>147A</td>
<td>146-1S</td>
<td>1370CS</td>
<td>1370-IE</td>
<td>1370DP</td>
</tr>
<tr>
<td>Production process</td>
<td>Hot pressing</td>
<td>Hot pressing</td>
<td>Hot pressing</td>
<td>Sintering</td>
</tr>
<tr>
<td>Properties</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical purity-metal based (%)</td>
<td>&gt;98.9%</td>
<td>99.3%</td>
<td>95%</td>
<td>99.7%</td>
</tr>
<tr>
<td>Color</td>
<td>Gray-Tan</td>
<td>Black</td>
<td>Black</td>
<td>Gray-Tan</td>
</tr>
<tr>
<td>Density</td>
<td>3.18</td>
<td>&gt;3.12</td>
<td>3.3</td>
<td>3.26</td>
</tr>
<tr>
<td>Mean grain intercept size, typical (µm)</td>
<td>–</td>
<td>5–10 (typical)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Flexural strength (MPa)</td>
<td>700</td>
<td>350</td>
<td>350</td>
<td>330</td>
</tr>
<tr>
<td>Elastic modulus (GPa)</td>
<td>310</td>
<td>400</td>
<td>320</td>
<td>320</td>
</tr>
<tr>
<td>Poisson’s ratio</td>
<td>0.23</td>
<td>0.16</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>Hardness -HV1 (Kg/mm²)</td>
<td>1650 (HV5)</td>
<td>2300</td>
<td>920</td>
<td>1040</td>
</tr>
<tr>
<td>Fracture toughness (MPa•m¹/²)</td>
<td>4.5</td>
<td>3.0</td>
<td>4.4</td>
<td>4.46</td>
</tr>
<tr>
<td>Thermal expansion coefficient RT-1000°C (10⁻⁶/K)</td>
<td>3.2</td>
<td>4.5</td>
<td>4.4</td>
<td>4.46</td>
</tr>
<tr>
<td>Thermal conductivity @ 25°C (W/m•K)</td>
<td>42</td>
<td>&gt;150</td>
<td>&gt;140</td>
<td>76</td>
</tr>
<tr>
<td>Electrical resistivity (Ω•cm)</td>
<td>&gt;10¹⁴</td>
<td>&gt;10⁶</td>
<td>&gt;10¹⁴</td>
<td>&gt;10¹²</td>
</tr>
<tr>
<td>Dielectric constant, ε</td>
<td>9</td>
<td>–</td>
<td>8.9</td>
<td>9</td>
</tr>
<tr>
<td>Key features</td>
<td>High Purity, Excellent Mechanical Properties</td>
<td>High Purity, Corrosion Resistance, Wear Resistance</td>
<td>High Thermal Conductivity</td>
<td>High Purity</td>
</tr>
</tbody>
</table>

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