HARRICK Scientific Products
Solutions in Optical Spectroscopy

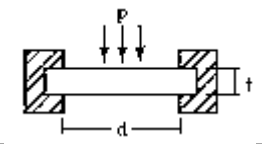
What are the properties of different optical materials?

Material[1]	Refractive Index n	Knoop Hardness psi	Rupture Modulus[2] psi	Transmission Range cm^{-1} (micrometers)		Chemical Properties
				Windows, *1-2mm*	IRE, *70mm*	
BK-7 Glass	1.52	520	2400	31,000-4300 (0.32-2.3)	29,000-5000 (0.34-1.97)	Insoluble in water.
Silica, UV Grade Fused SiO_2	1.45	461	7100	57,000-4600; 3500-2800 (0.175-2.2; 2.9-3.6)	50,000-5,000 (0.2-2.0)	Insoluble in water; soluble in HF.
UV Sapphire Al_2O_3	1.76	1370	65,000	66,000-2000 (0.15-5.0)	33,000-2800 (0.3-3.7)	Slightly soluble in acids and bases.
Strontium Titanate $SrTiO_3$	*2.31*	*595*	*7500*	*25,000-1700 (0.395-6)*	*25,000-2500 (0.4-4)*	*Readily attacked by HF; resistant to most solvents.*
Titanium Dioxide TiO_2	*2.48*	*800*	*700*	*24,000-1700 (0.42-6)*	*20,000-2200 (0.5-4.5)*	*Soluble in H_2SO_4 and alkalis; insoluble in water and acid.*
Zirconium Dioxide ZrO_2	*2.13*	*1250*	*7800*	*27,000-1,500 (0.36-7)*	*25,000-1800 (0.4-5.5)*	*Insoluble in water; soluble in HF and H_2SO_4.*
Magnesium Oxide MgO	*1.72*	*640*	*19,000*	*25,000-1300 (0.4-8.0)*	*20,000-1700 (0.5-6.0)*	*Soluble in acids and NH_4 salts.*
Silicon Si	3.42	1150	9000	10,000-100 (1.0-100)	9500-1500; 350-FIR (1.06-6.7; 30-FIR)	Insoluble in most acids and bases; soluble in HF and HNO_3.
Calcium Fluoride CaF_2	1.43	158	5300	66,000-1300 (0.15-8.0)	33,000-1500 (0.3-7.0)	Insoluble in water; resists most acids and bases; soluble in NH_4 salts.
Strontium Fluoride SrF_2	*1.44*	*1405*	*500*	*66,000-1000 (0.15-11)*	*33,000-1100 (0.3-9.5)*	*Very slightly soluble in water; soluble in hot HCl.*
Barium Fluoride BaF_2	1.47	82	3900	50,000-1000 (0.2-11)	33,000-1100 (0.3-9.5)	Low water solubility; soluble in acid and NH_4Cl.
Zinc Sulfide ZnS	2.19	355	10,000	22,000-750 (0.45-14.0)	14,000-1000 (0.7-10)	Soluble in acid; insoluble in water.
Germanium Ge	4.0	550	7000	5000-600 (2.0-17)	5000-900 (2.0-1.4)	Insoluble in water; soluble in hot H_2SO_4 and aqua regia.
Sodium Chloride NaCl	1.53	15	350[3]	28,000-700 (0.35-15)	25,000-900 (0.4-12)	Hygroscopic; soluble in alcohol, water and NH_3.
AMTIR (GeAsSe Glass)	*2.5*	*170*	*2700*	*11,000-1000 (0.9-11)*	*11,000-1100 (0.9-9.5)*	*Insoluble in water.*
Gallium Arsenide GaAs	*3.14*	*750*	*11,000*	*10,000-600 (1-17)*	*10,000-700 (1-14)*	*Insoluble in water; slightly soluble in acids and bases.*
Zinc Selenide ZnSe	2.40	150	8000	20,000-500 (0.5-20)	20,000-700 (0.5-14.3)	Soluble in strong acids; dissolves in HNO_3.
Potassium Chloride KCl	1.48	7	330[3]	33,000-500 (0.3-20)	20,000-700 (0.5-15)	Hygroscopic; water soluble; slightly soluble in alcohol.
Potassium Bromide KBr	1.52	7	160[3]	33,000-400 (0.3-25)	20,000-500 (0.5-20)	Soluble in water, alcohol, and glycerine; hygroscopic.
Cadmium Telluride CdTe	*2.65*	*45*	*850*	*10,000-350 (1.0-28)*	*10,000-500 (1.0-22)*	*Insoluble in acid and water.*
Cesium Iodide CsI	*1.76*	*20*	*810*	*33,000-1 50 (0.3-70)*	*20,000-400 (0.5-30)*	*Soluble in water and alcohol; hygroscopic.*
Thallium Bromoiodide KRS-5	2.37	40	3800[3]	16,000-200 (0.6-60)	14,000-400 (0.7-30)	Slightly soluble in water; soluble in bases; insoluble in acids.
Quartz Crystal SiO_2	1.54	741	1500	50,000-4,000; 250-30 (0.2-2.4;40-333)	50,000-6,000 (0.2-2.0)	Soluble in HF; insoluble in water.
Polyethylene [PE] (high density)	1.55	5	400[3]	600-10 (16-1000)	600-FIR (16-FIR)	Resistant to most solvents.
Diamond C	2.4	7000	54,400	45,000-2500; 1600-FIR (0.22-4; 6-FIR)	45,000-2500; 1600-FIR (6-FIR[4])	Insoluble in water, acids, and bases.

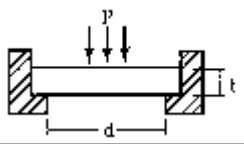
[1]Materials in italics are available only on special order; minimum quantity required.
[2]The modulus of rupture, m, determines the size of the window needed to withstand a pressure, **p**.
[3]The apparent elastic limit is reported for those materials which permanently bend prior to rupturing.
[4]Pathlength of a few mm.

For a four times safety factor, the thickness of a mounted window, t, with an unsupported diameter, **d,** is:

Clamped Window
$t_{clamped} = 0.866\ d\ (p/m)^{1/2}$



Unclamped Window
$t_{unclamped} = 1.05\ d\ (p/m)^{1/2}$



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