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Materials Overview

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Sapphire

Zerodur® (Schott)

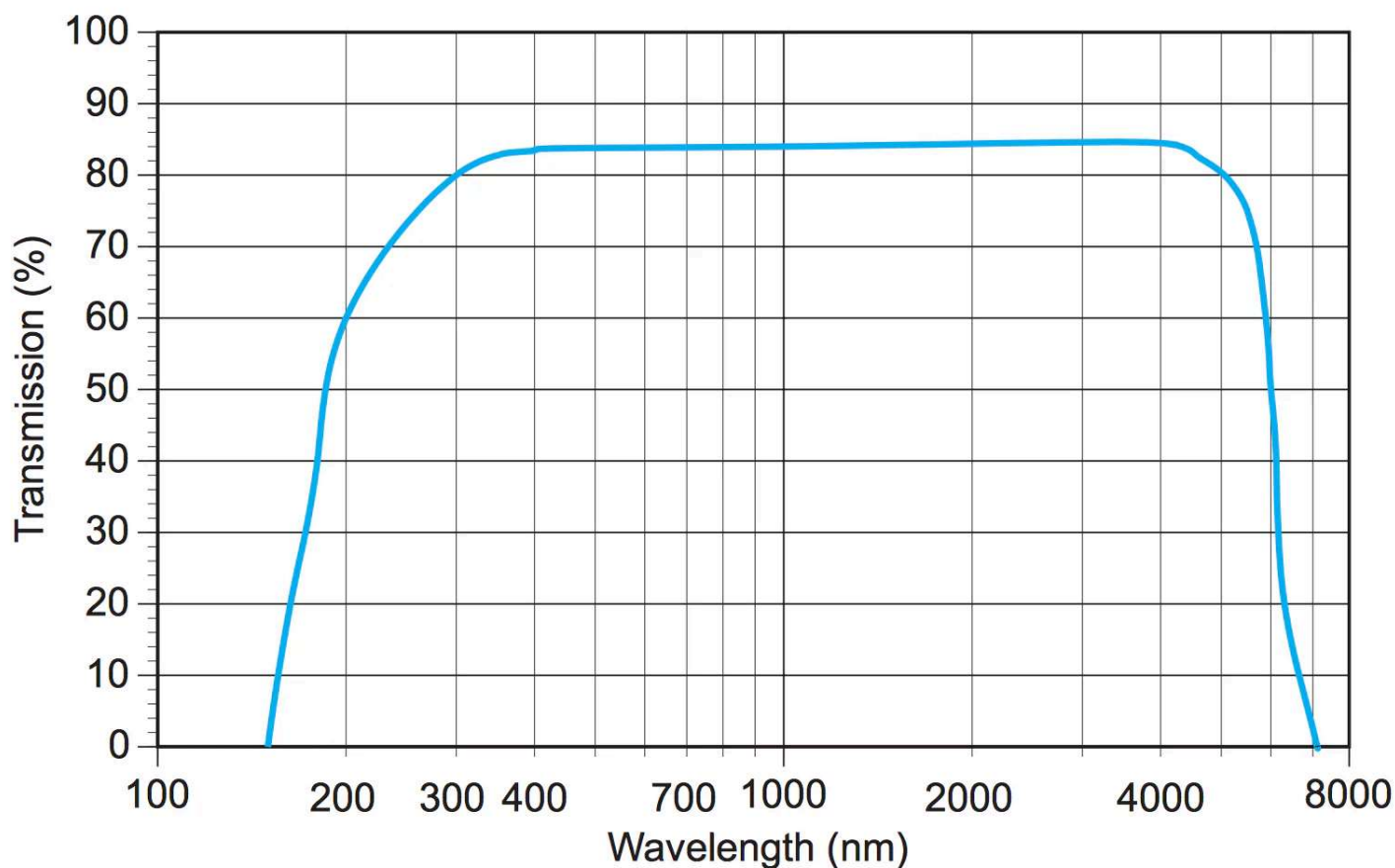
Sapphire

We can custom manufacture nearly any shape and size of sapphire.

Let us know how we can help you? EscoOptics.com/quote

Optimum Transmission Range:	Ideal Applications:
200 nm - 5.0 μm	With PbS, PbSe, and InSb detectors. Spectral transmittance matches spectral sensitivity of detectors
	Infrared, high temperature, high pressure, high thermal shock environments
	Scratch resistant elements used in rain resistance, bar code scanning applications

Synthetic sapphire is an anisotropic crystalline material composed of single crystal aluminum oxide (Al₂O₃). Esco works with only high quality, optical grade sapphire. It is essentially 100% pure. The various properties of sapphire are a function of the direction within the crystal with respect to the optic axis. It has an extremely wide transmission spectrum (150 nm to 6.0 μm). Its high melting point, good thermal conductivity and low thermal expansion provide excellent performance in high temperature environments. The extreme hardness of sapphire makes it difficult to polish using standard techniques. High optical quality finishes on sapphire are not always possible.



Optical Properties

Refractive Indices:

Ordinary Ray (No) (C-axis direction): 1.768

Extraordinary Ray (Ne) (perpendicular to C-axis direction): 1.760

Birefringence (Ne – No): 0.008

Temperature Coefficient of Refractive Index: $13 \times 10^{-6}/^{\circ}\text{C}$ (@ 0.57 μm , 20°C) Transmittance:

>85% 0.3-4.0 μm (@ 0.1 mm thick) uncorrected Emissivity @ 3,4,5 μm : 16%, 25%, 70% (@500°C)

Absorption @ 0.66 mm @ 1600°C: 0.1 – 0.2 cm^{-1}

Thermal Properties

Melting Point: ~2053°C (3727°F)

Most properties useful to (maximum): ~1800°C (3272°F) Conductivity: 40 W/M°K @ 298°K

Expansion @ 25°C: $4.5 \times 10^{-6}/K$ -1 and @ 1000°C: $9.0 \times 10^{-6}/K$ -1 (90° orientation)
Specific Heat Capacity: 750 J/K at 300°K Viscosity @ 2053°C: 0.0584 Pa•s

Mechanical Properties

Hardness (9 Mohs std): 2000 kg/mm²,
Knoop Coefficient of friction: 0.14 (on steel)
Young's Modulus: 400 GPa @ 20°C Poisson's Ratio: 0.29
Compressive Strength: 2.0 GPa Creep @ 100 Mpa, 1600°C: $1.5 \times 10^{-4}/hr$
Fracture Toughness: 2.0 MPa (m^{1/2})
Flexural Strength: 900 MPa
Bulk Modulus: 240 GPa
Shear Modulus: 175 GPa (Rigidity Modulus)
Tensile Strength: 300 to 400 MPa
Rupture Modulus: 65 – 100,000 psi

Physical Properties

Density: 3.98 g/cm³, (0.143 lbs./in³)
Hardness: Knoop microindenter: 1800 FACE perpendicular to c-axis, 2200 FACE parallel to c-axis
Young's Modulus: 400 GPa @ 20°C
Tensile Strength: 300 to 400 MPa

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American Owned & Operated

Esco Optics is a leading manufacturer of custom and catalog optics, precision optical components, and ITAR optics in the United States.



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