GLOBAL OPTICS

CaF2
Calcium Fluoride

🔷 Key Properties of Calcium Fluoride (CaF2)

🔍 Low Refractive Index: ~1.43 at 589 nm — ideal for minimizing Fresnel reflection without AR coatings.

🌈 Broad Transmission Range: 130 nm – 10 µm — suitable for UV, visible, and mid-IR applications.

❄️ Excellent UV Transparency: Performs well in deep UV systems including excimer lasers and lithography.
🔥 High Thermal Stability: Melting point over 1400 °C and low thermal expansion (~18.85 × 10^{-6}/°C).

🛡️ Chemically Durable: Resistant to most acids and moisture — more stable than many fluoride materials.

🔬 Low Dispersion: High Abbe number (~95) — used in high-precision imaging and chromatic correction optics.

⚙️ Machinable & Polishable: Available in blanks, lenses, windows, and prisms with AR/UV/IR coatings.

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🧩 Applications of Calcium Fluoride (CaF2)

🔬 UV and Deep-UV Optics: CaF_2 is highly transparent in the vacuum ultraviolet (VUV) region, making it essential in lithography, laser micromachining, and excimer laser optics.

🔭 Astronomy and Spectroscopy: Its low dispersion and wide spectral transmission are ideal for telescope lenses, spectrometers, and space-based instrumentation.

💡 IR Windows and Lenses: CaF_2 performs exceptionally in the mid-infrared region, suitable for thermal imaging, IR spectroscopy, and gas sensing optics

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🛡️ Laser Systems: Used in laser-grade optics, CaF_2 components are valued for their high laser damage threshold and low fluorescence — ideal for high-energy and UV laser paths.

🧪 Analytical and Scientific Equipment: Frequently used in FTIR spectrometers, X-ray windows, and optical cryogenics due to its chemical stability and low absorption.

🧭 Optical Fabrication & Coating Substrates: Due to its machinability and low refractive index, CaF_2 is widely used as a substrate for multilayer AR and mirror coatings across the UV-IR spectrum.

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Technical Parameters of Calcium Fluoride (CaF2)

Property	Typical Value
Transmission Range	~150 nm to 9 µm
Refractive Index	~1.43 @ 5 µm
Density	3.18 g/cm³
Hardness (Knoop)	158 kg/mm²
Melting Point	~1418 °C
Thermal Expansion	~18.85 × 10^{-6}/°C @ 20–300 °C
Thermal Conductivity	~9.71 W/m·K
Crystal Structure	Cubic (Fluorite)
Hygroscopic	No — stable under normal conditions
Chemical Formula	CaF_2
Laser Damage Threshold	>15 J/cm² @ 1064 nm (10 ns pulse)
Applications	UV optics, IR spectroscopy, laser systems, lithography,
Coating Compatibility	Broadband AR, V-coats (UV–IR), dielectric mirror coatings

Calcium Fluoride (CaF_2) is a durable optical crystal with outstanding transmission from the deep ultraviolet (~130 nm) to the mid-infrared (~9 µm).

It has a low refractive index (~1.434 at 589 nm), no birefringence, and excellent chemical stability, making it ideal for UV, IR, and high-power laser applications.

With low thermal expansion, high damage threshold, and good hardness (Mohs 4), CaF_2 is widely used in lenses, windows, and prisms for spectroscopy, lithography, and astronomy.

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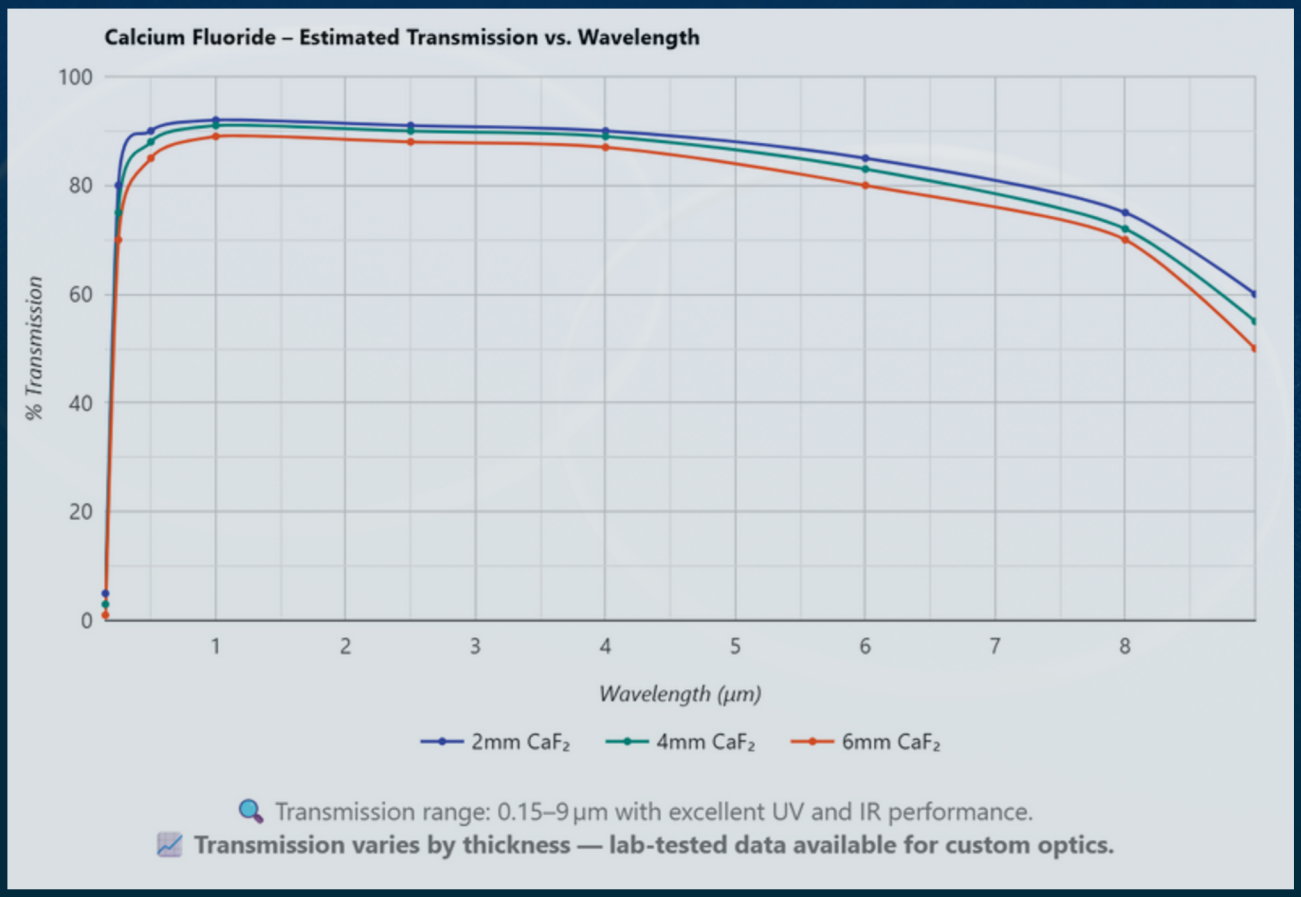
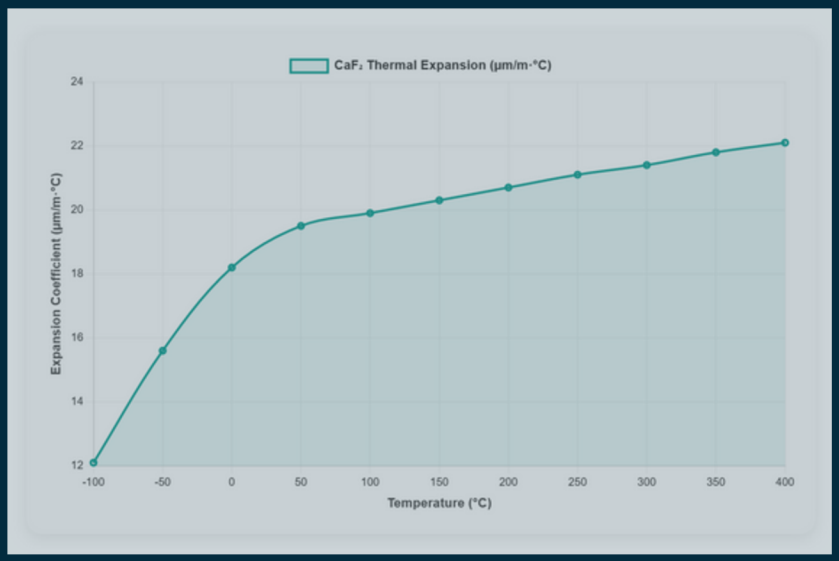


Transmission:

Calcium Fluoride (CaF_2) offers outstanding transmission from the deep ultraviolet to the mid-infrared, typically spanning ~0.13 µm to 9 µm.
It maintains very high optical clarity and low absorption across the visible and infrared ranges.
With minimal dispersion and no birefringence, CaF_2 is ideal for broadband imaging, spectroscopy, and laser optics where consistent performance across wide wavelengths is required.



Thermal Expansion:

Calcium Fluoride (CaF_2) exhibits very low and isotropic thermal expansion, with a coefficient of approximately 18.85 × 10^{-6} /°C at room temperature.
Its uniform cubic structure ensures excellent dimensional stability under temperature changes, minimizing thermal stress and preserving optical alignment.
This stability, combined with its high laser damage threshold, makes CaF_2 ideal for precision and high-power optical applications.

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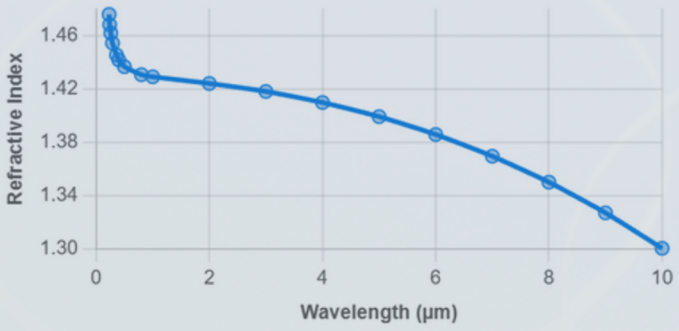
Refractive Index of Calcium Fluoride (CaF_2) vs. Wavelength



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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