BaF2
Barium Fluoride

🔷 Key Properties of Barium Fluoride (BaF2)

🔬 **Wide Optical Transmission:** 0.15 µm (UV) to 12.5 µm (IR) — ideal for spectroscopy and thermal imaging.
🔁 **Low Refractive Index:** ~1.46 at 1 µm — minimises Fresnel loss and coating requirements.
☀️ **UV & Radiation Resistant:** Durable under high-energy UV and ionising radiation.
🌡️ **Moderate Thermal Conductivity:** Better thermal performance than most fluoride optics.
💧 **Low Hygroscopicity:** Stable in dry environments — store in desiccated conditions for longevity.
⚠️ **Soft & Brittle:** Knoop hardness ~82 kg/mm² — requires careful handling and machining.
⚛️ **Scintillation-Capable:** Fast decay (~0.6 ns), suitable for gamma/X-ray detection.
🧪 **Chemically Stable:** Insoluble in most acids; slightly water-soluble (~0.17 g/100 mL at 25 °C).

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🧩 Applications of Barium Fluoride (BaF2)

🔬 Infrared (IR) Optics

- **IR Windows & Lenses:** Excellent transmission in the 0.15–12.5 µm range makes BaF_2 ideal for infrared spectroscopy, thermal imaging, and gas analysis systems.
- **High-Performance FTIR Systems:** Widely used in Fourier-transform infrared (FTIR) spectrometers as beam splitters and sample windows due to low absorption and broad IR range.

🔭 UV and Laser Applications

- **Excimer Laser Windows:** UV-grade BaF_2 is suitable for 193 nm excimer lasers thanks to its high UV transmittance and resistance to radiation damage.
- **UV Beam Delivery:** Effective in delivering UV radiation for photolithography, medical UV treatment, and precision light sources.

⚛️ Scintillation Detectors

- **Gamma-Ray & X-Ray Detection:** BaF_2 is used in scintillators for nuclear physics, PET/CT imaging, and security scanning due to:
  - Fast decay time (~0.6 ns component)
  - Moderate light output
  - Radiation hardness

🛰️ Aerospace & Defense

- **Infrared Targeting Systems:** Used in airborne and spaceborne IR sensors thanks to wide-range IR transparency and optical stability.
- **Space Optics:** Resistant to UV degradation, making it ideal for space-based sensors and optical payloads.

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Technical Parameters of Barium Fluoride (BaF_2)

Property	Typical Value
Transmission Range	0.15 to 12.5 µm
Refractive Index	1.4511 at 5 µm
Reflection Loss	6.5% at 5 µm (2 surfaces)
Absorption Coefficient	3.2×10^{-4} cm^{-1} @ 6 µm
Reststrahlen Peak	47 µm
dn/dT	-15.2×10^{-6} /°C
dn/dµ = 0	1.95 µm
Melting Point	1354 °C
Thermal Conductivity	7.1 W/m·°C at 38 °C
Thermal Expansion	$(16.5–19.2) \times 10^{-6}$ /°C over ±60 °C
Thermal Stability	10 ±2 °C
Hardness	Knoop under micro indenter
Specific Heat Capacity	0.456×10^{3} J/kg·°C
Dielectric Constant	7.33 at 1 MHz

Density	4.83 g/cm^3 at 20 °C
Mohs Hardness	3
Vickers Micro Hardness	82×10^{7}
Young's Modulus (E)	<100>: 65.4 GPa <111>: 66.3 GPa
Shear Modulus (G)	<100>: 25.1 GPa <111>: 25.3 GPa
Bulk Modulus (K)	56.4 GPa
Elastic Coefficients	C11 = 89.2, C12 = 40.0, C44 = 25.4
Apparent Elastic Limit	26.9 MPa (300 psi)
Poisson's Ratio	0.307
Solubility	0.17 g/100 cm^3 in water
Molecular Weight	175.3
Class / Structure	Cubic (111) cleavage

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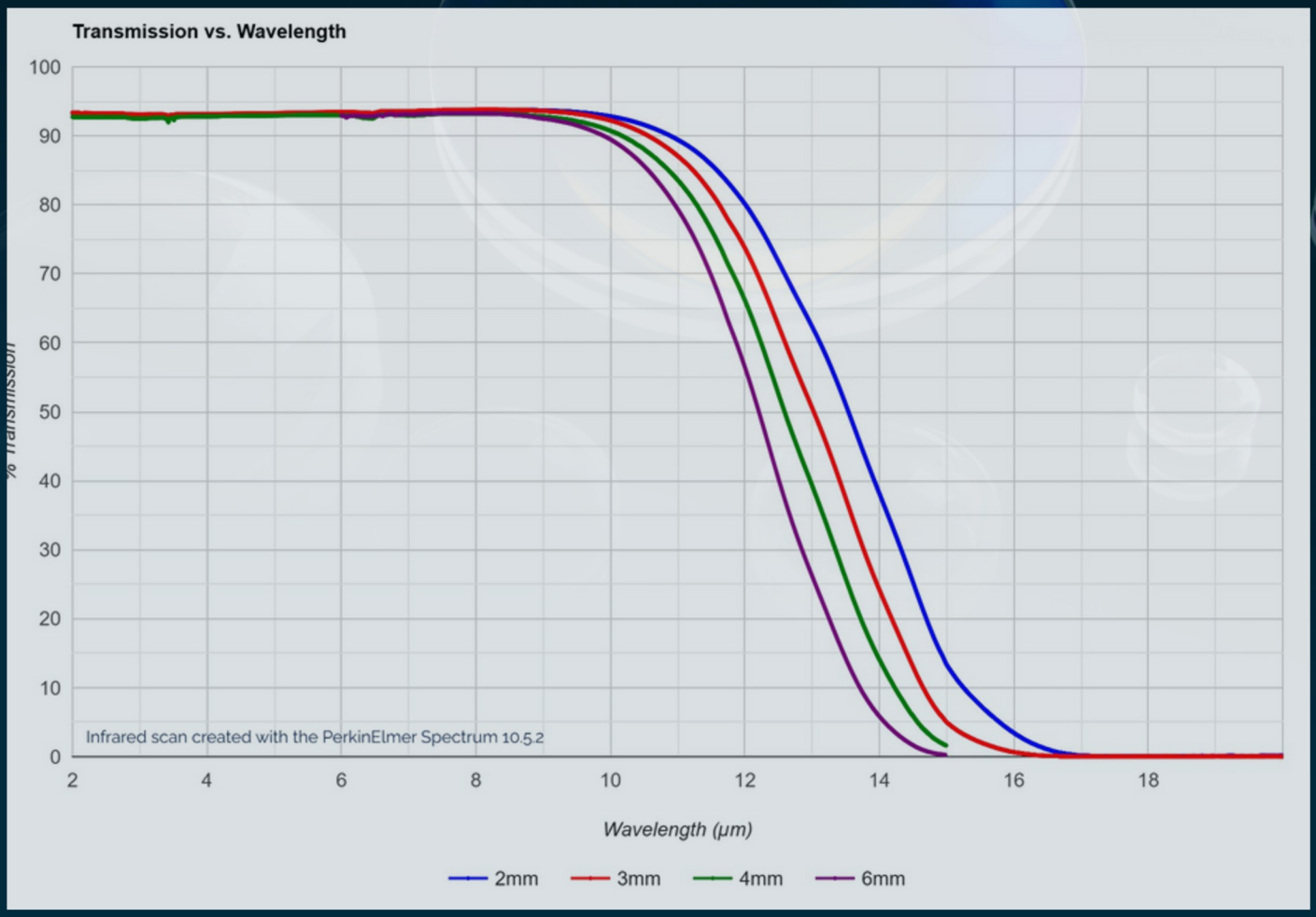

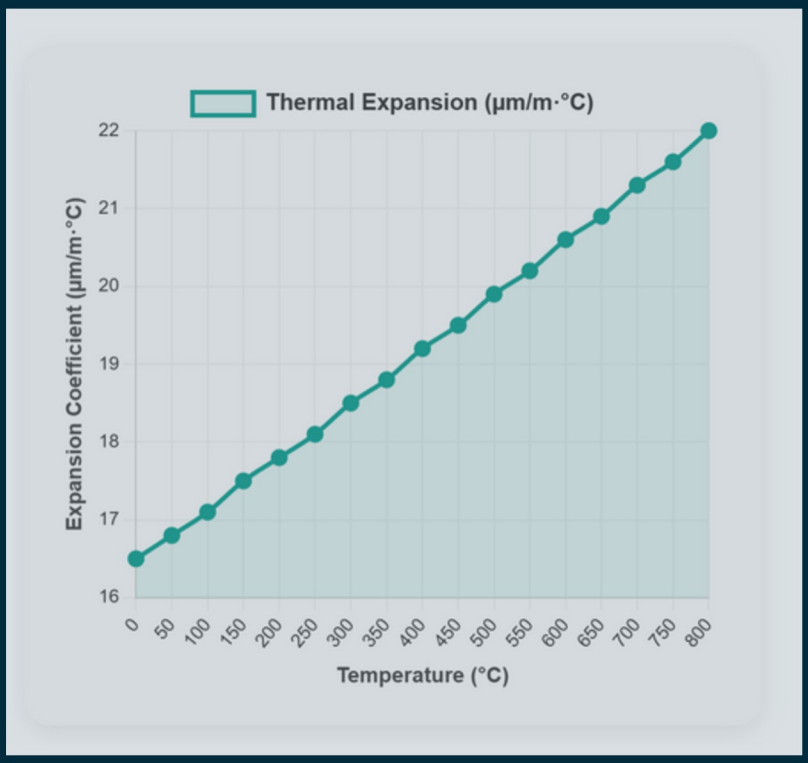

Transmission:

BaF_2 offers high transmission from UV to long-wave IR, maintaining over 90% up to around 11–12 µm. Transmission decreases gradually at longer wavelengths, with thicker samples showing slightly lower values.

Thermal Expansion:

The expansion coefficient rises linearly from ~16 µm/m·°C at room temperature to ~22 µm/m·°C at 800 °C, ensuring stable performance across a wide temperature range.

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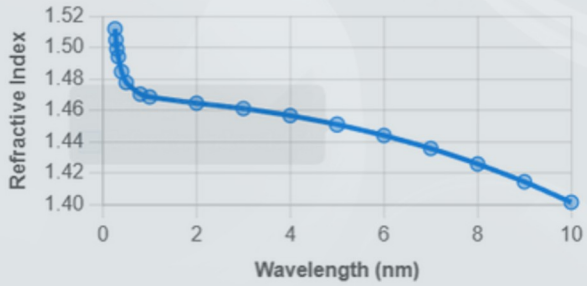
📈 Refractive Index of Barium Fluoride (BaF_2) vs. Wavelength



Real-world measurement data (CSV loaded dynamically)

Wavelength	Refractive index
0.26	1.5121
0.28	1.5050
0.30	1.4992
0.33	1.4943
0.40	1.4848
0.50	1.4778
0.80	1.4704
1.00	1.4686
2.00	1.4646
3.00	1.4612
4.00	1.4567
5.00	1.4510
6.00	1.4440
7.00	1.4357
8.00	1.4258
9.00	1.4144
10.00	1.4013

FAQ

Q: What is Barium Fluoride (BaF_2) used for?
A: BaF_2 is used in spectroscopy, FTIR optics, IR and UV transmission systems, radiation detection, and aerospace targeting due to its wide transmission range and radiation hardness.

Q: Is Barium Fluoride suitable for IR applications?
A: Yes, BaF_2 transmits from 0.15 to 12.5 µm, making it ideal for IR windows and FTIR spectrometers.

Q: Is BaF_2 hygroscopic?
A: BaF_2 has low hygroscopicity. It is stable in dry environments but should be stored with desiccants to avoid moisture degradation.

Q: Can Barium Fluoride be used in scintillation?
A: Yes, it has fast scintillation decay (~0.6 ns) and is used in gamma and X-ray detection.

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