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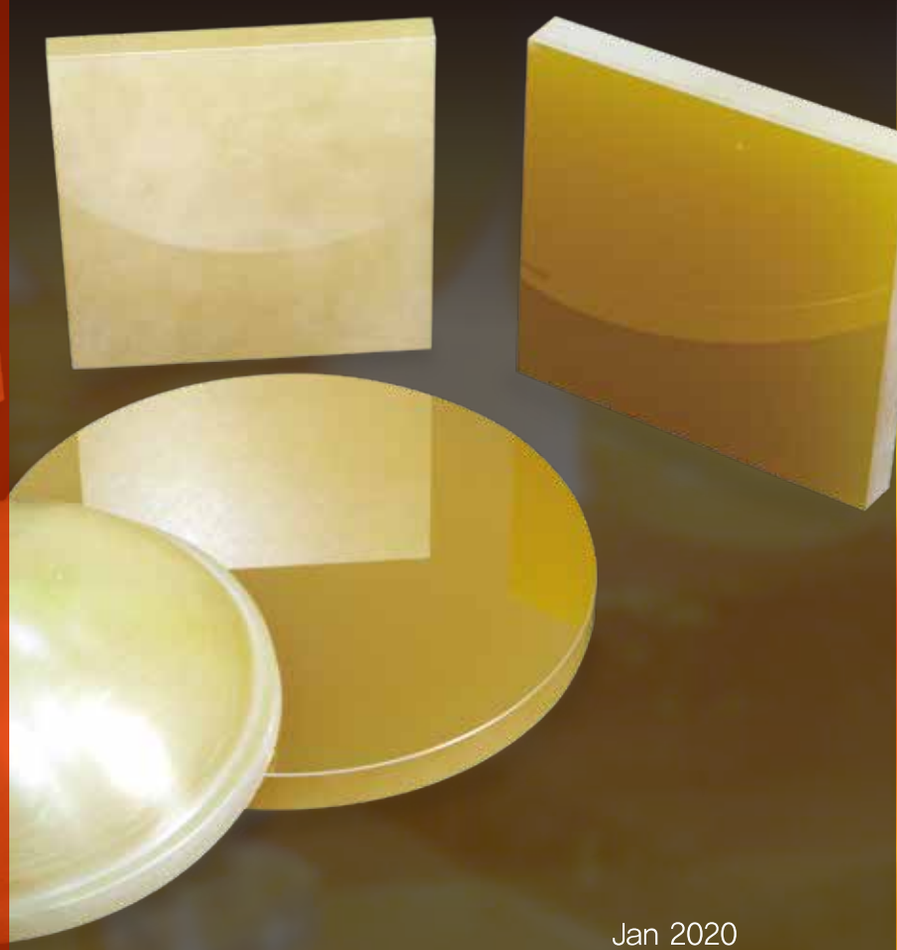
GREEN
OPTICS
MATERIAL



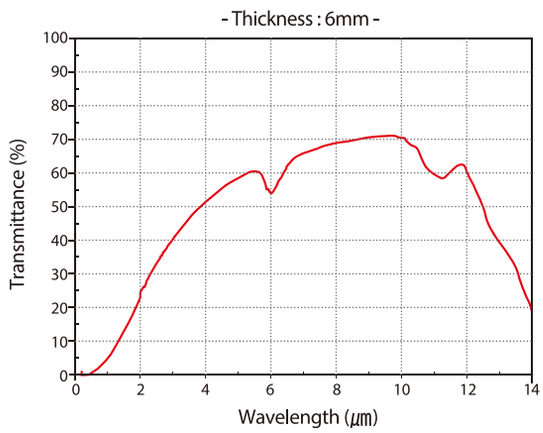
Materials for Infrared Optics

GREEN OPTICS

Jan 2020

Zinc Sulfide (CVD-ZnS)

Polycrystalline Zinc Sulfide is grown by a Chemical Vapor Deposition (CVD) process. CVD-ZnS has high hardness and fracture strength. This material used in the 3~5㎛ and 8~12㎛ thermal band which is suitable for military and enhanced industry applications.



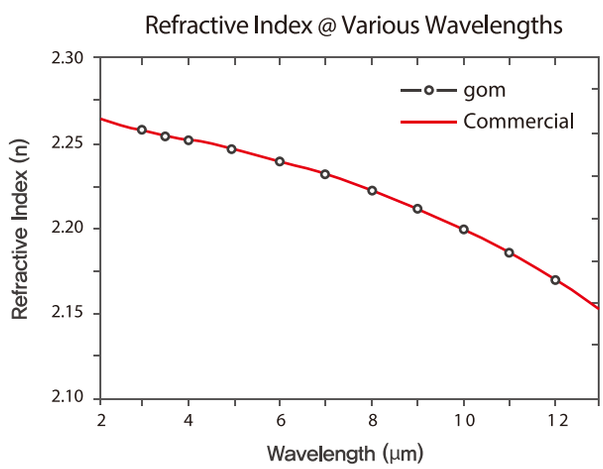
Material Properties

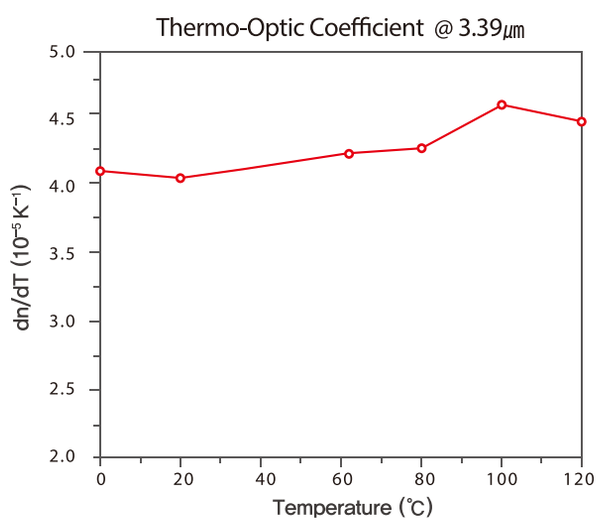
Optical Properties	Refractive Index @ 10.6㎛		2.192
	Index of Refraction Inhomogeneity @ 10.6㎛	ppm	〈 100
	Bulk Absorption Coefficient @ 10.6㎛	cm^{-1}	≤ 0.24
Physical Properties	Crystal Structure		Cubic
	Grain Size	㎛	3 ~ 8
	Density	g/cm^3	4.09
	Chemical Purity	%	≥ 99.9996
	Inclusion	mm	None 〉 0.5
	Resistivity	Ω·cm	〉 10^{13}
Thermal Properties	Coefficient of Thermal Expansion	K^{-1} @ 293K	5.98×10^{-6}
		K^{-1} @ 373K	7.24×10^{-6}
		K^{-1} @ 473K	7.69×10^{-6}
	Thermal Conductivity @ 298K	W/mK	21.2
	Heat Capacity	J/gK	0.480
Mechanical Properties	Knoop Hardness	kg/mm^2	206 – 223
	Flexural Strength (3 pt.)	psi	16,389
		MPa	113
	Fracture Toughness	$MPam^{1/2}$	1.33
	Young's Modulus	psi	12.9×10^6
		GPa	89
	Poisson's Ratio		0.28

ZnS

Refractive Indices @ 23℃

Wavelength (㎛)	n
3	2.25706
3.5	2.25433
4	2.25168
5	2.24599
6	2.23940
7	2.23178
8	2.22292
9	2.21248
10	2.20048
11	2.18663
12	2.17073



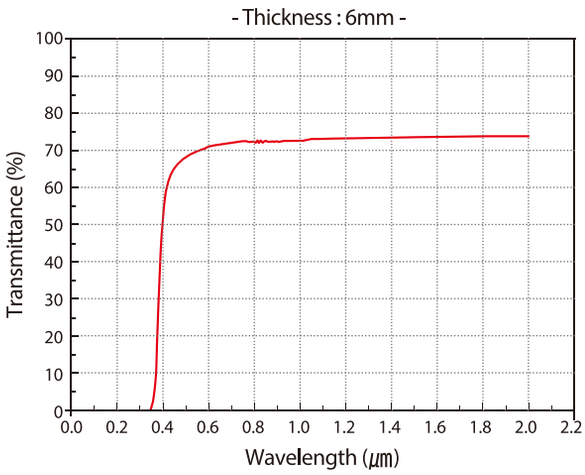


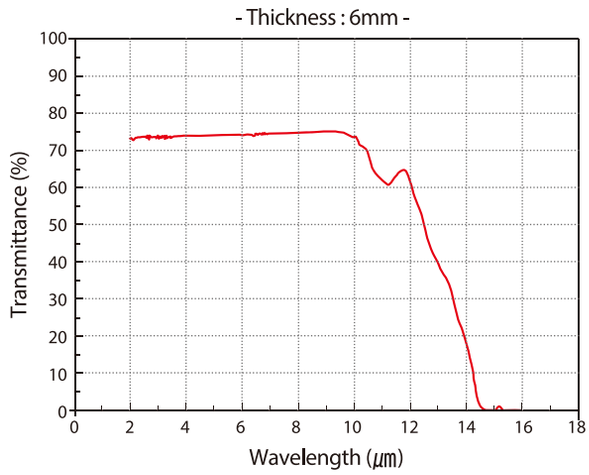
Multispectral ZnS (ZnS – MS)

Multispectral ZnS is rare infrared optical material, transmitting from visible to over long wavelength Infrared. This material is modified by HIP method from as–grown ZnS by CVD. It has low absorption and scatter throughout its broad transmitting range and high optical quality. It is useful for multi–spectral applications that requires a single window for light transmission of several wavebands.

Material Properties

Optical Properties	Refractive Index @ 632.8nm		2.351
	Index of Refraction Inhomogeneity @ 632.8nm	ppm	〈 20
	Forward Scatter @ 632.8nm	cm^{-1}	〈 6%
Physical Properties	Crystal Structure		Cubic
	Grain Size	㎛	〈 100
	Density	g/cm^3	4.09
	Chemical Purity	%	≥ 99.9996
	Inclusions	mm	None 〉 0.2
Thermal Properties	Coefficient of Thermal Expansion @ 293K	K^{-1}	6.4×10^{-6}
	Thermal Conductivity @ 298K	W/mK	30.7
	Heat capacity	J/gK	0.516
Mechanical Properties	Knoop Hardness	kg/mm^2	141 – 162
	Flecural Strength (3 pt.)	MPa	60
	Fracture Toughness	$MPam^{1/2}$	1.7
	Young's Modulus	GPa	84
	Poisson's Ratio		0.33





Refractive Indices @ 23℃

Wavelength (㎛)	n
0.405	2.545512
0.436	2.489456
0.468	2.449356
0.480	2.437103
0.509	2.412972
0.546	2.388558
0.588	2.368060
0.644	2.347455
0.668	2.340468
0.707	2.330851
0.780	2.316785
1.014	2.291723
1.129	2.284937
1.530	2.272124
2.325	2.262938

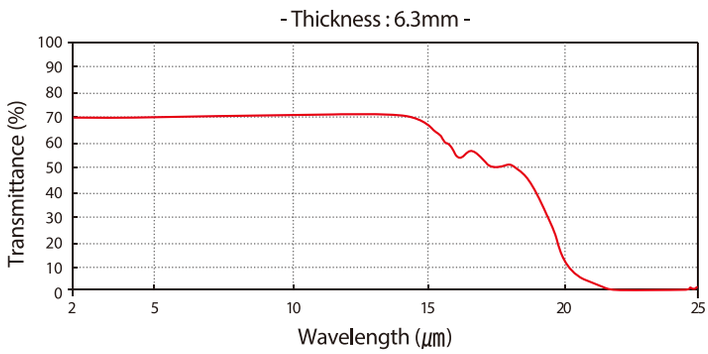
Wavelength (㎛)	n
3	2.257563
4	2.252173
5	2.246469
6	2.239561
7	2.232233
8	2.223282
9	2.212822
10	2.200797
11	2.186945
12	2.170993

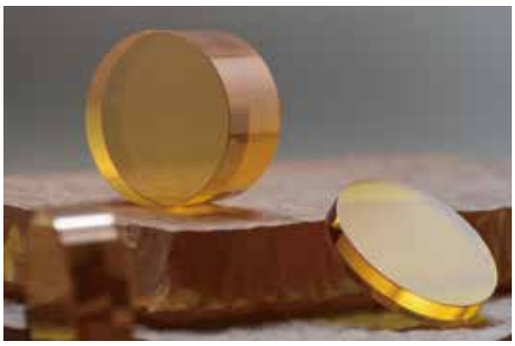
Available Maximum Size

- CVD-ZnS: Ø800 x 25mmT
- ZnS-MS: Ø350 x 25mmT
- Dome and special shape: Consult us

Zinc Selenide (ZnSe)

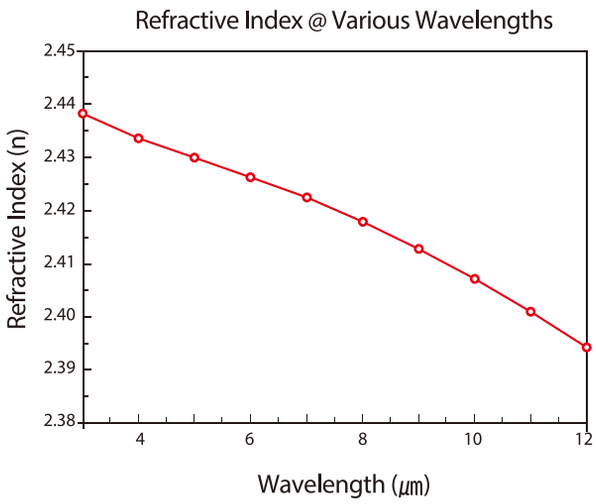
Chemical Vapor–Deposited ZnSe has very low bulk absorption at 10.6 μm.
It is suitable for high–power CO2 lasers and high–resolution infrared optical components.

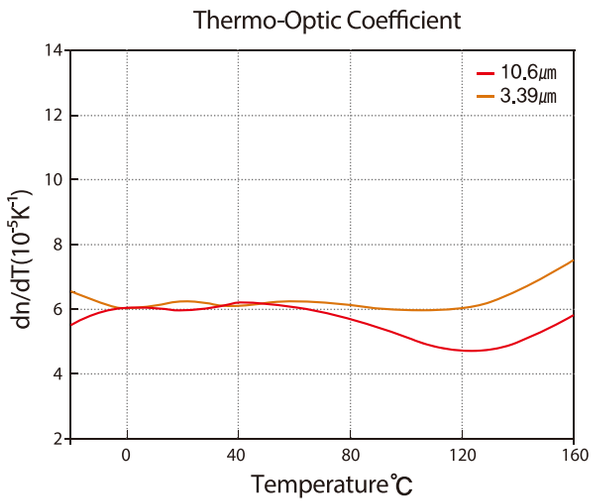




Material Properties

Optical Properties	Refractive Index @ 10.6㎛		2.034
	Refractive Index Inhomogeneity @ 10.6㎛	ppm	〈 3
	Bulk Absorption Coefficient @ 10.6㎛	cm^{-1}	〈 0.0005
Physical Properties	Crystal Structure		Cubic
	Grain Size	㎛	〈 100
	Density	g/cm^3	5.27
	Chemical Purity	%	〉 99.999
	Inclusions	㎜	None 〉 0.05
	Resistivity	Ω cm	〉 10^{12}
Thermal Properties	Coefficient of Thermal Expansion @ 293K	K^{-1}	7.48×10^{-6}
	Thermal Conductivity @ 298K	W/mK	20
	Heat Specific	J/gK	0.377
Mechanical Properties	Knoop Hardness	kg/mm^2	110
	Flexural Strength (3 pt.)	MPa	54
	Fracture Toughness	$MPam^{1/2}$	1.1
	Young's Modulus	GPa	71
	Poisson's Ratio		0.32





Refractive Indices @ 23℃

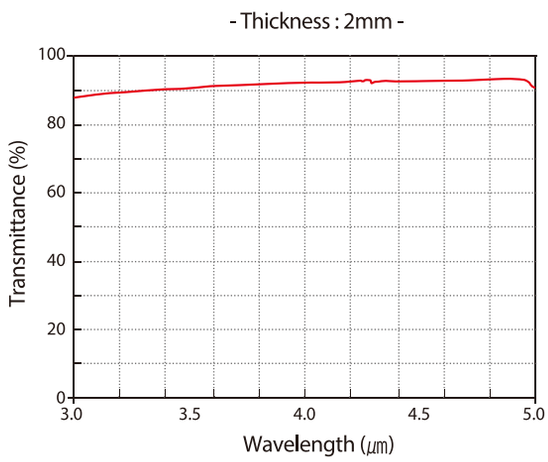
Wavelength (㎛)	n
3	2.438034
4	2.433621
5	2.429995
6	2.426309
7	2.422390
8	2.417920
9	2.412854
9.4	2.410666
10	2.407196
10.6	2.403427
11	2.400807
12	2.393692

Available Maximum Size

- Ø800 x 17mmT
- Dome and special shape: Consult us

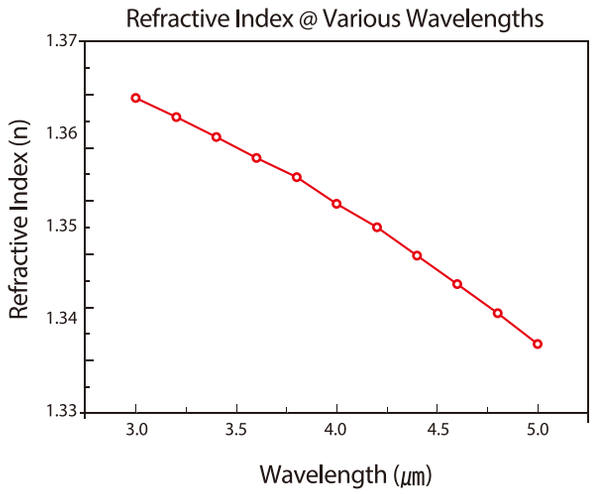
HP-MgF_2

Polycrystalline MgF2 is sintered by a hot press process. It has high hardness and strength.
But it can be used just for the thermal band, 3~5㎛.



Material Properties

Optical Properties	Refractive Index	@ 3㎛	1.364
		@ 4㎛	1.352
		@ 5㎛	1.337
	Thermo Optic Coefficient (dn/dT) @ 3.39 ㎛	K^{-1} @ 243–303K	0.5×10^{-5}
Physical Properties	Crystal Structure		Tetragonal
	Grain Size	㎛	≤ 1
	Density	g/cm^3	3.17
	Chemical Purity	%	≥ 99.9
Thermal Properties	Coefficient of Thermal Expansion	K^{-1} @ 293K	8.71×10^{-6}
		K^{-1} @ 373K	11.20×10^{-6}
		K^{-1} @ 473K	12.40×10^{-6}
		K^{-1} @ 573K	12.80×10^{-6}
Mechanical Properties	Knoop Hardness	kg/mm^2	610 – 650
	Flexural Strength (3 pt.)	MPa	129



Refractive Indices @ 23℃

Wavelength (μm)	n
3.0	1.3640317
3.2	1.3620122
3.4	1.3598521
3.6	1.3575701
3.8	1.3555227
4.0	1.3526261
4.2	1.3500772
4.4	1.3469882
4.6	1.3439660
4.8	1.3407901
5.0	1.3374819

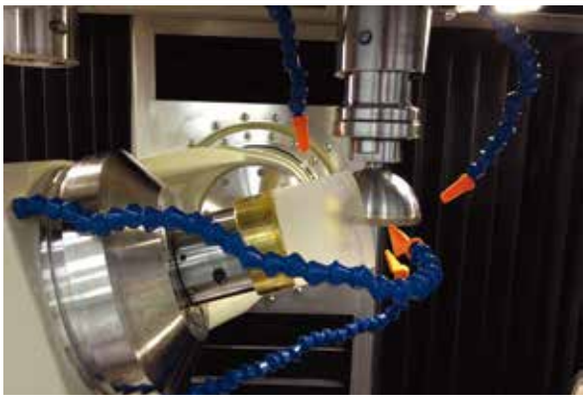
Available Maximum Size

- Ø190 x 20mT
- Dome and special shape: Consult us

Chemical Vapor Deposition

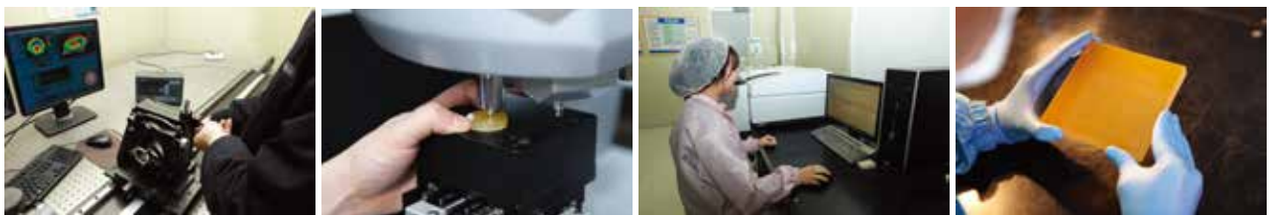
Bulk of ZnS for infrared windows is manufactured in large reactors through CVD process. Ultra high purity, Zinc Sulfide was specifically developed with high purity raw material and semiconductor grade utility to meet the world class quality.

Fabrication



Any shape of material that meets specification for different applications such as windows, prisms, dome, lens blank and etc. can be manufactured as required by customers. To purchase the material deposited to a dome shape is much more economical & more advantageous over the processing of a flat material.

Quality Assurance



Optical testing is performed in in-house optical material testing lab to assure quality of the material.
GOM is always striving to enhance its material manufacturability and it would be glad to cooperate in helping customers to choose the high quality materials effort for manufacturability.

Total optics service

Green Optics provides super polishing and a variety of coating services for the material with the world's latest equipment with high-technology.

- Super Polishing: DTM / MRF
- Coating: E-beam Vacuum Coater / Sputter Coater / Plasma Clean System, etc.

Supplier of Infrared Optical Materials

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