



Single crystal sapphire possesses a unique combination of excellent optical, physical and chemical properties. The hardest of the oxide crystals, sapphire retains its high strength at high temperatures, has good thermal properties and excellent transparency. It is chemically resistant to common acids and alkali at temperatures up to 1000 °C as well as to HF below 300 °C. These properties encourage its wide use in hostile environments where optical transmission in the range from the visible to the near infrared is required.

OPTICAL PROPERTIES

Transmission Range	0.17 to 5.5 microns
Refractive Index	1.75449 (o) 1.74663 (e) at 1.06 microns
Reflection Loss	at 1.06 μm (2 surfaces) for o-ray – 11.7%; for e-ray – 14.2%
Index of Absorption	0.3 x 10 ⁻³ cm ⁻¹ at 2.4μm
Reststrahlen Peak	13.5μm
dN/dT	13.7 x 10 ⁻⁶ at 5.4μm
dN/dμ = 0	1.5μm

PHYSICAL PROPERTIES

Density	3.97 g/cm ³
Melting Point	2040°C
Thermal Conductivity	27.21 W/(m? K) at 300K
Thermal Expansion	5.6 (paral) & 5.0 (perp) x 10 ⁻⁶ /K
Hardness	Knoop 2000 with 2000g indenter
Specific Heat Capacity	419 J/(kg? K)
Dielectric Constant	11.5 (paral) 9.4 (perp) at 1MHz
Young's Modulus (E)	335 GPa
Shear Modulus (G)	148.1 GPa
Bulk Modulus (K)	240 GPa
Elastic Coefficients	C ₁₁ =496 C ₁₂ =164 C ₁₃ =115 C ₃₃ =498 C ₄₄ =148
Apparent Elastic Limit	275 MPa (40,000 psi)
Poisson Ratio	0.25

CHEMICAL PROPERTIES

Solubility	98? 10 ⁻⁶ g/100g water
Molecular Weight	101.96
Class/Structure	Trigonal (hex), R3c

Wavelength, μm	0.193	0.213	0.222	0.226	0.244	0.248	0.257	0.266	0.280
Refractive Index n_o	1.929	1.889	1.875	1.870	1.851	1.847	1.839	1.833	1.824
Refractive Index n_e	1.917	1.878	1.865	1.860	1.841	1.837	1.830	1.824	1.815

Wavelength, μm	0.308	0.325	0.337	0.351	0.355	0.442	0.458	0.488	0.515
Refractive Index n_e	1.811	1.805	1.801	1.797	1.796	1.780	1.778	1.775	1.773
Refractive Index n_e	1.802	1.796	1.792	1.788	1.787	1.772	1.770	1.767	1.765

Wavelength, μm	0.532	0.590	0.633	0.670	0.694	0.755	0.780	0.800
Refractive Index n_o	1.772	1.768	1.766	1.764	1.763	1.761	1.761	1.760
Refractive Index n_e	1.764	1.760	1.758	1.756	1.755	1.753	1.753	1.752

Wavelength, μm	0.820	0.980	1.064	1.320	1.550	2.010	2.249	2.703
Refractive Index n_e	1.760	1.756	1.754	1.750	1.746	1.737	1.732	1.719
Refractive Index n_e	1.7528	1.748	1.747	1.742	1.738	1.729	1.724	1.711

Wavelength, μm	2.941	3.333	3.704	4.000	4.348	4.762	5.000	5.263
Refractive Index n_e	1.712	1.701	1.687	1.674	1.658	1.636	1.623	1.607
Refractive Index n_e	1.704	1.693	1.679	1.666	1.65	1.628	1.615	1.599