Infrared Materials

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VOT

VITAL OPTICS TECHNOLOGY

Infrared Materials

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COMPANY INTRODUCTION

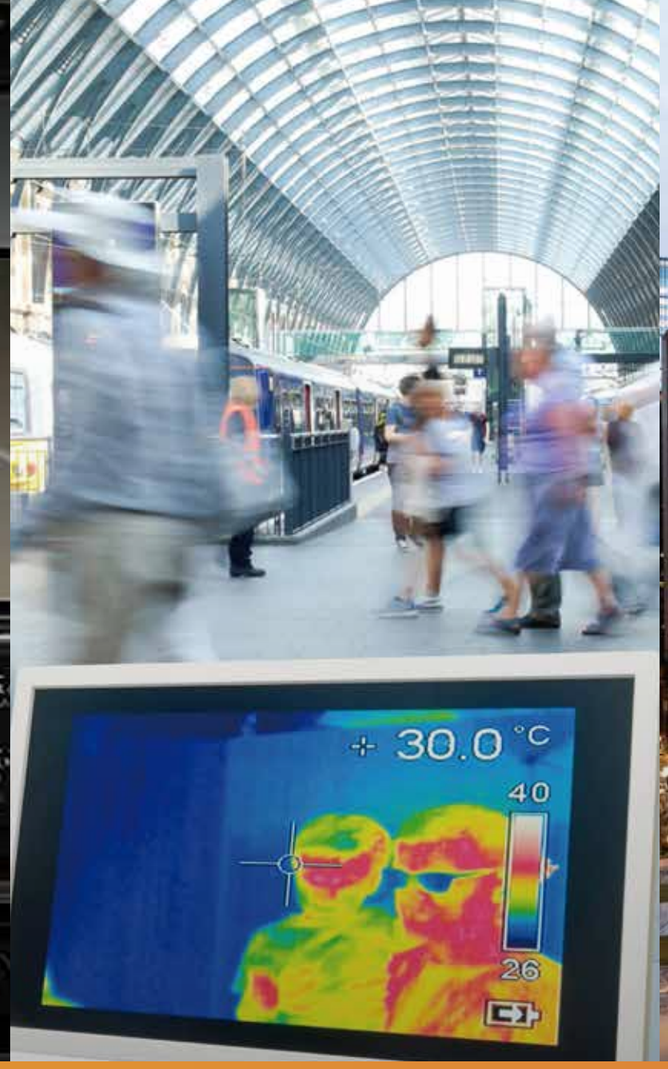
Vital Optics Technology (VOT) was formerly known as IR & Laser Business Unit of Vital Materials Group, which was established in 1995.

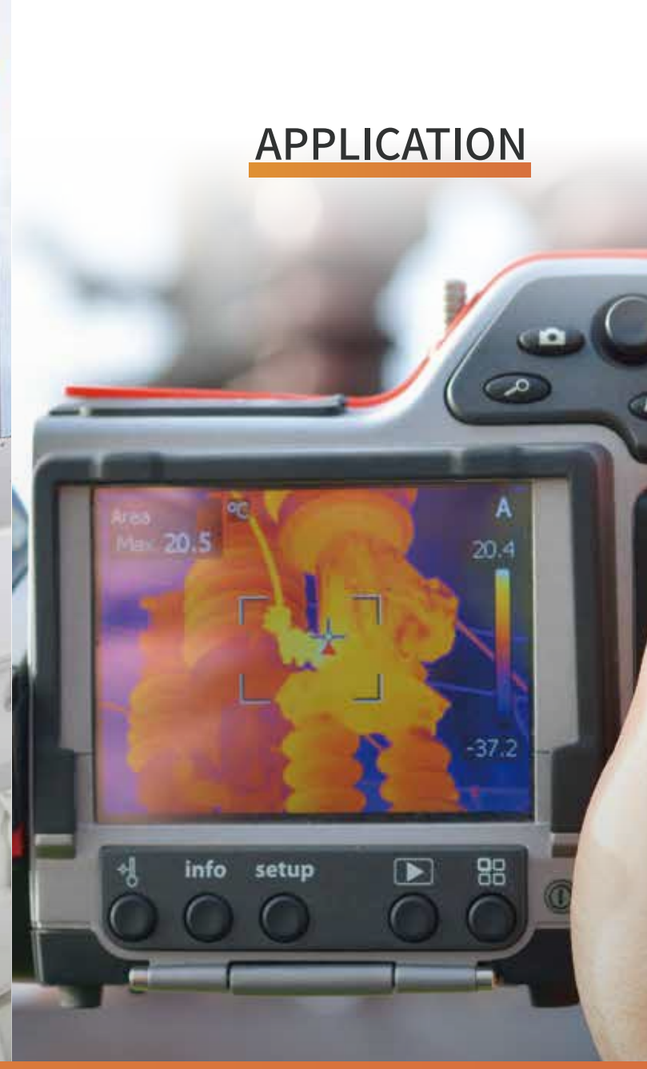
VOT focuses on R&D, production, and sales of infrared materials and radiation detection materials. By following our vertical integration strategy, VOT's product range spans from typical blanks to coated finished optics. Our personnel have over 30 years experience in crystal growth and infrared materials production.

Our products include Germanium (Ge), Zinc Selenide (ZnSe), Zinc Sulfide (ZnS), Chalcogenide Glass, Silicon (Si), Gallium Arsenide (GaAs), fluorides, as well as Ce:LYSO Crystals.

These are widely used in lenses, infrared detectors, radiation detectors, lasers, and modules. VOT is internationally known for producing some of the highest quality Infrared Materials in the world.

INDUSTRIAL CHAIN





AUTOMOTIVE

Automotive night vision systems utilize thermal imaging technology to visualize the contours of people and objects in dark or inclement weather. When road conditions cannot be reliably recognized by human eyes in fog, dust, smoke, and rainstorms situation, automotive night vision allows the driver to identify objects, slow down and brake in advance, enable them to prevent accidents.

MEDICAL

Medical thermal imaging cameras can accurately measure overall or partial temperature mapping images of human or animal bodies. Comparing the infrared thermal imaging of the diseased with normal physiological tissues, it can accurately locate the abnormal temperature caused by the diseased physiological tissues. Medical infrared cameras have a wide range of applications in medical diagnostics.

SECURITY

Thermal imaging cameras provide the ability to see through smoke, fog, rain, and dust with a visual range of up to several kilometers, making them ideal in fields such as border control, intelligent surveillance and smart city applications.

INDUSTRY

In industry, thermal imaging cameras can be used as a detecting system for operating power equipment, industrial pipelines, machinery and equipment. The workers can quickly, safely and easily find potential problems of the key equipment. The cameras help saving time and costs, avoiding fire and other accidents.

Infrared Materials

Vital Optics Technology (VOT) focuses on the R&D, production and sales of infrared materials. Our products including Germanium, ZnSe, ZnS, Chalcogenide Glass, and laser crystal. We provide services for many different materials, including optical component processing, coating and testing. Our processing services include slicing, milling, grinding, polishing, diamond turning for aspheric and diffractive surfaces, and optical coating.

Germanium (Ge)

Germanium features high refractive index, wide infrared transmission range, low absorption coefficient, low dispersion, and is easy to process. Germanium is the most commonly used material for producing IR optical lenses and IR optical windows.

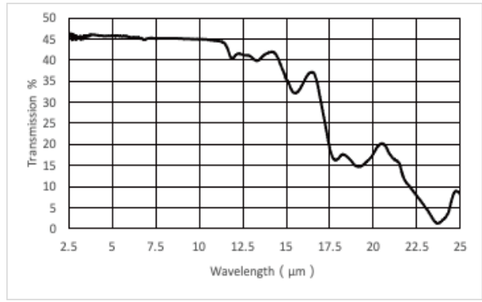
Due to its excellent infrared light transmittance and opacity in the visible spectrum, Germanium is highly suitable for fabricating optical components used in infrared lasers and thermal imaging applications. It can be used as a material for windows, lenses, prisms, and filters for thermal imagers and infrared radar, and in other infrared optical devices used in critical civilian applications.

Specification

Physical Properties	
Crystal Growth	CZ
Crystal Structure	Monocrystalline/Polycrystalline
Purity	⩾6N
Conductivity Type	n
Resistivity	5-40 Ω · cm 1-5 Ω · cm >50 Ω · cm
Surface Finish	Ra_{max} 0.2 μm to 4.0 μm (D7 to D46)

Formats/Sizes	
Circular Disks	Monocrystalline: 3 – 310mm Polycrystal: 3 - 400mm Thickness: >0.5mm
Rectangular Sheets	Length x Width: 4×4~350×350mm Thickness: >0.5mm Parallelism: <0.03mm
Lenses (Spherical/ Aspherical)	Diameter: 5-270mm ETV<0.03mm
Other Shapes	Available on request
Tolerance	Roughness: 0.2μm-4μm

Optical Properties	
Transmission Spectrum	2-14 μm
Coefficient of Refractive Index (dn/dT)	400 x 10^{-6} K
Refractive Index 10.6 μm	4.0046
Refractive Index Homogeneity	⩽1.0 + 10^{-4}
Absorption Coefficient, 10.6 μm, (/cm)	⩽ 0.035 cm^{-1}
Optical Transmittance, 10.6 μm	>46%



Wavelength, μm	Refractive Index
2	4.1097
3	4.0455
4	4.0255
5	4.0165
6	4.0117
7	4.0087
8	4.0069
9	4.0055
10	4.0046
11	4.0038
12	4.0032
13	4.0027

Zinc Selenide (ZnSe)

Zinc Selenide (ZnSe) is an optical material featuring high purity and strong environmental adaptability. ZnSe is widely used in laser and infrared thermal imaging systems. It possesses low light transmission loss and excellent transmission properties. ZnSe has a low absorption rate at 10.6 microns, making it the preferred material for high-power CO_2 laser optical components. ZnSe is also used in various focusing mirrors, window materials, output coupling, and beam expanders, and has wide applications in optoelectronics.

ZnSe features excellent refractive index uniformity and consistency, making it an ideal material for protecting windows and optical components in thermal imaging systems, and can be used in window materials and high-resolution forward-looking infrared (FLIR) thermal imagers.

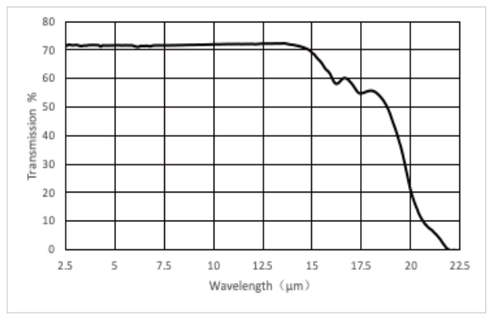
Due to its excellent optical properties, it has become a commonly used material for various optical systems. It is widely used in fields such as lasers, medicine, astronomy, and infrared night vision.

Leveraging its world-class technology and years of manufacturing experience, Vital Optics supplies high quality ZnSe blanks and optical lenses to many well-known international companies.

Specification

Physical Properties	
Crystal Growth	CVD
Crystal Structure	Polycrystalline
Particle Size	⩽100μm
Purity	5N
Grade	Optical, laser, low power

Optical Properties	
Transmission Spectrum	0.5-22 μm
Max Transmittance, 10.6 μm	≥70%
Absorption Coefficient, 10.6 μm	≤0.0005cm $^{-1}$
Refractive Index Homogeneity, 10.6 μm	3x10^{-3}
Refractive Index, 10 μm	2.4070
Coefficient of Refractive Index (dn/dT)	6.1x10^{-5}/K $^{-1}$



Formats/Sizes	
Circular Disks	Diameter: 4 -350mm Thickness: 0.5-40mm Cylinders can be polished
Rectangular Sheets	Length x Width: 350x350mm Thickness: 0.5-40mm
Lenses (Spherical /Aspherical)	Diameter: 5-250mm
Other Shapes	Available on request
Tolerance	Roughness: ⩽1μm Roundness: ⩽0.03mm

Wavelength, μm	Refractive Index
2	2.4467
3	2.4380
4	2.4336
5	2.4300
6	2.4263
7	2.4223
8	2.4178
9	2.4127
10	2.4070
11	2.4006
12	2.3935
13	2.3857
14	2.3768

Zinc Sulfide (ZnS)

Zinc Sulfide (ZnS) can be classified into infrared ZnS and multispectral zinc sulfide. Zinc Sulfide is grown by the chemical vapor deposition (CVD) process. Multispectral ZnS is obtained from infrared ZnS through a hot isostatic pressing treatment. Multispectral grade ZnS features high purity, is insoluble in water, has moderate density and is easy to process, and is widely applied in the manufacture of IR windows and IR optical components.

Furthermore, due to its low absorption, wide transmission range, and excellent visible and infrared band transmittance features, multispectral ZnS is ideal for sensor systems including visible, infrared, near-infrared, short-wave infrared, mid-wave infrared, and long-wave infrared.

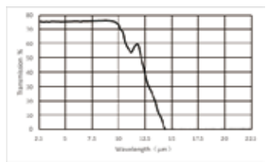
ZnS also has a high transmittance in the mid-infrared band. Compared with ZnSe, multispectral ZnS features high hardness, high fracture strength, and high resistance to harsh environments, making it highly suitable for external infrared window materials in aerospace environments.

Specification

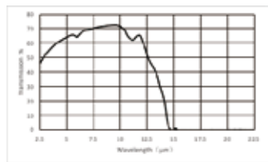
Physical Properties		
Crystal Growth	CVD	
Grade	CVD ZnS, cleartran ZnS	
Purity	5N	
Optical Properties	**ZnS**	**MS ZnS**
Transmission Spectrum	0.45-14 μm	0.38-14 μm
Max Transmittance, 10.6 μm	70%	71%
Absorption Coefficient, 10.6 μm	⩽0.24 cm $^{-1}$	⩽0.20 cm $^{-1}$
Coefficient of Refractive Index (dn/dT)	41 x 10 $^{-6}$/°C	38 x 10 $^{-6}$/°C
Refractive Index Homogeneity,0.6328μm	< 100 x 10 $^{-6}$	< 20 x 10 $^{-6}$

Formats/Sizes	
Circular Disks	Diameter: 4-300mm Roughness: ⩽1μm Roundness: ⩽0.03mm Cylinders can be polished
Rectangular Sheets	Length x Width: 250x250 mm Roughness: ⩽1μm
Lenses (Spherical/Aspherical)	Diameter: 10-250mm Roughness: ⩽1μm Roundness: ⩽0.03mm

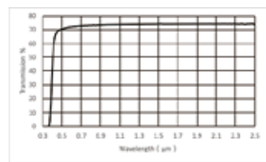
Wavelength, μm	ZnS	MS ZnS
1	2.2921	2.2926
2	2.2655	2.2662
3	2.2578	2.2577
4	2.2521	2.2523
5	2.2467	2.2466
6	2.2395	2.2391
7	2.2321	2.2328
8	2.2234	2.2233
9	2.2121	2.2129
10	2.2005	2.2008
11	2.1867	2.1892
12	2.1765	2.1710
13	2.1523	2.1525
14	2.1305	2.1301
15	2.1065	2.1068
16	2.0789	2.0782



Infrared transmittance, MS ZnS



Infrared transmittance, ZnS



Visible Transmittance, MS ZnS

Chalcogenide Glass

Chalcogenide glass features superior refractive index uniformity and stability, making it an ideal optical material for chromatic aberration correction of infrared optical lenses and avoidance of thermal defocus in the range of 2-12 μm. At the same time, due to its amorphous nature, low glass transition temperatures and stable chemical properties, chalcogenide glass can be used to effectively and efficiently manufacture optics for mass production by precision glass molding. Chalcogenide glass is mainly used in monitoring equipment and systems as well as marine/maritime, fire/police, sensors and infrared products.

Vital Optics produces high quality chalcogenide glass from its own refined materials, ensuring the high levels of quality control. VOT chalcogenide glasses feature high purity, high uniformity in various compositions and sizes, including Ge-As-Se, Ge-Sb-Se, and As-Se products. Chalcogenide glass can be processed using a variety of means to produce flat, spherical, and aspherical products through molding, machining, and polishing

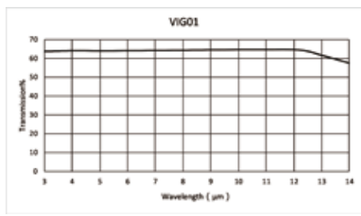
Specification

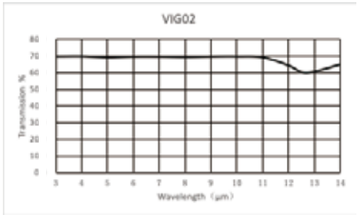
Formats/Sizes	
Circular Disks	Diameter: 5-100mm Roughness: Rq<0.2μm ETV<0.03mm
Lenses (Spherical/Aspherical)	Diameter: 5-100mm Roughness: Ra<0.5μm Parallelism: <0.03mm

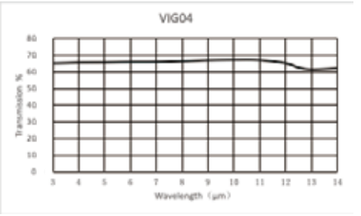
Properties	VIG 01 $Se_{63}As_{30}Sb_4Sn_3$	VIG 02 $Ge_{33}As_{12}Se_{55}$	VIG 04 $Ge_{10}As_{40}Se_{50}$	VIG 05 $Ge_{28}Sb_{12}Se_{60}$	VIG 06 $As_{40}Se_{60}$	VIG 07 $Ge_{20}Sb_{15}Se_{65}$	VIG 08 $Ge_{22}As_{20}Se_{58}$	VIG 09
Coefficient of Refractive Index (dn/dT), $X10^{-6}K^{-1}$	18.6	67	20	60.5	30.9	37	58.2	166

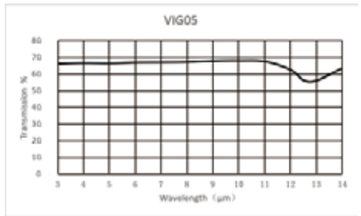
Refractive Index λ/μm	VIG 01 $Se_{63}As_{30}Sb_4Sn_3$	VIG 02 $Ge_{33}As_{12}Se_{55}$	VIG 04 $Ge_{10}As_{40}Se_{50}$	VIG 05 $Ge_{28}Sb_{12}Se_{60}$	VIG 06 $As_{40}Se_{60}$	VIG 07 $Ge_{20}Sb_{15}Se_{65}$	VIG 08 $Ge_{22}As_{20}Se_{58}$	VIG 09
2	2.8086	2.5299	2.6413	2.6412	2.8193	2.6256	2.5268	3.2184
3	2.7923	2.5179	2.6272	2.6264	2.8011	2.6107	2.5150	3.1903
4	2.7851	2.5130	2.6218	2.6206	2.7943	2.6040	2.5103	3.1755
5	2.7802	2.5103	2.6189	2.6171	2.7905	2.6010	2.5074	3.1684
6	2.7781	2.5075	2.6167	2.6142	2.7878	2.5976	2.5050	3.1643
7	2.7747	2.5051	2.6145	2.6113	2.7853	2.5945	2.5026	3.1612
8	2.7731	2.5024	2.6126	2.6084	2.7831	2.5914	2.5002	3.1586
9	2.7713	2.4993	2.6106	2.6054	2.7805	2.5885	2.4976	3.1564
10	2.7678	2.4962	2.6084	2.6019	2.7779	2.5851	2.4946	3.1542
11	2.7639	2.4924	2.6059	2.5982	2.7750	2.5813	2.4914	3.1519
12	2.7621	2.4885	2.6034	2.5944	2.7717	2.5765	2.4877	3.1497

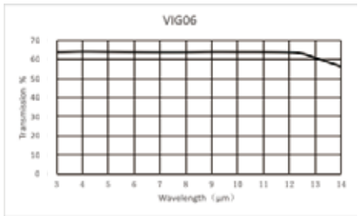
Transmittance %	VIG 01 $Se_{63}As_{30}Sb_4Sn_3$	VIG 02 $Ge_{33}As_{12}Se_{55}$	VIG 04 $Ge_{10}As_{40}Se_{50}$	VIG 05 $Ge_{28}Sb_{12}Se_{60}$	VIG 06 $As_{40}Se_{60}$	VIG 07 $Ge_{20}Sb_{15}Se_{65}$	VIG 08 $Ge_{22}As_{20}Se_{58}$	VIG 09
2.5	64.08	70.05	65.42	66.34	64.63	68.54	67.19	56.58
3	63.78	69.61	65.14	65.92	64.09	68.03	66.76	56.93
4	64.11	69.62	65.48	66.32	64.30	67.99	66.93	57.47
5	64.05	69.03	65.57	66.16	64.20	67.75	67.07	57.44
6	64.11	69.45	65.82	66.68	64.07	67.73	67.44	57.61
7	64.24	69.45	65.89	66.79	64.00	67.73	67.44	57.78
8	64.36	69.22	66.35	66.98	64.02	67.41	67.93	57.89
9	64.55	69.51	66.92	67.72	64.18	67.80	68.67	58.35
10	64.64	69.56	67.14	67.90	64.15	67.82	68.91	58.43
11	64.69	68.96	66.97	67.35	64.12	67.06	68.52	58.57
12	64.66	64.04	65.10	62.22	63.90	61.15	64.38	58.32
12.5	63.82	60.03	62.46	55.92	63.18	53.69	59.81	56.58
13	61.73	60.47	61.38	55.83	60.95	54.36	60.26	54.53
14	57.60	64.86	62.05	63.40	56.32	63.89	64.32	57.28
8-12	64.58	68.26	66.50	66.43	64.07	66.25	67.68	58.31

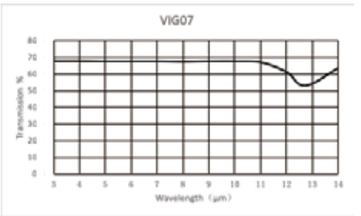


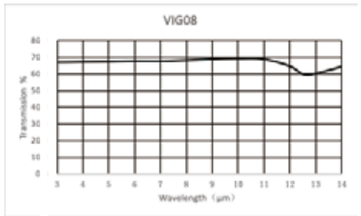


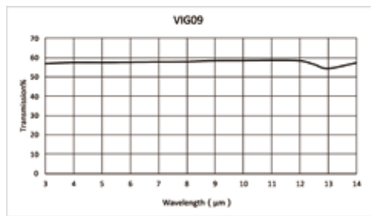








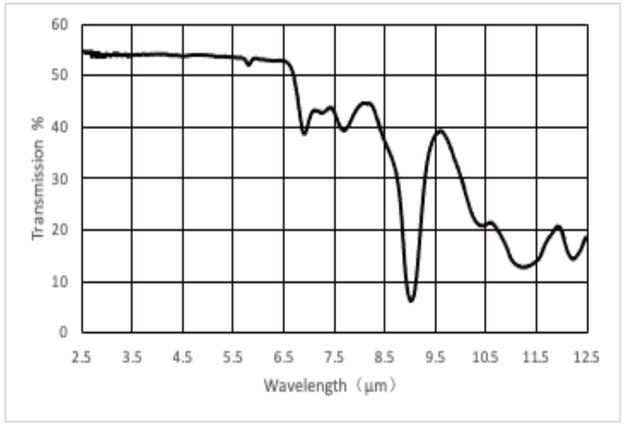




Silicon (Si)

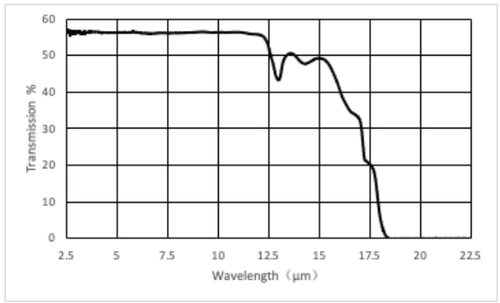
Silicon is commonly used as an IR reflector and window material in the 1.5–8-micron range. Vital Optics' silicon products include silicon wafers, blanks, and lenses. Silicon is one of the most widely used infrared materials and is commonly used in infrared windows for optoelectronic components due to its durability, high thermal conductivity, and low density. Vital Optic's is positioned to offer both FZ and CZ Grades of silicon based on your particular requirements.

Wavelength, µm	Refractive Index
2	3.4516
3	3.4321
4	3.4257
5	3.4223
6	3.4202
7	3.4189
8	3.4184
9	3.4181
10	3.4179
11	3.4176



Gallium Arsenide (GaAs)

High purity GaAs single crystals produced by the vertical gradient freeze (VGF) growth method can reach ⩾55% transmittance in the 2-12 µm infrared band. In case of relatively thick products (⩾3 mm), the transmittance rate gradually decreases with increasing thickness, and is generally around 51%-55%. GaAs can be used in practical applications where the strength and stiffness of the IR material are critical factors, and can also be used in CO_2 laser applications as an alternative to ZnSe optical lenses or mirrors.



Processing Capabilities

Conventional Processing

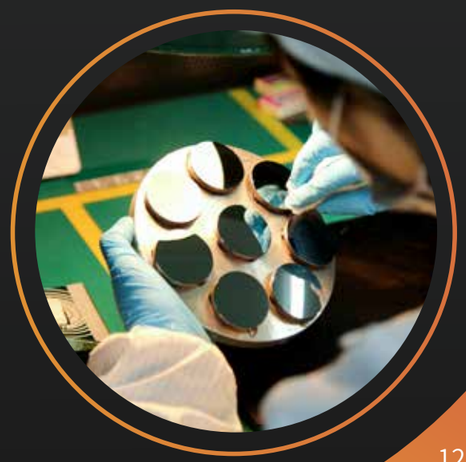
Vital Optics can process a variety of high-precision laser and infrared windows, lenses, and rectifiers. from conventional grind and polish technology. Materials include germanium, silicon, ZnS, ZnSe, GaAs, chalcogenide glass, magnesium fluoride, and other optical materials. The maximum processing aperture exceeds 300 mm, with high precision and excellent surface quality.

Diamond Turning

Our ultra-precision single-point diamond turning lathe equipment can be used to process high precision and high finish optical components such as aspherical, diffractive, and free-form surfaces of various infrared materials and non-ferrous metals such as germanium, ZnSe, and chalcogenide glass. The maximum processing diameter is up to 700 mm with a surface roughness of Ra<1 nm and a shape error of P-V<0.1 µm.

Optical Coating

Vital Optics' workshops use advanced optical coating equipment and various coating technologies such as thermal evaporation (resistance heating and electron gun) coating, plasma-assisted chemical vapor deposition coating, and sputtering coating, to provide customers with products that can satisfy various coating requirements, including diamond-like carbon film, infrared enhancement film, and laser damage resistance film.



Metrology Capabilities

Our Optics Workshop is equipped with dozens of precision processing machines including high precision CNC lathes, three-axis and four-axis milling centers, high efficiency wire cut EDM machines and much more. Our workshop also includes dedicated metrology including three-dimensional coordinate measuring machines and other testing equipment.

The infrared lens assembly workshop has a 4,300 sq. ft. ultra-clean assembly room and is equipped with all the necessary of optical assembly, alignment, and testing equipment to make world-class infrared optical assemblies. The workshop is equipped with internationally advanced testing equipment, including ZYGO interferometers, spherometers, surface profilers, including autocollimators, dual optical path centration measurement instruments, internal focusing telescopes, MTF and MRTD testers. We also have a laboratory dedicated to conducting complete environmental testing.
All of our infrared lens products undergo comprehensive testing to ensure they meet all customer requirements. Through our in-depth testing, we ensure superior product quality and services.

We are ISO9001:2015 certified and have an established, highly sophisticated quality management system.