Zinc Selenide (ZnSe) Optics

Due to the very wide transmission range covering 0.6 to 20 μ m Zinc Selenide (ZnSe) is the most popular material for infrared application. CVD grown ZnSe high optical quality material is used to manufacture optical components (windows, mirrors, lenses etc.) for IR lasers.

Physical Properties

Crystal type	cubic
Lattice constant	a=5.657Å
Density	5.27 g/cm^3 at 25° C
Melting point	1525 ° C
Refractive index	2.417 - 2.385 @ 8 - 13 μ m 2.40272 at 10.6 μ m
Transmission band	0.6 to 20 μ m
Bulk absorption coefficient	5×10^{-4} cm^{-1} @ 10.6 μ m
Young's Modulus	6.72×10^9 dynes/mm^2
Specific Heat at 25 ° C	0.085 ca/g° C
Linear thermal expansion	7.57×10^{-6} /° C at 20° C

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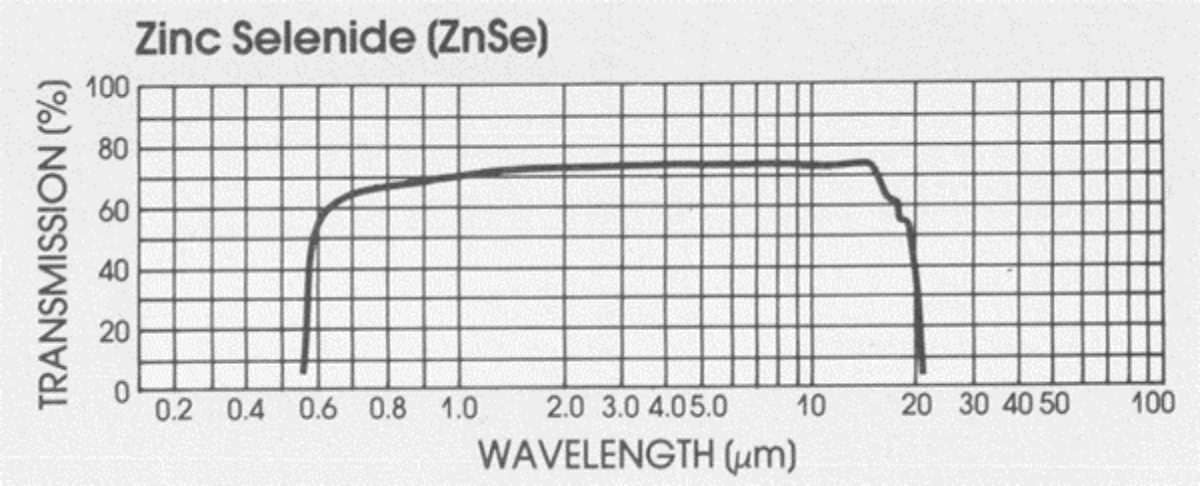
Transmission



Refractive Index

Wavelength, μm	2.75	5.00	7.50	9.50	11.0	12.5	13.5	15.0	16.0	16.9	17.8	18.6	19.3	20.0
Refractive Index	2.44	2.43	2.42	2.41	2.40	2.39	2.38	2.37	2.36	2.35	2.34	2.33	2.32	2.31

Although the internal transmission of zinc selenide is very high (absorption <= 0.0005cm^{-1} at 10.6μm), the relatively high refractive index (2.4 at 10.6μ m) cause reflection losses of nearly 30%. Unless such losses can be tolerated, zinc selenide optics should always be antireflection coated. Because of the high refractive index, single and double layer antireflection coatings can be very effective.

Zinc selenide is not hygroscopic unlike certain salts, which are used for windows in the infrared.

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General Specifications of Zinc Selenide Windows

Material	ZnSe
Surface Quality	40-20 scratch & dig
Clear aperture	90% of diameter
Diameter tolerance	+0.0, -0.25 mm
Thickness tolerance	+0.1, -0.25 mm
Surface Irregularity	λ /2 per inch @ 633 nm over clear aperture
Coatings	Typical available coatings for ZnSe include BBAR for 0.8 to 2.5µm, 3 to 5µm, 1 to 5µm, 8 to 12µm, and the 3 to 12µm spectral regions and single wavelength AR coating at 10.6µm R≤ 0.5% per surface. Many other specialized wavelength bands are possible within the 0.6 to 16µm range.

Standard ZnSe windows (uncoated)

Diameter, mm	Thickness, mm	Cat.-No	Price, US$
12.5 (or 0.5")	2.0	40701	69
25.0 (or 1")	3.0	40703	99
40.0 (or 1.5")	4.0	40705	129
50.0 (or 2")	5.0	40707	269
3”	6.0	40709	625

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4”	8.0	40711	1390
125.00 (or 5”)	10.0	40712	2070
6”	0.25”	40713	2590
6”	15	40714	

Zinc Selenide custom made windows, lenses, Brewster windows, mirrors, beamsplitters and other components are available on request.

Zinc selenide most obvious and important advantage over other materials is its low absorption in the red end of the visible spectrum. This allows the ubiquitous helium neon laser to be used as a convenient and inexpensive alignment or sighting tool for infrared laser beams. Prealignment of optics may be necessary merely because the infrared beam is invisible to the eye, or in addition because the infrared laser beam is of such a high energy misdirected laser beam can be extremely dangerous to equipment or personnel.

Although zinc selenide has this clear advantage over silicon and germanium, unfortunately it is not an easy material from which to produce optics. Firstly, it is not a naturally occurring material and has to be synthesized using a difficult process (CVD). Secondly, the dust, which is generated when zinc selenide is ground and polished, constitutes a significant health hazard as a cumulative toxin. Also, it is not a particularly hard substance and scratches easily.

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