SiO2
Fused Silica

🔷 Key Properties of Fused Silica (SiO2)

🌈 Wide Transmission Range: ~180 nm – 2.5 µm — excellent for UV, visible, and near-IR applications.

🔍 Low Refractive Index: ~1.46 at 1 µm — reduces need for AR coatings in many systems.

🛡️ Ultra-Pure & Low Absorption: Negligible fluorescence and minimal absorption, ideal for high-power laser use.

🔥 High Laser Damage Threshold: Extremely resistant to laser-induced damage compared with standard glass.

❄️ Thermal & Environmental Stability: Very low coefficient of thermal expansion (~0.55 × 10^{-6}/°C) ensures stability under temperature changes.

🔬 Excellent Homogeneity: Provides uniform optical performance across large apertures for precision systems.

⚙️ Versatile Fabrication: Supplied as blanks, lenses, windows, prisms, and custom optics with UV/AR coatings available.

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🧩 Applications of Fused Silica (SiO2)

🔬 UV and Deep-UV Optics: With outstanding transparency down to ~180 nm, fused silica is essential in excimer laser systems, UV lithography, and microelectronics manufacturing.

🛰️ Metrology and High-Precision Instrumentation: Its thermal stability and homogeneity make it ideal for interferometry, precision measurement, and reference optics.

💡 Laser Systems: Extensively used in high-power laser applications thanks to its extremely high laser damage threshold and minimal fluorescence.

🔭 Astronomy and Scientific Optics: Fused silica's low thermal expansion and broad spectral transmission make it suitable for telescope mirrors, lenses, and space instrumentation.

🧪 Spectroscopy and Analytical Equipment: Common in UV–NIR spectrometers, FTIR accessories, and optical benches requiring low absorption and high environmental durability.

🧭 Optical Fabrication & Coating Substrates: Fused silica's excellent polishability and chemical stability make it a premium substrate for multilayer dielectric coatings and mirror systems.

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Technical Parameters of Calcium Fluoride (CaF2)

Property	Typical Value
Transmission Range	~180 nm to 2.5 µm
Refractive Index	~1.46 @ 1 µm
Density	2.20 g/cm³
Hardness (Knoop)	~522 kg/mm²
Melting Point	~1715 °C
Thermal Expansion	~0.55 × 10^{-6}/°C @ 20–300 °C
Thermal Conductivity	~1.38 W/m·K
Crystal Structure	Amorphous (non-crystalline)
Hygroscopic	No — highly stable and non-hygroscopic
Chemical Formula	SiO_2
Laser Damage Threshold	>20 J/cm² @ 1064 nm (10 ns pulse)
Applications	UV lithography, laser optics, metrology, spectroscopy, astronomy, coatings
Coating Compatibility	Broadband AR, UV coatings, dielectric mirrors, high-LDT coatings

Fused Silica (SiO_2) is a highly durable, amorphous optical material known for its exceptional transmission from the deep ultraviolet (~180 nm) to the near-infrared (~3.5 µm).

It features a low refractive index (~1.458 at 589 nm), excellent thermal stability, and virtually zero birefringence, making it ideal for laser, UV, and precision imaging applications.

With extremely low thermal expansion, high damage threshold, and superior chemical resistance, fused silica is widely used in windows, lenses, and substrates for spectroscopy, semiconductor, and high-energy laser systems.

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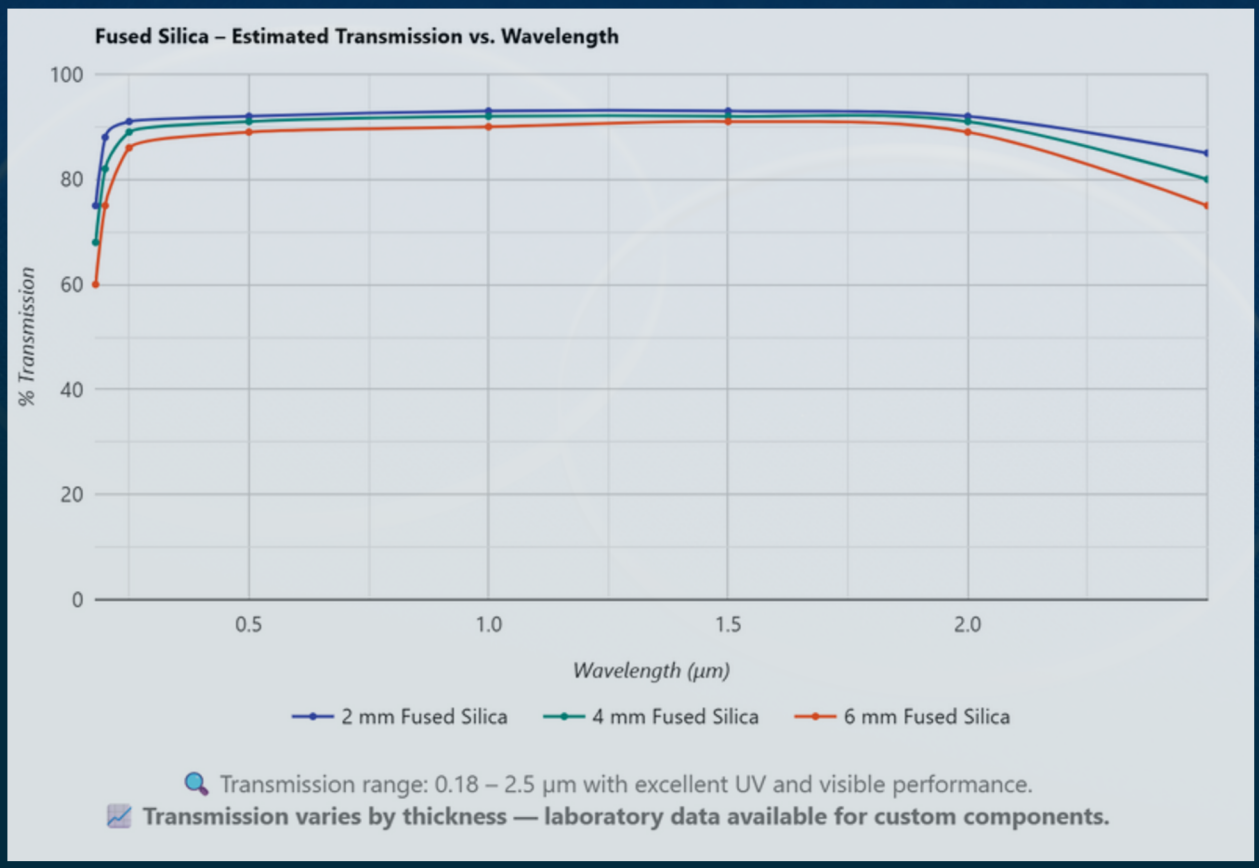

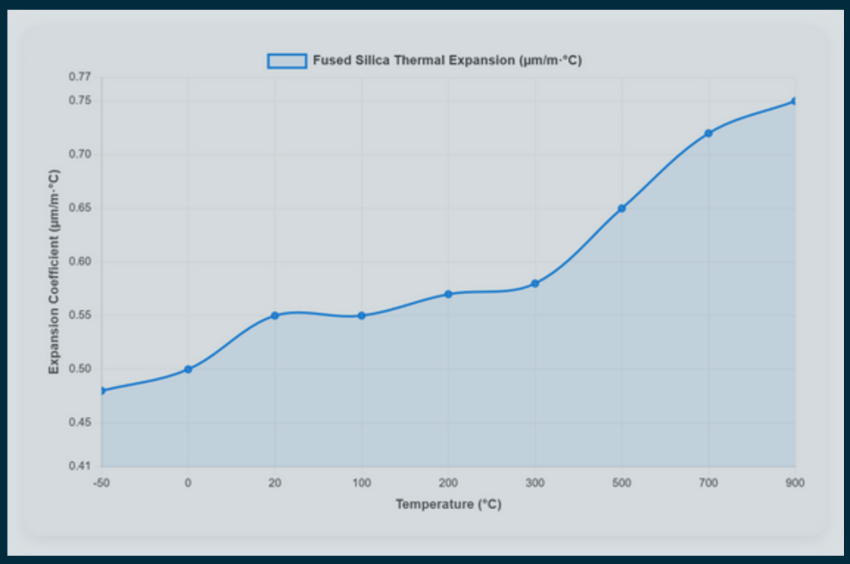

Transmission:

Fused Silica provides excellent transmission from ~0.18 µm to 3.5 µm, covering the deep UV through the near-infrared.

It exhibits very low absorption and scattering, making it ideal for UV optics, laser windows, and precision imaging systems.

Its consistent optical performance and high resistance to solarization ensure long-term stability even under intense UV or laser exposure.

Thermal Expansion:

Fused Silica has an extremely low coefficient of thermal expansion (~0.55 × 10^{-6} /°C), providing exceptional dimensional stability across wide temperature ranges.

This property minimizes focus drift and thermal stress, making it ideal for high-precision optical assemblies, space optics, and high-power laser applications.

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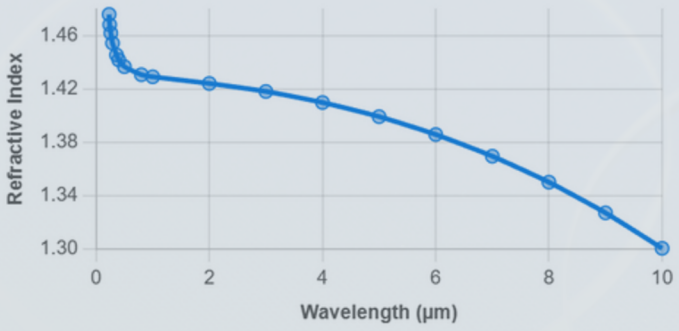
Refractive Index of Calcium Fluoride (CaF_2) vs. Wavelength



Real-world measurement data (CSV loaded dynamically)

Wavelength	Refractive index
0.23	1.4757
0.24	1.468
0.26	1.4617
0.29	1.4542
0.36	1.4453
0.40	1.4416
0.50	1.4365

FAQ

Q: What is Calcium Fluoride used for?
A: CaF_2 is widely used in infrared and ultraviolet optical systems, including lenses, windows, and prisms for spectroscopy, thermal imaging, laser systems, and astronomy.

Q: What is the transmission range of CaF_2?
A: Calcium Fluoride offers excellent transmission from approximately 150 nm (UV) to over 9 µm (IR), covering a wide spectral range for various optical applications.

Q: Is CaF_2 mechanically durable?
A: Yes, CaF_2 is relatively hard (Knoop ~158) and chemically stable, but it is brittle and prone to chipping under mechanical stress. It should be handled with care during fabrication and mounting.

Q: Is Calcium Fluoride hygroscopic?
A: No, CaF_2 is non-hygroscopic and resistant to moisture, making it suitable for use in humid or outdoor environments.

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