

# Infrared

# CAPABILITIES



- 650+ Stock Components Available for Immediate Delivery
- Design Expertise in SWIR, Mid-Wave, and Long-Wave Assemblies
- Flat, Spherical, and Aspherical Manufacturing Expertise

Edmund Optics® is leading the way in providing standard infrared optical components to OEMs and researchers alike. With over 650 off-the-shelf lenses, mirrors, windows, filters, polarizers, beamsplitters, and prisms specifically designed for applications in the Mid-Wave (MWIR) and Long-Wave (LWIR) infrared spectra, our components have been designed into countless Defense, Manufacturing, Machine Vision, and Semiconductor applications. With a global manufacturing footprint, Edmund Optics® is able to provide state-of-the-art standard and custom infrared components at a competitive price to meet the most challenging requirements. EO's capabilities include windows, prisms, spherical lenses, aspherical lenses, off-axis parabolic mirrors, and laser and imaging subassemblies and assemblies.




<b>Infrared Materials:</b>	Fluorides (CaF <sub>2</sub> , BaF <sub>2</sub> , MgF <sub>2</sub> , LiF) Zinc Selenide (ZnSe) and Zinc Sulfide (ZnS) Silicon (Si) and Germanium (Ge) Chalcogenide Materials Other Materials Upon Request
<b>Processing Techniques:</b>	Conventional Polishing, Diamond Turning, Magneto-Rheological Finishing (MRF)
<b>Coating:</b>	Reflective, Anti-Reflective, Beamsplitting, Filter, etc. from 190 nm to 22 μm
<b>Optic Types:</b>	Flats (Windows, Mirrors, Prisms, Beamsplitters) Spherical (PCX, DCX, PCV, DCV, Meniscus) Aspherical (Parabolic, Hyperbolic, Hybrid, etc.) Assemblies (Doublets, Beam Expanders, Objectives, etc)

# WINDOWS

- Wide Range of Substrates Available
- Designed for NIR, SWIR, MWIR, and LWIR Applications
- Multiple Anti-Reflection Coating Options

IR Windows are designed using a variety of substrates to achieve optimal performance across broad ranges of the infrared spectrum, and are ideal for applications including FTIR spectroscopy, thermal imaging, FLIR, and medical systems. Because windows do not introduce optical magnification into systems, IR windows should be chosen based on the compatibility between the application's needs and the substrate's mechanical and optical properties. Characteristics such as the window's performance in the required portion of the infrared and the substrate's durability should be considered.



Photo	Material	Index of Refraction ( $n_d$ )	Density ( $\text{g}/\text{cm}^3$ )	Coefficient of Thermal Expansion ( $\mu\text{m}/\text{m}^\circ\text{C}$ )	Softening Temp. ( $^\circ\text{C}$ )	Size Range	Thickness Range	Coating Options
	Calcium Fluoride (CaF <sub>2</sub> )	1,434	3,18	18,85	800	5 - 50 mm	1,0 - 3,0 mm	Uncoated
	Germanium (Ge)	4,003	5,33	6,1	936	10 - 75 mm	1,0 - 5,0 mm	Uncoated, 3 - 12 $\mu\text{m}$ , 8 - 12 $\mu\text{m}$
	Magnesium Fluoride (MgF <sub>2</sub> )	1,413	3,18	13,7	1.255	5 - 50 mm	1,0 - 3,0 mm	Uncoated
	Potassium Bromide (KBr)	1,527	2,75	43	730	13 - 50 mm	1,0 - 5,0 mm	Uncoated
	Sapphire (Al <sub>2</sub> O <sub>3</sub> )	1,768	3,97	5,3	2.000	2,5 - 75 mm	0,5 - 3,2 mm	Uncoated
	Silicon (Si)	3,422	2,33	2,55	1.500	10 - 50 mm	1,0 - 3,0 mm	Uncoated, 3 - 5 $\mu\text{m}$
	Sodium Chloride (NaCl)	1,491	2,17	44	801	13 - 50 mm	1,0 - 5,0 mm	Uncoated
	Zinc Selenide (ZnSe)	2,403	5,27	7,1	250	10 - 75 mm	1,0 - 6,0 mm	Uncoated, 3 - 12 $\mu\text{m}$ , 8 - 12 $\mu\text{m}$
	Zinc Sulfide (ZnS)	2,631	5,27	7,6	1.525	12,5 - 50 mm	2,0 - 3,0 mm	Uncoated, 3 - 12 $\mu\text{m}$

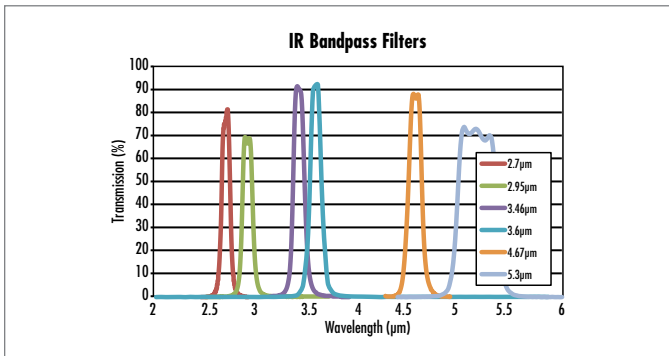
# FILTERS AND BEAMSPLITTERS

- Designed to Selectively Transmit Infrared Wavelengths
- Multiple Substrates and Filter Types Available
- Ideal for a Variety of Infrared Applications

## IR BANDPASS FILTERS



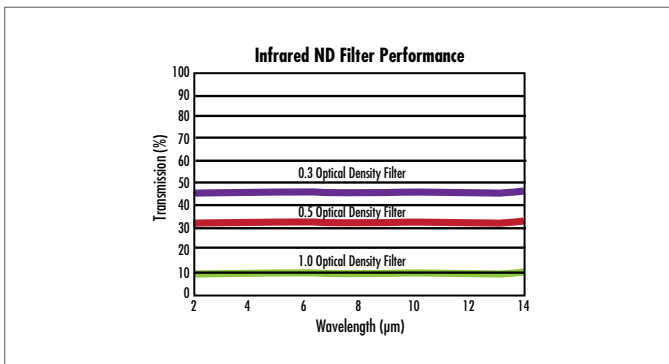
- Ideal for Gas Analysis
- Center Wavelengths of 2,7 - 5,3  $\mu\text{m}$
- Single Substrate Interference Filter



## IR ND FILTERS



- Spectrally Flat from 2  $\mu\text{m}$  to 14  $\mu\text{m}$
- Precision Germanium Substrate
- Multiple OD Options Available

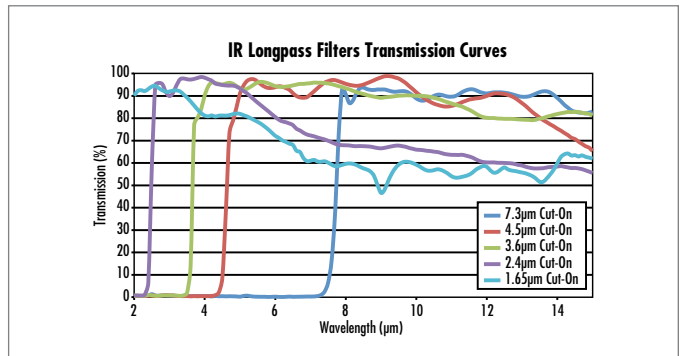


A variety of filter types that have been optimized for performance in the infrared spectrum are available. Longpass filters are designed to provide a sharp cut-off below a particular wavelength, bandpass filters are used to isolate narrow spectral regions, and IR neutral density filters can be used to control throughput and saturation in thermal imaging applications. For broadband infrared applications, beamsplitters are also available that provide a 50 % reflection / 50 % transmission ratio.

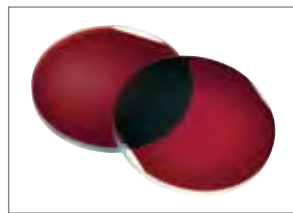
## IR LONGPASS FILTERS



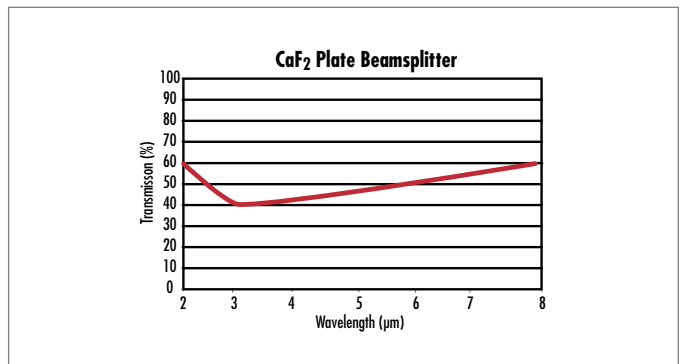
- Ideal for Isolating Broad Spectral Regions
- Durable, First-Surface Coatings
- Ideal for FTIR Spectroscopy



## IR BEAMSPLITTERS



- Broadband 50 % Reflection / 50 % Transmission
- $\text{CaF}_2$  Option for 2 - 8  $\mu\text{m}$  Range
- ZnSe Option for 7 - 14  $\mu\text{m}$  Range



# LENSES

## TECHSPEC® GERMANIUM PLANO-CONVEX (PCX) LENSES



- Wavelength Range of 2 - 16  $\mu\text{m}$
- Rugged, Durable Material
- Ideal for Defense, Security, and Thermal Imaging Applications

**Diameters Available:** 25, 50 mm  
**Focal Length Range:** 25 - 250 mm

## TECHSPEC® SILICON PLANO-CONVEX (PCX) LENSES



- Wavelength Range of 1,2 - 7  $\mu\text{m}$
- Low Density and Dispersion
- Focal Lengths of 25 - 250 mm Available

**Diameters Available:** 25 mm  
**Focal Length Range:** 25 - 250 mm

## CALCIUM FLUORIDE (CaF<sub>2</sub>) LENSES



- Greater Than 90 % Transmission From 350 nm - 7  $\mu\text{m}$
- Low Index of Refraction

**Diameters Available:** 12,7; 25,4; 50,8 mm  
**Focal Length Range:** 25 - 1.000 mm

## ZINC SELENIDE (ZnSe) LENSES



- Usable Transmission Range is 600 nm - 16  $\mu\text{m}$
- Low Dispersion

**Diameters Available:** 12,7; 25,4; 50,8 mm  
**Focal Length Range:** 25,4 - 500 mm

## FEATURED PRODUCT

### TECHSPEC® INFRARED ACHROMATIC LENSES



- Color-Corrected for 3 - 5  $\mu\text{m}$  or 8 - 12  $\mu\text{m}$
- Near Diffraction-Limited Focusing
- Full Prescription Data Available

Our TECHSPEC® Infrared Achromatic Lenses are ideal components for designers and researchers working in the 3 - 5  $\mu\text{m}$  or 8 - 12  $\mu\text{m}$  spectral regions. Designed to provide near diffraction-limited performance over their full spectral range, our lenses are ideal for applications in FTIR Spectroscopy, Thermal Imaging, and for use with tunable QCL and other infrared lasers. The lenses provide significantly improved performance vs. comparable singlets, allowing designers in industrial, medical, scientific, and military applications to use the full dynamic range and quantum efficiency of their infrared sensors.

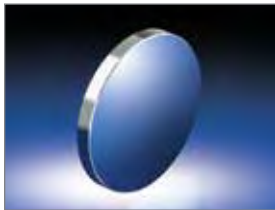
Infrared Achromatic Lenses	Diameter	Focal Lengths	Coating
MWIR Achromatic Lenses	30 mm	40, 50, 60, 75 mm	3 - 5 $\mu\text{m}$ AR
LWIR Achromatic Lenses	30 mm	40, 50, 60, 75 mm	8 - 12 $\mu\text{m}$ AR

# ASPHERES

- Near Diffraction Limited Focusing Performance
- Full Prescription Data Available
- Multiple Substrates and Anti-Reflection Coating Options Available

Aspheric lenses are ideal for a variety of infrared applications, including for integration into FTIR spectrometers or IR imaging systems. IR aspheric lenses utilize a variety of substrates, coating options, and single element designs to eliminate spherical aberration and achieve optimal performance across designated infrared wavelength ranges, while minimizing the number of lenses needed in multi-lens optical assemblies. The reduction in total element count helps simplify the assembly process and decrease total system size and weight. Hybrid aspheric lenses featuring combined refractive/diffractive designs are also available for applications requiring increased performance and reduced spot size.

## TECHSPEC® GERMANIUM IR ASPHERIC LENSES



- Diffraction Limited Performance
- Variety of Coating Options
- Full Prescription Data Available

Our TECHSPEC® Germanium IR Aspheric Lenses provide diffraction limited focusing performance over a broad spectral range in the Mid and Long Wave infrared regions. Ideal for monochromatic light sources, such as quantum cascade lasers, these lenses offer a high performance alternative to standard plano-convex lenses.

<b>Diameters Available:</b>	25 mm
<b>Focal Length Range:</b>	12.5 - 1.000 mm
<b>Coating:</b>	3 - 5 μm AR

## ZINC SELENIDE INFRARED ASPHERIC LENSES



- ZnSe Substrate
- Diffraction Limited Design
- Ideal for Focusing CO<sub>2</sub> Lasers
- Full Prescription Data Available

## MID AND LONG WAVE INFRARED ASPHERIC LENSES



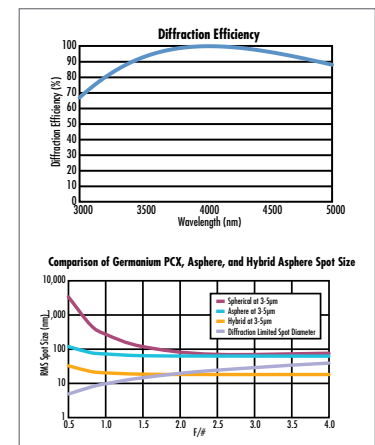
- Wavelength Range of 1 - 14 μm
- Mounted and Unmounted Solutions
- Black Diamond™ BD-2 Substrate
- Full Prescription Data Available

## FEATURED PRODUCT

### TECHSPEC® GERMANIUM HYBRID ASPHERES

- Color Corrected for 3 - 5 μm
- Near Diffraction Limited Focusing Performance
- Full Prescription Data Available

Our TECHSPEC® Germanium IR Hybrid Aspheric Lenses provide diffraction limited focusing performance at any wavelength in the 3 - 5 μm region, and near diffraction limited performance when used over the entire 3 - 5 μm spectral range. They are ideal for integration into imaging applications, FTIR spectrometers, or any Mid-Wave IR application utilizing a broad band light source. See curve for focusing performance comparison between typical Germanium PCX lenses, aspheres, and our TECHSPEC® hybrid aspheres for various f/# ratios.



# MIRRORS

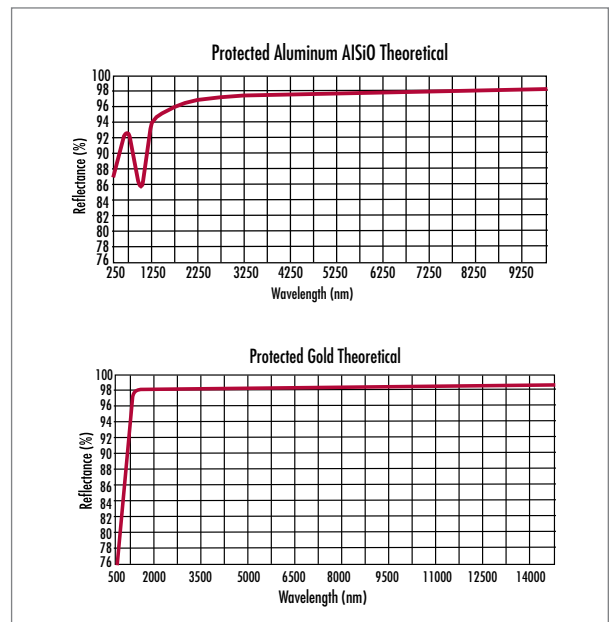


## OFF-AXIS PARABOLIC METAL MIRRORS

- Aluminum Substrate Mirrors
- Available in 15°, 30°, 45°, 60°, or 90° Off-Axis Options
- Protected Aluminum, Protected Gold, and Bare Gold Coating Options

Unlike standard parabolic mirrors, Off-Axis Parabolic Metal Mirrors direct and focus incident collimated light at a specific angle, allowing unrestricted access to the focal point. Typically, these mirrors are used as collimators in Schlieren and MTF systems, but gold coated Off-Axis Parabolic mirrors can also be used in FLIR test systems. Note: Due to the 175 Å surface roughness, these mirrors are not suitable for visible and UV applications that require low scatter.

Description	Diameter	Focal Length Options
15° Off-Axis	25,4	381,0; 635,0
	50,8	304,0; 508,0
	101,6	381,0; 508,0
30° Off-Axis	25,4	25,4; 50,8
	50,8	50,8; 101,6
	76,2	152,4; 254,0; 304,8
45° Off-Axis	101,6	304,8
	25,4	101,6; 127,0
	50,8	50,8; 76,2
60° Off-Axis	76,2	76,2; 152,4
	25,4	25,4; 38,1; 50,8
90° Off-Axis	50,8	50,8; 76,2; 101,6
	76,2	12,7; 25,4; 38,1; 50,8; 76,2; 101,6
	101,6	25,4; 38,1; 50,8; 76,2; 88,9; 95,3
		25,4; 38,1; 63,5; 76,2; 88,9
		76,2



# PRISMS



## TECHSPEC® IR RIGHT ANGLE PRISMS

- CaF<sub>2</sub>, Ge, and ZnSe Substrates
- Ray Deviation of 90°
- Ideal for Use with Collimated Sources

Infrared (IR) Right Angle Prisms are available in three substrate options. Calcium Fluoride is a low index (1,434) material with excellent transmission from 0,19 - 7 μm, making it ideal for applications throughout the UV, Visible, and Infrared spectra. Germanium is a dense material with a high index ( $n_{10,6\mu\text{m}} = 4,0034$ ), making it ideal for applications from 3 - 12 μm where the optical path length needs to be maximized. Zinc Selenide ( $n_{10,6\mu\text{m}} = 2,4028$ ) is commonly used with CO<sub>2</sub> laser applications, and features high transmission from 1 - 16 μm.

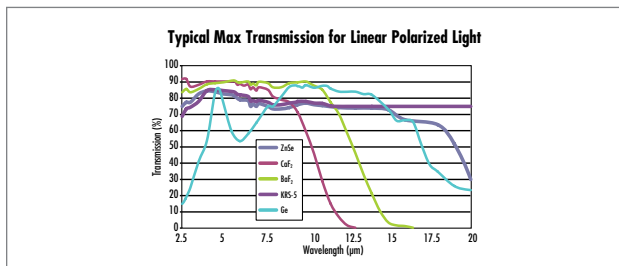
# POLARIZERS AND WAVEPLATES

## INFRARED (IR) WIRE GRID POLARIZERS



- Designed for Wavelengths Ranging from 2 - 30  $\mu\text{m}$
- Holographic Polarizers Available in Many Substrates
- Ruled Polarizers Ideal for High-Power Lasers

Infrared (IR) Wire Grid Polarizers are used to polarize light from unpolarized infrared laser sources, as well as attenuate light from polarized ones. When two wire grid polarizers are used together, high extinction ratios greater than 40,000:1 can be achieved. The polarization axis of each polarizer is marked by two white lines etched into the surface of its protective ring. We offer both ruled and holographic configurations. Note: Special care should be taken when handling KRS-5 and Zinc Selenide as they are toxic materials. Always wear rubber or plastic gloves to avoid risk of contamination.



Description	Wire Grid Spacing	Substrate Options	Sizes Available
Ruled Polarizers	1.200 grooves/mm	CaF <sub>2</sub> , ZnSe	25 mm, 50 mm
Holographic Polarizers	2.700 grooves/mm	BaF <sub>2</sub> , ZnSe, KRS-5, Ge	25 mm, 50 mm

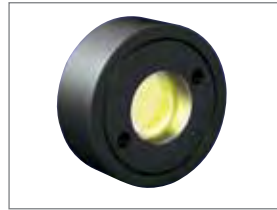
## MWIR POLARIZERS



- 1,5 - 5  $\mu\text{m}$  Wavelength Range
- Mounted for Easy Handling and System Integration
- Highly Durable Soda Lime Substrate

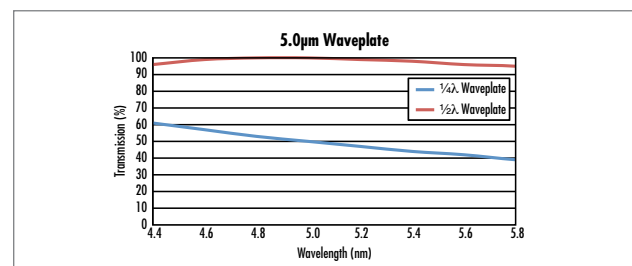
Featuring high contrast ratios and transmittances, Mid-Wave Infrared (MWIR) Polarizers are designed for applications operating in the 1,5 - 5  $\mu\text{m}$  wavelength range. Ideal for harsh environments, each MWIR polarizer is constructed of a dichroic glass substrate which provides a high resistance to UV radiation and chemicals, as well as an operating temperature of up to 120°C.

## MWIR AND LWIR WAVEPLATES



- Ideal for Applications in the 3 - 9  $\mu\text{m}$  Range
- $\frac{1}{4} \lambda$  and  $\frac{1}{2} \lambda$  Retardance
- Mounted for Easy Alignment and System Integration

Our zero order Mid-Wave Infrared (MWIR) and Long-Wave Infrared (LWIR) Waveplates are designed for applications in the 3 - 9  $\mu\text{m}$  wavelength range. When compared to multiple order waveplates, zero order waveplates provide increased bandwidth and lower sensitivity to temperature change. These waveplates are available with  $\frac{1}{4} \lambda$  or  $\frac{1}{2} \lambda$  retardance in a range of wavelengths, offer efficient retardation over broad spectral ranges, and are ideal for a variety of infrared (IR) applications. Each MWIR and LWIR waveplate is anti-reflection coated, and has been mounted to ease system integration.



Substrate	Design Wavelengths	Size
Calcium Thiogallate	3, 4, 5, 6, 7, 8, 9 $\mu\text{m}$	25,4 mm

## ULTRA BROADBAND POLARIZERS



- Reflect S-Polarized Light
- Transmit P-Polarized Light
- Excellent Performance from UV to IR

Ultra Broadband Wire Grid Polarizers consist of a thin layer of aluminum MicroWires™ layered between two Fused Silica windows. Designed for multi-wavelength applications, these polarizers have excellent heat resistance and performance beginning in the UV and extending into the infrared (IR). Note: The input beam should be oriented towards the cover glass side, indicated by a reference mark. When the reference mark is located in the upper left side of the polarizer, the transmission axis will be oriented from left to right.

For a **COMPLETE LISTING OF OUR IR OPTICS**, go to [www.edmundoptics.eu/ir](http://www.edmundoptics.eu/ir)

# INFRARED MATERIAL SELECTION GUIDE

When choosing the correct IR material, there are three simple points to consider. Though the selection process is easier because there is a much smaller practical selection of materials for use in the infrared compared to the visible, these materials also tend to be more expensive due to fabrication and material costs.

## Transmission

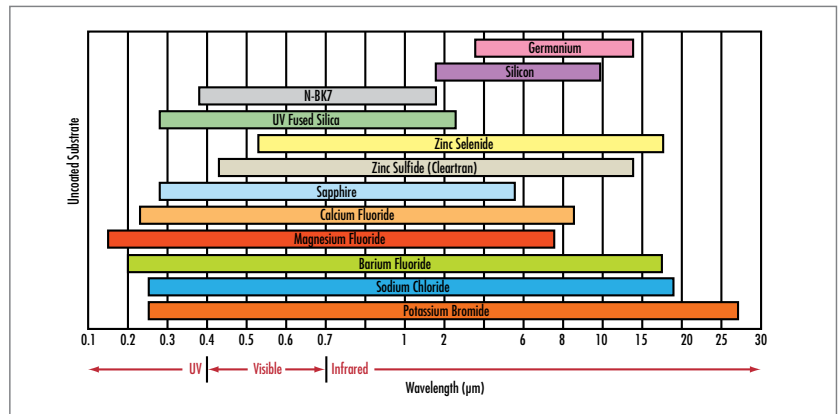
Different applications operate within different regions of the IR spectrum. Certain IR substrates perform better depending on the wavelength of interest. For example, if the system is meant to operate in the MWIR, Germanium is a better choice than Sapphire, which works well in the NIR.

## Thermal Properties

Frequently, optical materials are placed in environments where they are subjected to varying temperatures. Additionally, a common concern with IR applications is their tendency to produce a large amount of heat. A material's index gradient and coefficient of thermal expansion (CTE) should be evaluated to ensure the user is met with the desired performance. CTE is the rate at which a material expands or contracts given a change in temperature.

## Index of Refraction

IR materials vary in terms of index of refraction far more than visible materials do, allowing for more variation in system design. Unlike visible materials (such as N-BK7) that work well throughout the entire visible spectrum, IR materials are often limited to a small band within the IR spectrum, especially when anti-reflection coatings are applied.



Infrared Substrate Transmission Ranges

IR MATERIAL COMPARISON		
Material	Properties	Typical Applications
Calcium Fluoride (CaF <sub>2</sub> )	Low Absorption, High Refractive Index Homogeneity	Spectroscopy, Semiconductor Processing, Cooled Thermal Imaging
Fused Silica	Low CTE and Excellent Transmission in IR	Interferometry, Laser Instrumentation, Spectroscopy
Germanium (Ge)	High n <sub>0</sub> , High Knoop Hardness, Excellent MWIR to LWIR Transmission	Thermal Imaging, Rugged IR Imaging
Magnesium Fluoride (MgF <sub>2</sub> )	High CTE, Low Index of Refraction, Good Transmission from Visible to MWIR	Windows, Lenses, and Polarizers that Do Not Require Anti-Reflection Coatings
Potassium Bromide (KBr)	Good Resistance to Mechanical Shock, Water Soluble, Broad Transmission Range	FTIR spectroscopy
Sapphire (Al <sub>2</sub> O <sub>3</sub> )	Very Durable and Good Transmission in IR	IR Laser Systems, Spectroscopy, and Rugged Environmental Equipment
Silicon (Si)	Low Cost and Lightweight	Spectroscopy, MWIR Laser Systems, THz Imaging
Sodium Chloride (NaCl)	Water Soluble, Low Cost, Excellent Transmission from 250 nm to 16 µm, Sensitive to Thermal Shock	FTIR spectroscopy
Zinc Selenide (ZnSe)	Low Absorption, High Resistance to Thermal Shock	CO <sub>2</sub> Laser Systems and Thermal Imaging
Zinc Sulfide (ZnS)	Excellent Transmission in Both Visible and IR, Harder and More Chemically Resistant than ZnSe	Thermal Imaging

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