MgF_2
Magnesium Fluoride

Magnesium fluoride is used as an optical window transmitting from the vacuum ultraviolet into the infrared. It is a birefringent material making possible polarizing optics for the ultraviolet region.

MgF_2 along with CaF_2 is a preferred material for UV laser use. Due to its chemical composition MgF_2 is a good candidate for use in fluorine environments. Generally, material for laser use is recommended to be oriented along the optic axis to avoid birefringent effects.

Vacuum Ultraviolet Use: MgF_2 is warranted to transmit at least 40% at 1216Å for a 2mm path length.

Properties

Solubility[1]: 7.6×10^{-3} g/100g H_2O at 18°C.

Refractive Index[2]: MgF_2 is birefringent. The refractive indices for ordinary and extraordinary rays are known from λ=0.4046 to 0.7065μ for 21°C. In this spectral region n_o varies from 1.38359 to 1.37599 and n_e from 1.39566 to 1.38771. The refractive indices for λ(Na)=0.58937μ are n_o=1.37770 and n_e=l.38950. The Interpolation formulas are:

$$n_o = 1.36957 + 35.821/(\lambda - 1492.5)$$
$$n_e = 1.36100 + 37.415/(\lambda - 1494.7)$$

Temperature Coefficient[2]:

λ=0.4047μ, $dn_o/dT = +0.23 \times 10^{-5}$/°C
λ=0.4047μ, $dn_e/dT = +0.17 \times 10^{-5}$/°C
λ=0.7065μ, $dn_o/dT = +0.19 \times 10^{-5}$/°C
λ=0.7065μ, $dn_e/dT = +0.10 \times 10^{-5}$/°C

Dispersion *(dn/dλ)*: Can be computed from refractive indices.

Transmission Range[2]: Extends from 0.11 to 7.5μ. For 2mm thickness the transmission at 9.7μ is still 10%.

Reflection Loss: For a plane parallel plate and $\theta = 0°$

	n_o=1.3777	n_e=1.3895
Without multiple reflection	5.0%	5.2%
With multiple reflection	4.9%	5.1%

Infrared Absorption Maxima: 21.3μ, 24.7μ, 37.0μ

Reststrahl Frequencies[3]: Reststrahl maxima: 17.5μ, 20.8μ, 24.7μ, 34.5μ, 37.0μ. From 16.5 to 23μ the reflection is over 50%.

References

1. Handbook of Chemistry and Physics, 59th Ed., 1979.
2. A. Duncanson and R. W. H. Stevenson, Proc. Phys. Soc. (London), *72*, 1001 (1958).
3. G. R. Hunt, C. H. Perry and J. Ferguson, Phys. Rev. *134*, A. 688 (1964).
4. J. Kervitsky, "Report of NRL Progress," February 1960, pp.38-39.
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Some Practical Limitations

Moisture: Magnesium fluoride can safely be used as a transmission window in the laboratory. This material is slightly more soluble than CaF_2 and is, therefore, not very susceptible to damage due to moisture in the atmosphere.

Temperature: Magnesium fluoride undergoes a thermal reaction with water vapor when heated above 500°C in a moist atmosphere. When overheated, the material will become crazed or cloudy with many small cracks appearing on the surface. In a nominally dry atmosphere of air or nitrogen at temperatures above 800°C similar effects appear. Magnesium fluoride is sensitive to thermal shock and care must be taken in cutting and polishing operations and where any rapid temperature change might be encountered.

Pressure: See the section Design of Pressure Windows.

Irradiation: Magnesium fluoride is recommended for use as an ultraviolet optical component for use in space work since it is only mildly affected by high energy radiation.

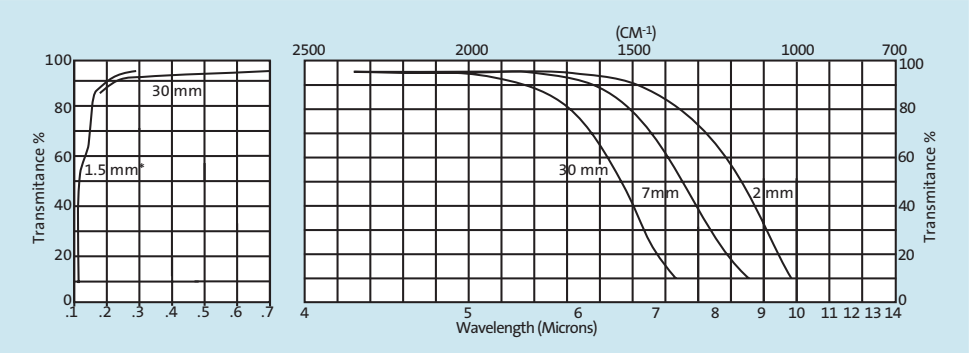
Handling–Orientation: Magnesium fluoride does not normally cleave and orientation may be determined by x-ray or suitable optical techniques.

Cleavage: Magnesium fluoride does not cleave.

Cutting and Polishing: Magnesium fluoride is relatively hard and should be cut and shaped with diamond tools. Polishing is accomplished by using aluminum oxide with water as a vehicle, or diamond used with a commercial polishing vehicle, Diamond is preferred in the polishing of magnesium fluoride.

Sealing: Vacuum seals with magnesium fluoride can be made with either silver chloride[4,5] or a suitable epoxy. We have experience in designing and building mounted magnesium fluoride windows.

Transmission Spectrum



*D. Heath and P. Sacher, Applied Opt., *15*, 937 (1966)

The data presented is believed to be correct but not guaranteed to be so.

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