

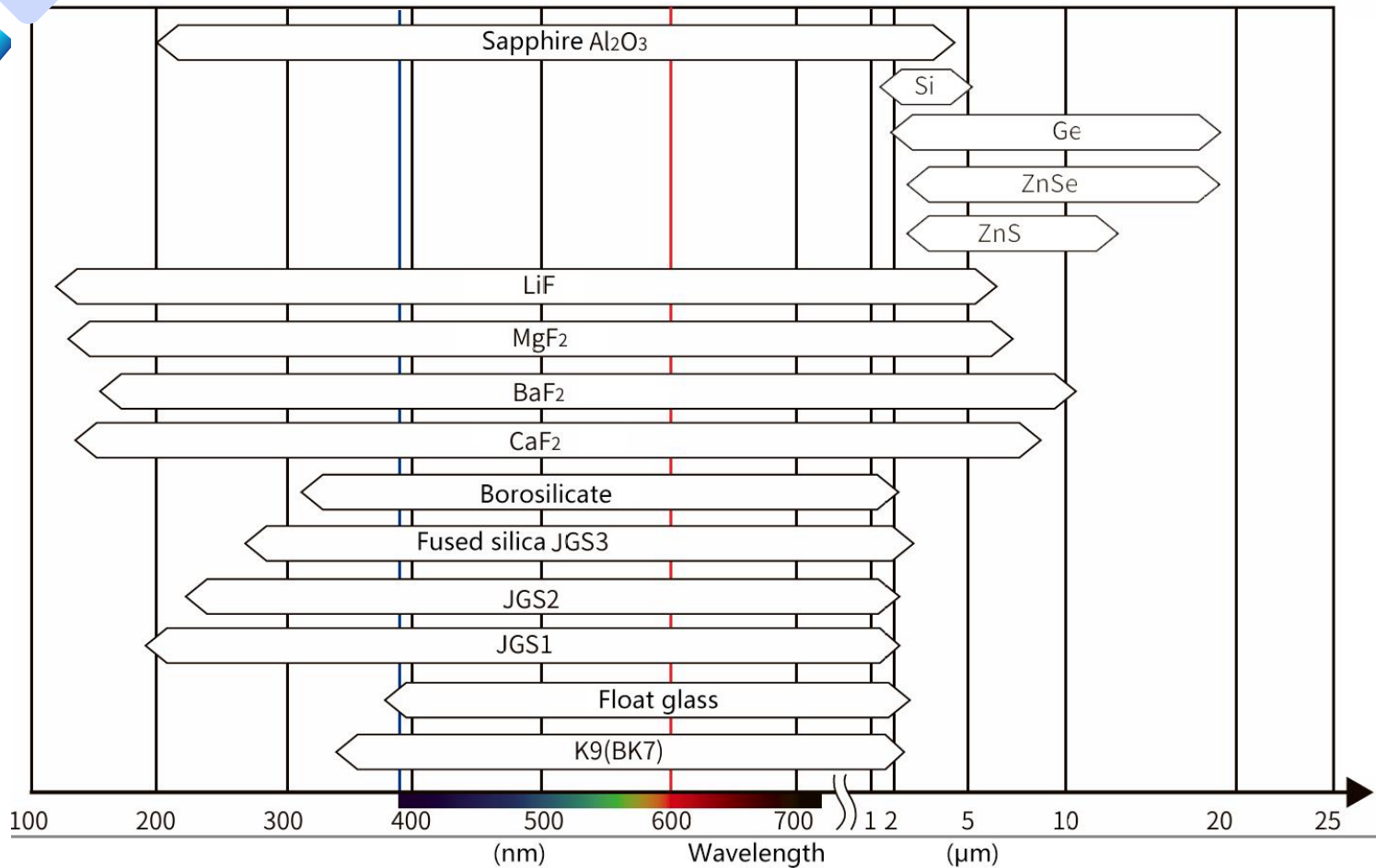


Optical flat/ window

Thin film coating blank / Witness

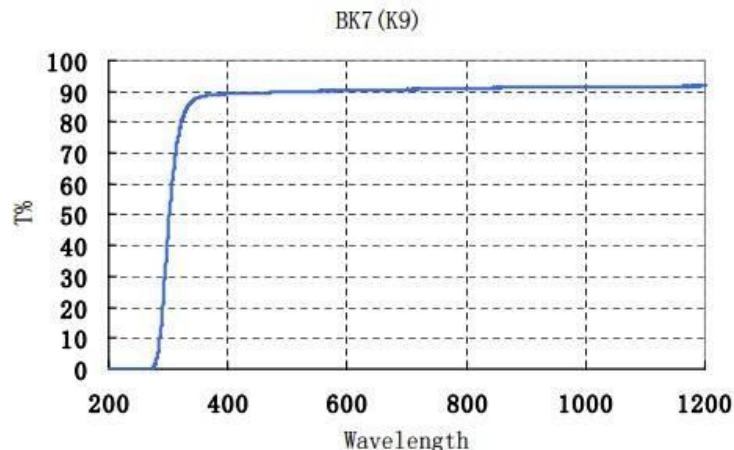
Bena Optics is committed to providing top-class optical components, and thanks to our advanced processing equipment and superior technical capabilities, we offer our customers a wide range of high-precision window slices for a wide range of applications. We have a number of advanced processing equipment, including double-sided polishing machines and multiple ring polishing machines, ranging in size from 1.2 meters to 2.0 meters, allowing us to achieve ultra-high precision machining and ensure excellent product performance. Our window products offer extremely high flatness (up to $\lambda/20$) and extremely low surface roughness (up to 1nm), providing excellent optical transmittance and surface quality. Bena Optics offers a wide range of structures, including round window, square window, stepped window, ellipsoid window and Brewster window, to meet the needs of different applications. Bena Optics' high-precision Windows are widely used in scientific experiments, industrial testing, medical equipment and aerospace, ensuring high-quality imaging results and stable performance. We also provide customer customization services, customized processing according to special needs, to provide the most suitable solutions.

Material selection guide



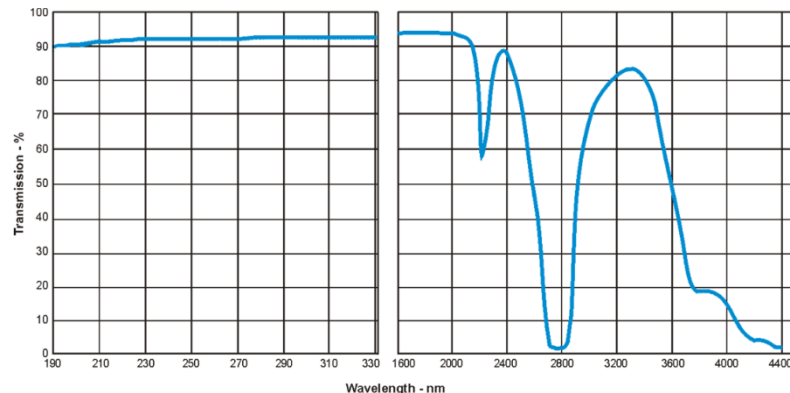
The VIS optical window from Bena Optics is designed to deliver exceptional performance in the visible spectrum. Crafted from high-quality optical materials such as BK7 or some color glass, these windows offer excellent transmission and minimal absorption across the visible wavelength range. Our advanced processing techniques ensure that each VIS optical window achieves superior flatness and surface quality, with flatness up to $\lambda/10$ and surface quality meet 10/5 scratch/dig. These characteristics make our VIS optical windows ideal for applications requiring high precision and clarity, such as imaging systems, laser applications, and scientific instrumentation. With Bena Optics' commitment to quality and precision, our VIS optical windows provide reliable and outstanding

Specifications	Commercial spec.	High precision spec.
Material	VIS glass (Schott, CDGM, HOYA, color glass etc.)	
Diameter	Ø5mm~Ø350mm	
Diameter tolerance	±0.1mm	±0.05mm
Surface quality	60/40	40/20
Surface flatness	1/4λ	1/10λ
Clear aperture	>85% of dia	>90% of dia
Bevel	<0.2mm x 45deg	<0.1mm x 45deg
Coating	Up on clients' request	



The UV optical window from Bena Optics is meticulously engineered to excel in ultraviolet applications. Constructed from premium materials such as UV-grade fused silica, calcium fluoride, borosilicate, or others UV materials, these windows offer exceptional transmission and minimal absorption in the UV wavelength range. Our state-of-the-art processing techniques ensure that each UV optical window achieves outstanding flatness and surface quality, with flatness up to $\lambda/20$ and surface roughness as low as 1nm. These precise characteristics make our UV optical windows ideal for applications requiring high UV transparency and durability, such as UV spectroscopy, photolithography, and laser systems. With Bena Optics' unwavering commitment to quality and precision,

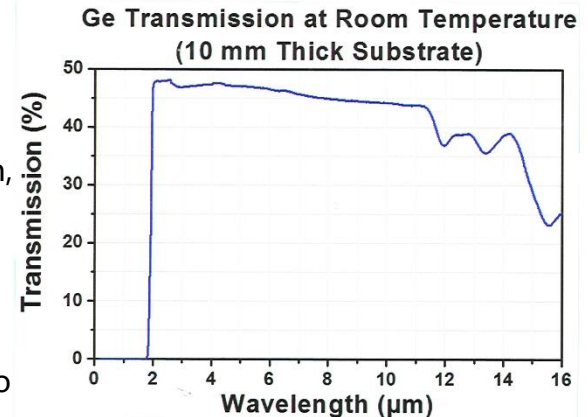
Specifications	Commercial spec.	High precision spec.
Material	UV glass (Fused silica JGS-1, Corning 7980, Heraeus, CaF ₂ , Borosilicate, etc..)	
Diameter	Ø5mm~Ø350mm	
Diameter tolerance	±0.1mm	±0.05mm
Surface quality	60/40	40/20
Surface flatness	1/4 λ	1/10 λ
Clear aperture	>85% of dia	>90% of dia
Bevel	<0.2mm x 45deg	<0.1mm x 45deg
Coating	Up on clients' request	



Bena Optics offers a diverse range of infrared (IR) windows, utilizing high-quality substrates such as silicon, ZnSe, sapphire, and germanium. Each material is selected for its unique properties to meet the specific demands of various IR applications.

Bena Optics' advanced manufacturing processes ensure that each IR window achieves superior flatness and surface quality, with flatness up to $\lambda/10$. These precise characteristics make our IR windows suitable for demanding applications in fields such as thermal imaging, spectroscopy, laser systems, and industrial process monitoring. With Bena Optics' commitment to quality and precision, our IR windows provide reliable and outstanding optical performance for your most challenging infrared applications.

- **Silicon windows** provide excellent transmission in the mid-IR range and are known for their durability and thermal stability.
- **ZnSe windows** offer broad transmission from the visible to the far-IR spectrum, making them ideal for high-power CO2 laser systems.
- **Sapphire windows** are renowned for their exceptional hardness and scratch resistance, along with high transmission in the near-IR range.
- **Germanium windows**, with their high refractive index and excellent transmission in the mid- to far-IR range, are perfect for thermal imaging and spectroscopy.



Bena Optics offers advanced coating solutions for various optical surfaces, including spherical, aspherical, and planar. To accurately assess the performance of these thin films, we used a spectrophotometer for film testing, which are particularly effective for planar surfaces. These systems derive data from witness samples, allowing us to measure key parameters such as transmittance, reflectivity, actual applicable temperature, and durability of the coatings. Our witness samples are sourced from top brands like CDGM, Schott, and CORNING, ensuring high quality and reliability. Typically, these samples have a diameter of about 1 inch and a thickness ranging from 1 to 3 mm, making them compatible with standard spectrophotometer tools. Depending on customer requirements, Bena Optics can polish these witness samples on one or both surfaces to meet specific needs for transmission or reflection thin film coatings. This meticulous approach ensures that our coatings deliver optimal performance across a wide range of applications.

Specification	
Diameter	20mm-25.4mm
Thickness	1mm-3mm
Clear aperture	> 85% of diameter
Surface quality	60/40 or better
Parallelism	<3 arc min or better
Flatness	$\lambda/4 - \lambda/10@633\text{nm}$
Edges	Fine ground
Beveled	<0.2mm x 45deg

Ultra – high precision optical window/ flat

- ◆ *Fused silica mirror blank*
- ◆ *Silicon Carbide(SiC) mirror blank*

Bena Optics' ultra-high precision fused silica mirror blanks are manufactured using state-of-the-art full-aperture intelligent ring polishing machines. This advanced technology allows us to polish one surface of the mirror blank to achieve exceptional flatness, with surface precision reaching up to $\lambda/20$. The resulting ultra-smooth surface boasts a roughness better than 1nm, making it ideal for the most demanding optical applications.

To further enhance the surface accuracy, we employ advanced ion beam or magnetorheological finishing techniques. These methods enable us to make precise surface corrections, ensuring that the mirror blanks meet the exact specifications outlined in customer drawings. The combination of intelligent ring polishing and precise surface correction ensures that our fused silica mirror blanks deliver unparalleled optical performance.

Bena Optics' commitment to utilizing cutting-edge equipment and techniques underscores our dedication to quality and precision. Our fused silica mirror blanks are perfect for applications in scientific research, high-power laser systems, and advanced imaging technologies. With our advanced processing capabilities, Bena Optics provides reliable and superior optical components that meet the most stringent requirements of our clients.

Why use the ultra-high precision fused silica mirror blank ?



Firstly, high-purity UV fused silica substrates offer superior uniformity and a lower coefficient of thermal expansion. This results in better performance under temperature fluctuations and greater resistance to environmental impacts. The choice of this substrate material directly influences the physical and chemical stability of the mirror, making it more suitable for use in complex and variable environments.

Moreover, the application of ultra-high precision fused silica substrates improves the reflectivity of mirrors. For instance, LBTEK high-power laser line mirrors are made using high-purity UV fused silica and ultra-high laser-induced damage threshold (LIDT) dielectric coatings. These mirrors can withstand high-energy pulses and have a high damage threshold. The UV fused silica substrate provides better uniformity and a lower coefficient of thermal expansion, ensuring superior performance under temperature fluctuations and greater resistance to environmental impacts. These mirrors operate at wavelengths of 266 nm, 355 nm, 532 nm, 780 nm, 1064 nm, 1550 nm, and dual wavelengths of 532 & 1064 nm, with incident angles ranging from 0 to 45° and reflectivity exceeding 99%.

In summary, ultra-high precision fused silica substrates significantly enhance the performance and stability of mirrors by offering better uniformity, lower thermal expansion coefficients, and higher reflectivity, making them excel in various application scenarios.

Bena Optics leverages state-of-the-art full-aperture intelligent ring polishing machines to manufacture silicon carbide (SiC) mirror blanks with exceptional precision. Our advanced technology achieves a perfect surface flatness, and ultra-smooth surfaces with roughness better than 1nm. This ensures that our SiC mirror blanks meet the highest standards of optical performance. Additionally, we employ cutting-edge ion beam and magnetorheological finishing techniques for precise surface corrections, guaranteeing that our SiC mirror blanks adhere to the exact specifications outlined by our customers.

These advanced processing capabilities make Bena Optics' SiC mirror blanks ideal for high-precision applications, offering unparalleled performance and reliability.

Our SiC mirror blanks are particularly suited for demanding environments such as space-based Earth observation, deep space exploration, astronomical observation, and advanced imaging systems. With a focus on quality and precision, Bena Optics provides SiC mirror blanks that not only meet but exceed the stringent requirements of our clients, driving the development and application of cutting-edge optical technologies.

Why use the ultra-high precision SiC mirror blank ?



The reasons for choosing silicon carbide (SiC) mirror blanks are primarily reflected in the following aspects:

1.Enhancing Image Quality: SiC mirror blanks can significantly improve the resolution and image quality of imaging systems, which is crucial for astronomical observations, space science research, and Earth observation.

2.Reducing Weight: SiC material has high specific stiffness and excellent thermal stability, allowing for weight reduction in the system while maintaining optical performance. This is essential for the design of large telescopes and satellites.

3.Adapting to Harsh Environments: SiC mirror blanks have good thermal conductivity and deformation resistance, enabling them to maintain stable performance in various extreme environments, making them suitable for observation tasks in harsh conditions.

4.Expanding Application Fields: With technological advancements, the application fields of SiC mirror blanks are continuously expanding, including space-based Earth observation, deep space exploration, astronomical observation, and quantum communication, providing strong support for scientific research and technological applications.

In summary, choosing SiC mirror blanks not only enhances image quality and system stability but also adapts to various complex application scenarios, driving the development and application of optical technology.

Fused silica mirror blank



SiC mirror blank



Bena Optics hold that a company should be as tolerant / encompassing as the vast ocean which admits hundreds of rivers and should draw upon other's strengths.



Leading in optics with cutting-edge technology