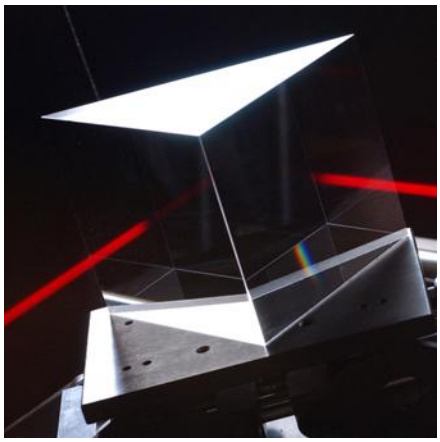
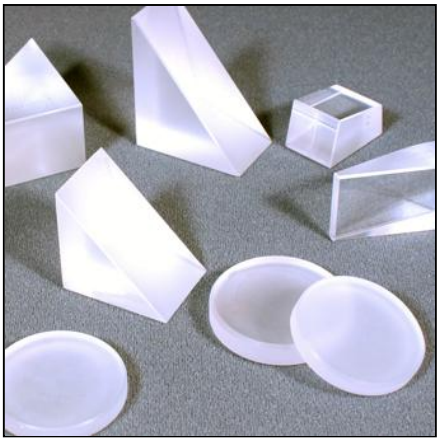
Fluoride Crystal Materials

Corning® Calcium Fluoride (CaF_2) - Code 9575

Specialty Materials

CORNING





Corning Specialty Materials is a premier supplier of fluoride crystal materials. With exceptional purity and quality, our crystal materials transmit at multiple wavelengths and can be used in a variety of applications for complete end-to-end optical solutions.

Corning also offers design engineering, fabricating, polishing and coating capabilities. With the ability to do it all under one roof, let Corning be the supplier of choice for your most complex optical requirements.

- Calcium Fluoride is uniquely suited for demanding optical applications from deep ultraviolet through the infrared.
- Physically stable and chemically inert with superior hardness, Calcium Fluoride is the material of choice for microlithography and laser optics applications.
- Single crystal ingots are grown using Corning's proprietary process from highly purified materials, ensuring consistent supply.
- A full range of geometries and finishes, from ingots and blanks to complex multi-faceted, highly polished parts are available. Standard (111) orientation as well as specifically oriented parts and materials are offered.
- Multiple material grades are available to match customer needs. *IR, UV, DUV, KrF, ArF, and High-Fluence*
- ***Low absorption coatings are customized to meet customer specifications, including coatings designed for enhanced laser durability in both reflective and anti-reflective.***

CTLO 001_A
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Physical and Chemical Properties

General Properties

CAS#	7789-75-5
Molecular Weight	78.08 g/mol
Structure	Cubic, fluorite type, space group Fm3m, a_0= 5.462 Angstroms, z = 4
Density	3.18 g/cm^3 at 25 °C
Melting Point	1360 °C
Boiling Point	2451 °C
Solubility	0.002 g/100g H_2O at 18 °C

Mechanical and Elastic Properties

Young's Modulus	75.8 GPa

Elastic Constants

Elastic Compliance (x10^{-2}/GPa)	**Elastic Stiffness** (x10^2 GPa)
S_{11} = 0.6867	C_{11} = 1.6420
S_{12} = 0.1451	C_{12} = 0.4398
S_{44} = 2.9764	C_{44} = 0.3370

Dielectric Constant	E_0 = 6.81 at 27 ºC
Poisson Ratio	0.26
Hardness	158.3 Knoop for both [100] and [110] directions

Thermal Properties

Heat Capacity

T [K]	**C_p [J/(g·K)]**
85.32	0.280
104.51	0.577
186.00	0.699
216.40	0.757
276.00	0.837
296.50	0.853

Thermal Conductivity

T [°C]	**[W/(m·K)]**
88	61.0
200	16.5
320	11.7

Linear Thermal Expansion Coefficient

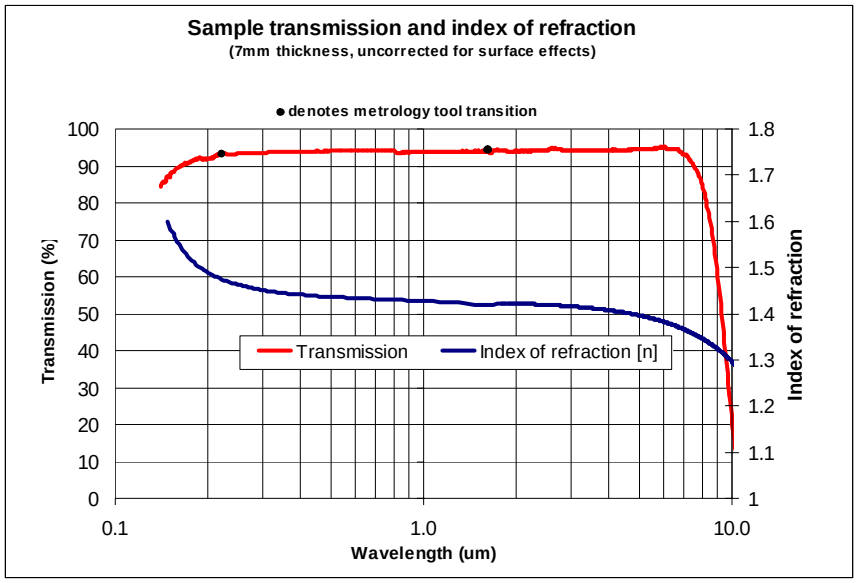
T [°C]	**T [K]**	**Coefficient [x10^{-6}/K]**	**T [°C]**	**T [K]**	**Coefficient [x10^{-6}/K]**
-180	93	6.7	20	293	18.7
-160	113	9.1	40	313	19.1
-140	133	11.1	60	333	19.4
-120	153	12.8	80	353	19.7
-100	173	14.1	100	373	20.0
-80	193	15.2	120	393	20.4
-60	213	16.2	140	413	20.8
-40	233	17.0	160	433	21.3
-20	253	17.7	180	453	21.7
-0	273	18.3	200	473	22.2

Debye Temperature

513 ± 2 K

Optical Properties

Transmission Range	0.12 µm to beyond 7.5 µm, depending on thickness
Energy Gap	10eV
Restrahl Frequency	35 µm and 25 µm maxima
Reciprocal Dispersive Power	94
Photoelasticity	In the visible region the piezo coefficients are: 10^{-12} Pa q_{11} = -0.038 q_{12} = 1.08 $(q_{11}-q_{12})$ = -1.46 q_{44} = 0.71 At 10.6 µm $(q_{11}-q_{12})$ = -0.513
Optic Modes	Transverse: 257/cm at 300 K and 267/cm at 80 K Longitudinal: 463/cm at 300 K and 472/cm at 80 K



Available Grades and Additional Information

Corning® Calcium Fluoride material is classified in the following general grades:

• Laser Durability	193 nm	*recommended for ArF*
• Super-Excimer	193 nm	*recommended for ArF*
• Excimer	193 nm	*recommended for KrF and ArF*
• Ultraviolet	200 nm – 400 nm	
• Visible-Infrared	400 nm – 10.6 µm	

Corning's crystal experts work actively with prospective customers to determine the most appropriate and cost-effective solution for each application. Depending on the application of interest, some or all of the following attributes may be considered in the selection process:

Feature	Capability
Internal transmittance	> 99.9% @ 193.3nm
Stress Birefringence	<1 nm/cm (avg.), [111], measured at 546 nm
Bubbles/Inclusions	ISO 10110 - 1/1 x 0.02
Scratch dig	To 10/5 available
Micro-roughness	To 2 Å available
Available raw material diameters	1.75", 1.9", 2.4", and 4.1" (typical) others upon request.
Orientation	(111) +/-2° typical, others upon request
Finish	Cleaved, saw cut, fine ground, polished, super-polished, enhanced super-polished
Coatings	Anti-reflective, highly reflective, partially reflective, low absorption, protective/enhanced durability, custom solutions upon request

Depending on customer requirements, Corning can provide solutions ranging from crystal blanks to complete turnkey optical packages. Corning can precisely manufacture a wide variety of laser optic components including: windows, prisms, mirrors, plano convex, plano concave, and hemispherical optics. With world-class coating engineering expertise, Corning can customize final optical performance to enhance transmission, reflectivity, and/or laser durability to customer specification in order to provide a comprehensive optical path solution.

For more information about fluoride crystals please contact us at:

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