

Technical Data Sheet of Single Crystal Sapphire

Chemical Properties

<i>General</i>	Extremely high chemical stability in many acid environments, even at high temperatures
<i>Chemical Formula</i>	99,997 Al ₂ O ₃

Physical Properties

<i>General</i>	Anisotropy, properties largely dependent on crystallographic orientation. High mechanical strength for high-pressure and shock-loading applications. Excellent rain erosion resistance and low frictional coefficient.
<i>Crystal structure</i>	Rhombohedral type single crystal, a=4,758 Å; c=12,991 Å
<i>Density</i>	3,98 g·cm ⁻³ at 20°C
<i>Hardness</i>	Mohs 9 (Knoop 2200, flat to C-axis; 1900 flat ⊥ to C-axis)
<i>Tensile strength</i>	0,4 GPa at 25°C; 0,35 GPa at 1000°C
<i>Compressive strength</i>	2,1 GPa at 25°C
<i>Flexural strength</i>	0,6 GPa at 25°C
<i>Young's modulus</i>	350 GPa at 25°C
<i>Compressive modulus</i>	380 GPa at 25°C
<i>Flexural modulus</i>	360 GPa at 25°C
<i>Rigidity modulus</i>	150 GPa at 25°C
<i>Bulk modulus</i>	240 GPa at 25°C
<i>Poisson's ratio</i>	0,29

Thermal Properties

<i>General</i>	High thermal conductivity, particularly at cryogenic temperatures, High thermal shock resistance
<i>Melting point</i>	2053°C
<i>Application temp.</i>	2000°C
<i>Thermal expansion</i>	6,2·10 ⁻⁶ °C ⁻¹ (20-50°C), to C-axis; 5,4·10 ⁻⁶ °C ⁻¹ (20-50°C) ⊥ to C-axis
<i>Heat capacity</i>	18,6 cal/(Mol·°C) at 25°C; 30 cal/(Mol·°C) at 1000°C
<i>Thermal conductivity</i>	40 (W·m ⁻¹ ·K ⁻¹) at 25°C; 12 (W·m ⁻¹ ·K ⁻¹) at 400°C; 4 (W·m ⁻¹ ·K ⁻¹) at 1200°C 10.000 (W·m ⁻¹ ·K ⁻¹) at -200°C
<i>Specific heat</i>	0,1 (cal g ⁻¹ ·°C ⁻¹) at 25°C

Optical Properties

<i>General</i>	High transparency from ultraviolet (~0,2µm) through the visible, near infrared (6,5µm) and again from about 50µm through the microwave spectrum
<i>Fraction</i>	1,8 at 0,3µm; 1,6 at 5µm
<i>Optical transmission</i>	0,17µm-6µm
<i>Reflection loss</i>	12% (1µm, by 2 surfaces)

Electrical Properties

<i>General</i>	High electrical resistivity, dielectric constant and strength
<i>Electrical resistivity</i>	10 ¹⁶ Ω·cm at 20°C; 10 ¹¹ Ω·cm at 500°C
<i>Dielectric constant</i>	11,6 to C-axis; 9,4 ⊥ to C-axis at 25°C (10 ³ – 10 ¹⁰ Hz)
<i>Dielectric strength</i>	480 kV·cm ⁻¹ (60 Hz)
<i>Dielectric dissipation</i>	6·10 ⁻⁵ to C-axis; 3·10 ⁻⁵ ⊥ to C-axis (10 GHz)