

Magnesium Fluoride MgF_2

Physical and Chemical Properties



CORNING
Discovering Beyond Imagination



Semiconductor
Optics

MgF_2 Magnesium Fluoride Physical & Chemical Properties

Environmental Effects:

Exposure to 100% relative humidity at room temperature does not fog polished surfaces even after one month. In normal working conditions, polished surfaces will not degrade. For temperatures exceeding $500^{\circ}C$, magnesium fluoride surfaces will degrade in the presence of moisture. In dry environments, calcium fluoride can be used up to $800^{\circ}C$. Magnesium fluoride is inert to organic chemicals and many acids including HF. It will slowly dissolve in nitric acid.

Fabrication:

Magnesium fluoride can be machined with standard diamond tools and water based coolants. The material takes a good polish using either aluminum oxide or diamond based polishing powders using either pitch or cloth laps.

Size: Corning Semiconductor Optics grows a range of MgF_2 with diameters up to 6 inches: *150 mm*.

Molecular Weight: 62.31

Structure: Tetragonal, SnO_2 type, space group $P4_2/m$, $a_0 = 4.623$ Angstroms, $C_0 = 3.052$ angstroms.

Density: 3.1766 g/cm³ at $25^{\circ}C$

Solubility: 0.0002 g. per 100g H_2O at room temperature.

Melting Point: $1585^{\circ}C$

Mechanical & Elastic Properties

Young's Modulus:

138.5 GPa

Elastic Constants:

Elastic Stiffness

$\times 10^3$ GPa

$$C_{11} = 1.237$$

$$C_{33} = 1.770$$

$$C_{44} = 0.552$$

$$C_{12} = 0.732$$

$$C_{13} = 0.536$$

$$C_{66} = 0.951$$

Dielectric Constant:

4.87 along C axis, 5.45 perpendicular between 95KHz and 42MHz.

Fracture Strength:

Measurements by NASA Goddard on Corning Semiconductor Optics single crystals show that the fracture strength is dependent on the process of fabrication. Fracture strengths varied from 110 MPa for rough finish pieces to 179 MPa for well annealed, optically polished material.

Rupture Modulus:

50 to 1.044×10^3 MPa

Poisson Ratio: 0.271

Hardness: 415 Knoop

Optical Properties

Transmission range:

0.11 microns to beyond 7.5 microns depending on thickness.

Energy Gap: 11eV

Restrahl Frequency: 17.5, 20.8, 24.7, 34.5 and 37.0 micron.

Reciprocal Dispersive Power: 100

Absorption Coefficients:

Wavelength microns	Absorption Coefficient cm^{-1}
2.8	0.0055
5.1	0.006
6.1	0.1

Non-Linear Refractive Index: 3×10^{-14} esu at 1.06 microns.

Thermal Properties

Heat Capacity:

TK	C_p J/gK
80.00	0.238
95.00	0.319
114.00	0.428
135.00	0.538
155.00	0.627
176.00	0.706
196.00	0.771
216.00	0.830
236.00	0.817
256.00	0.922
276.00	0.955

$$C_p = 16.93 + 2.52 \times 10^{-3} T - 2.55 \times 10^{-5} T^2$$

$T = ^\circ\text{C}$ between 25 and 100°C .

Linear Thermal Expansion Coefficient:

$^\circ\text{C}$	TK	Coefficient $\times 10^{-6}\text{K}^{-1}$	
		Perp c axis	Parallel c Axis
-180	93	0.72	2.90
-160	113	1.63	4.45
-140	133	2.65	5.95
-120	153	3.64	7.39
-100	173	4.58	8.86
-80	193	5.45	9.82
-60	213	6.23	10.86
-40	233	6.93	11.74
-20	253	7.52	12.47
0	273	8.04	13.07
20	293	8.48	13.70
40	313	8.88	14.09
60	333	9.25	14.54
80	353	9.60	14.94
100	373	9.93	15.32
120	393	10.22	15.67
140	413	10.49	16.00
160	433	10.71	16.33
180	453	10.91	16.67
200	473	11.10	17.00

Thermal Conductivity:

11.6 W/mK at room temperature.

Temperature Variation of Refractive Index dn/dT of MgF₂ (10⁻⁵K⁻¹)

Temperature		Wavelength microns							
°C	K	0.4579		0.6328		1.15		3.39	
		dn _e /dT	dn _o /dT	dn _e /dT	dn _o /dT	dn _e /dT	dn _o /dT	dn _e /dT	dn _o /dT
-180	93	0.177	0.244	0.165	0.223	0.144	0.199	0.15	0.20
-160	113	0.168	0.234	0.154	0.212	0.133	0.188	0.14	0.20
-140	133	0.159	0.225	0.144	0.201	0.122	0.177	0.13	0.19
-120	153	0.151	0.215	0.133	0.190	0.110	0.166	0.12	0.18
-100	173	0.142	0.205	0.122	0.179	0.099	0.155	0.12	0.17
-80	193	0.133	0.196	0.112	0.168	0.088	0.144	0.11	0.16
-60	213	0.124	0.186	0.101	0.157	0.077	0.132	0.10	0.15
-40	233	0.116	0.176	0.090	0.146	0.065	0.121	0.09	0.14
-20	253	0.107	0.166	0.080	0.135	0.054	0.110	0.08	0.13
0	273	0.098	0.157	0.069	0.124	0.043	0.099	0.07	0.12
20	293	0.089	0.147	0.058	0.112	0.032	0.088	0.06	0.11
40	313	0.081	0.137	0.048	0.101	0.020	0.077	0.05	0.10
60	333	0.072	0.128	0.037	0.090	0.009	0.066	0.04	0.10
80	353	0.063	0.118	0.027	0.079	-0.002	0.054	0.03	0.09
100	373	0.054	0.108	0.016	0.068	-0.013	0.043	0.02	0.08
120	393	0.046	0.099	0.005	0.057	-0.025	0.032	0.01	0.07
140	413	0.037	0.089	-0.005	0.046	-0.036	0.021	0.00	0.06
160	433	0.028	0.079	-0.016	0.035	-0.047	0.010	-0.01	0.05
180	453	0.019	0.070	-0.027	0.024	-0.059	-0.001	-0.02	0.04
200	473	0.011	0.060	-0.037	0.013	-0.070	-0.013	-0.03	0.03
0 ^a	273	0.009	0.014	0.009	0.012	0.010	0.014	0.02	0.01

^a Standard deviation from linear fit.

Refractive Index:

Wavelength (nm)	N _o	N _e	(N _e - N _o)
1970.1	1.36803	1.37928	0.01125
1529.6	1.37063	1.38206	0.01143
1064.0	1.37319	1.38478	0.01159
1014.0	1.37350	1.38510	0.01160
852.1	1.37462	1.38628	0.01166
706.5	1.37600	1.38774	0.01173
656.3	1.37664	1.38841	0.01176
643.9	1.37682	1.38859	0.01177
632.8	1.37698	1.38876	0.01178
589.3	1.37771	1.38952	0.01181
587.6	1.37774	1.38956	0.01181
546.1	1.37859	1.39045	0.01185
486.1	1.38020	1.39212	0.01192
480.0	1.38040	1.39233	0.01193
435.8	1.38207	1.39408	0.01200
404.7	1.38360	1.39567	0.01207
365.0	1.38617	1.39834	0.01217
334.2	1.38887	1.40115	0.01228
312.6	1.39129	1.40368	0.01238
296.7	1.39346	1.40592	0.01247
280.4	1.39613	1.40870	0.01257
250.0	1.40280	1.41562	0.01282
248.3	1.40326	1.41610	0.01284
240.0	1.40567	1.41859	0.01292
200.0	1.42309	1.43657	0.01348

CaF₂ and MgF₂ Applications VUV/UV Visible/IR Scintillator

- Cherenkov
- CO Laser Windows
- Eu Doped X-Ray Windows
- Excimer Beam Delivery Optics
- Excimer Laser Window Options
- FTIR Beamsplitter Substrates
- Gas Analyzer Windows & Lenses
- HDTV Lenses
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We are here to help you specify the best product for your application. For further information, please contact:

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