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THE COMPANY



Hind High Vacuum (HHV) is India's premier thin film and vacuum technology company with over 50 years of expertise in the design and manufacture of high vacuum equipment for research and industrial applications. HHV is a global developer of vacuum coating systems for optical, decorative and functional coatings, astronomical telescope mirror coaters and special purpose vacuum equipment for complex metallurgical applications.

HHV is a leading manufacturer of high precision optical components and thin film coatings. HHV's products are integral to multiple sectors that include Aerospace, Automotive, Defense and Space.

HHV has multiple manufacturing facilities located in Bengaluru, India and offices located globally. HHV is an ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007 certified company.

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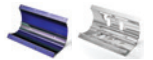
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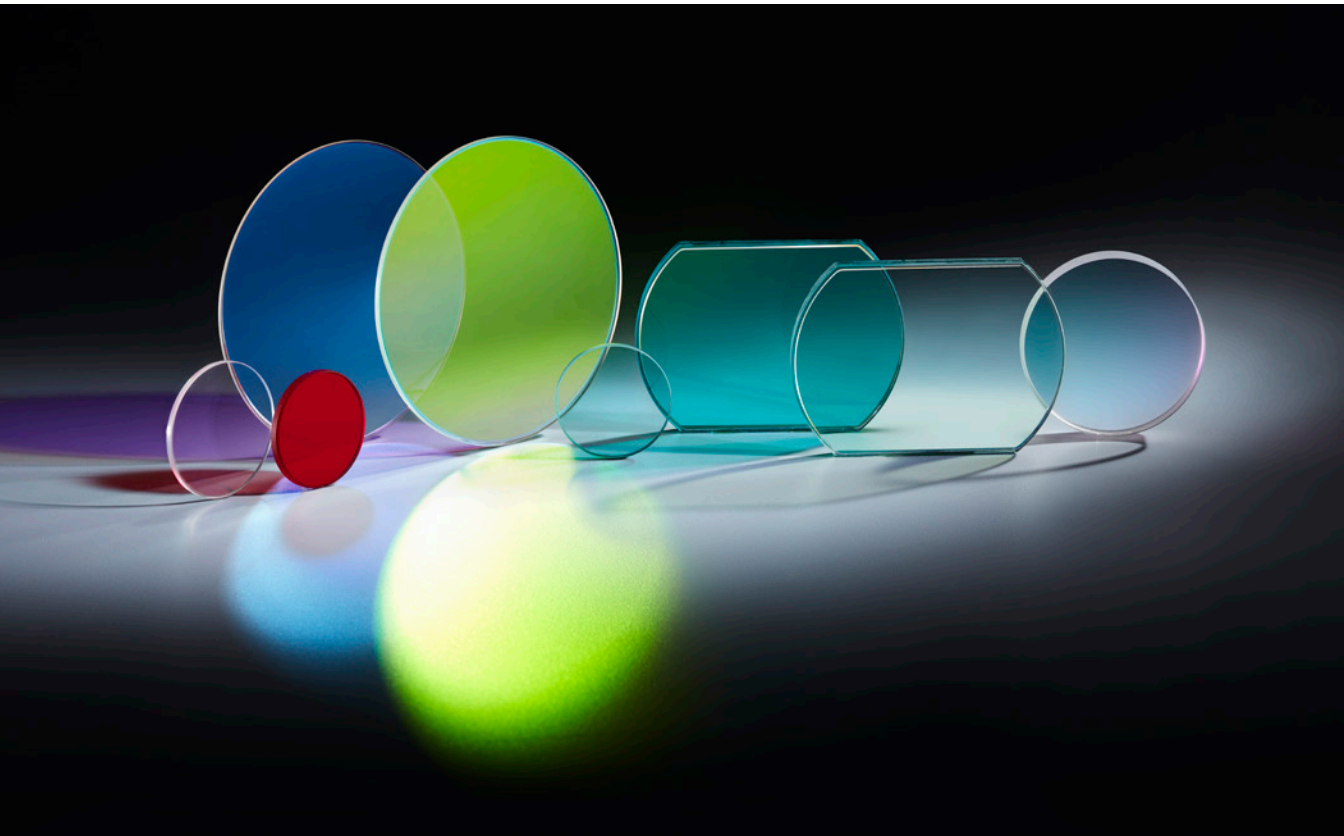


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TECHNOLOGY & EXPERTISE

HHV provides end to end services from customized design to supplying the final product. The Thin Films and Optics Division has a wide range of technical coating and optics focused capabilities.

THIN FILM COATING

The Thin Films and Optics Division has a wide range of technical coating and optics capabilities such as:

1. Single and wide band Anti-Reflection coatings
2. High Reflective Metal and Dielectric coatings
3. Beam Splitter coatings
4. Transparent Conductive coatings
5. Short pass, Long pass, Band pass and Notch Filter coatings
6. Custom coatings based on customer requirements

HHV's Thin Films and Optics Division has numerous coating systems with the capability for coating a full range of optical coating materials. Our coating technologies include:

1. Magnetron Sputtering systems
2. Ion-Assisted E-Beam Deposition systems
3. Resistance Evaporation systems
4. Plasma Enhanced Chemical Vapour Deposition systems
5. Atomic Layer Deposition systems

DESIGN CAPABILITIES

We utilize several software programs including Essential Macleod, TF-Calc and CODE to create coatings with the best possible design, optimisation, and sensitivity.

RESEARCH AND DEVELOPMENT TEAM

HHV's Thin Film and Optics R&D team consists of scientists and engineers who are uniquely qualified to provide a variety of application integration services to customers by creating ideal solutions for thin film requirements. Our R&D team is equipped to develop products through our extensive design and manufacturing resources to create products that meet customer needs.



PHOTOLITHOGRAPHY LAB

HHV's Photolithography Lab (PLL) develops Thin Film Metallized Circuits on alumina substrates.

The Photolithography Lab produces various types of circuits with multi-layers of metallization for different frequencies.

HHV's PLL is equipped with a laser writer for mask fabrication, UV exposure systems, an

etching room containing a chemical wet bench, dicing machines to cut the metallized substrates to required sizes and high-performance microscopes and profile projectors for inspection and measurement of the patterned substrates.

HHV's Photolithography Lab has ISO 7, ISO 8 clean rooms and class 100 laminar flow stations that allow us to achieve resolutions of up to 40 microns.



Clean Room



Metallization Lab



Photolithography Lab



Inspection Lab

PRECISION OPTICS
FABRICATION LAB

HHV's precision Optics Fabrication Lab (OFL) is equipped with state-of-the-art technology and machinery to fabricate high precision optical components for the visible and infrared spectrum.

HHV offers end to end solutions, from substrate manufacture to the thin film coated component, for complex optical system requirements, especially for space and defense departments.

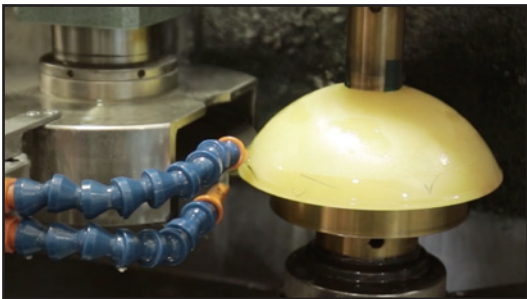
HHV's OFL is equipped with high quality machines for slitting, trepanning, curve generation, grinding, polishing, centring and edging for spherical and aspherical optics.

Finished products go through rigorous quality checks with equipment such as Zygo interferometers with transmission spheres to measure surface figures up to 1/10th of

lambda, Davidson autocollimators to measure surface angles and parallelism to an accuracy of one arc second, and Trioptics spherometers to measure the radius of curvature of various components to an accuracy of one micron.

HHV's expertise comes from its superior thin film coating ability and knowledge of handling materials like fused silica, zerodur, optical glass for the visible spectrum and silicon, germanium, zinc sulphide, barium fluoride, calcium fluoride and lithium fluoride materials for the infrared spectrum.

HHV's new OFL unit develops lenses, flats, prisms, aspherics and infra-red domes for applications including visible, night vision optics, binoculars, periscopes, astronomical telescopes and defense products.



Optics Fabrication Lab

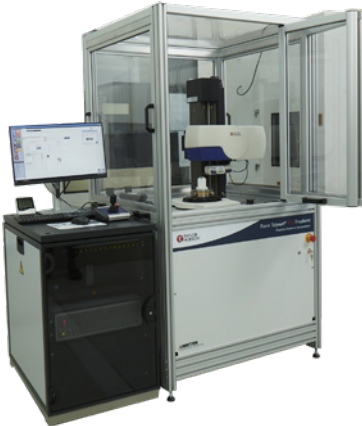


HHV has the capability to manufacture a wide variety of prisms with tight tolerances, accurate fringe control, and angle precision. We offer different types of prisms such as dispersion prisms, deflection or reflection prisms, rotating prisms and offset prisms.



SINGLE POINT DIAMOND TURNING

HHV has Single Point Diamond Turning (SPDT) ultra-precision machines to fabricate crystalline infrared materials like Silicon and Germanium. Our SPDT systems are used to manufacture spherical and aspherical optical components.



Talysurf PGI Freeform for freeform and aspheric optics



Nanoform systems for Single Point Diamond turning

QUALITY ASSURANCE

HHV has the ability to perform a wide range of quality tests to ensure products are compliant to customer standards. All our characterization equipment are tested, controlled, calibrated and maintained to meet the requirements of our Quality System.



Characterization Lab

PRODUCTS

HHV produces high-quality, standard and custom designed thin film and optics products for a wide range of scientific, industrial, defense and space applications.

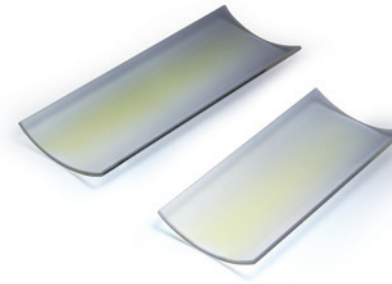
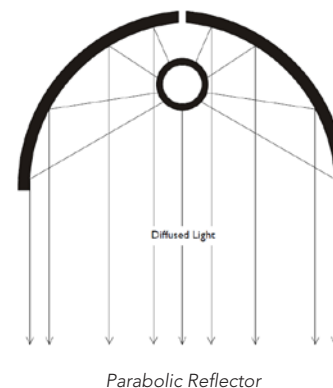
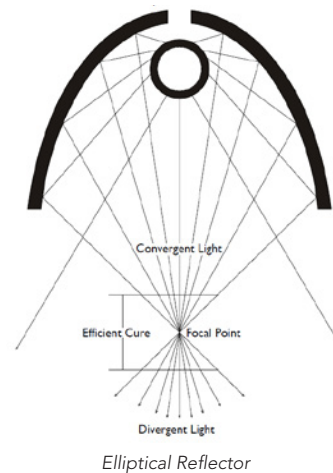
1. UV REFLECTOR Glass & Aluminium

HHV is the world's largest manufacturer of UV reflectors. UV reflectors direct UV light on to substrates that are being cured. They play a critical role in UV curing systems by enhancing the efficiency of the curing process.

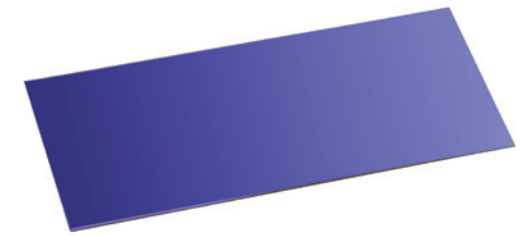
UV reflectors are widely used for flexographic printing where UV curable ink offers images with sharper colours and outputs that consume less energy. Label printing industries use UV reflectors to dry UV curable inks and varnishes. UV dichroic reflectors reflect UV radiation and transmit IR radiation, thus acting as a cold mirror, which significantly reduces the heating up of objects being cured.

Aluminium reflectors are used for low wattage applications, whereas as quartz glass reflectors are used for higher temperature applications.

Our coatings ensure higher output and lower energy consumption and are available in spherical and elliptical profiles. Our coatings provide thermal stability up to 350 °C on glass and 250 °C on aluminium and ensure high reflectivity within the UV spectrum and high transmission and absorption for wavelengths in the visible and IR spectrum.



UV Reflectors : Glass



UV Reflectors : Aluminium

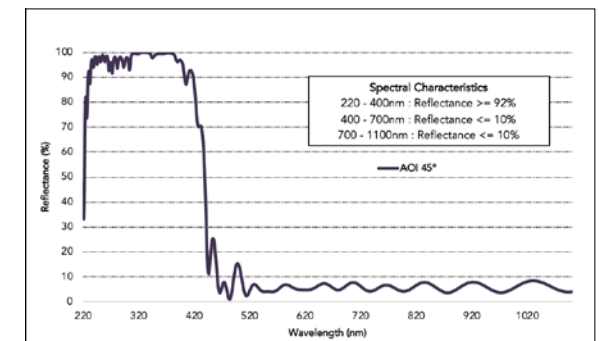
We provide end to end services from cutting and bending the substrate to coating and marking the reflectors.

PRODUCT FEATURES

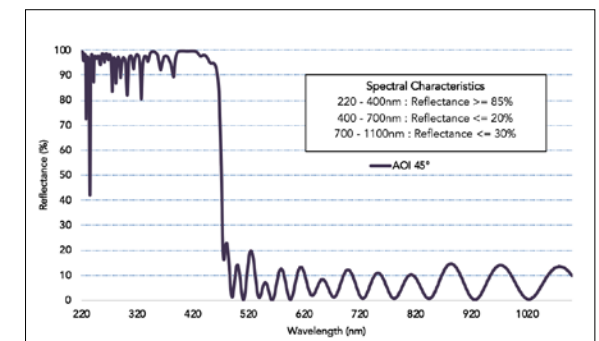
- Substrate: Borosilicate Glass, Quartz, Stainless Steel, Aluminium
- Dimension: Lengths up to 1200 mm
- Durability: MIL-C-48497A
- Custom profiles and designs available upon request

APPLICATIONS

- Drying and curing inks for label printing
- Adhesion reduction of semiconductor dicing tape
- Curing optically clear adhesives in LCD panels
- Curing varnishes and paints to process wood
- Curing conformal coatings on electronic components
- Curing adhesives for mobile phone components



Spectral Graph : Glass



Spectral Graph : Aluminium

2. UV REFLECTOR

Fibre Optics

UV curing systems utilize UV reflectors to rapidly and evenly cure fibre optic cables, from core to clad, using high intensity light. Glass optical fibre is produced on a multi-story drawing tower where a preform is heated and pulled to thin strands at high speeds. Fibres cured with UV radiation are especially resistant to abrasion and scratches at higher production speeds.

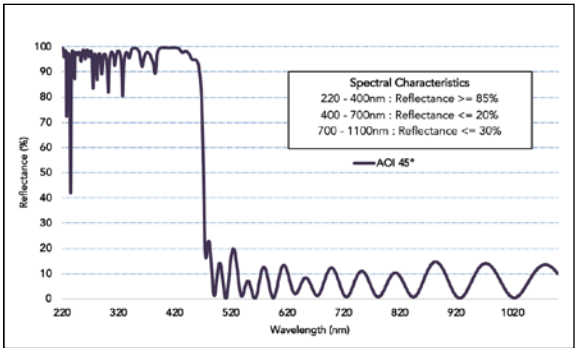
HHV's fibre optic reflector coatings are carried out through a thin film deposition technique that uses alternate layers of high and low index oxide layers.

The UV cured optical fibre coating is used to close notches that occur during pultrusion. It also prevents cracks and protects and strengthens the optical fibres.

UV paints are applied and cured on optical fibres for colour coding and marking. Vented reflectors are commonly used with microwave powered UV lamp systems that are required to filter ozone out of the system. Based on the configuration and placement of the reflector with respect to the UV lamp source, the reflector can be classified as front or back and act as a hot or cold mirror.

End reflectors include a small hole for holding the UV bulb in the focus position for maximum peak irradiance. The reflectors have precisely shaped geometry to maximise UV light and can directly replace OEM products.

The coatings have high reflectance in the UVA, UVB and UVC regions with high absorbance of IR energy. Our reflectors are available with or without dichroic coatings.



Spectral Graph : Fiber Optics

PRODUCT FEATURES

- Substrate: Aluminium
- Dimension: Lengths up to 1200mm
- Durability: MIL-C-48497A
- Custom profiles and designs available upon request



APPLICATIONS

- Curing of optical fibres for telecommunications
- Curing of inks on wire and cable products for colouring



UV Reflectors Fiber Optics

3. IR BLOCKERS

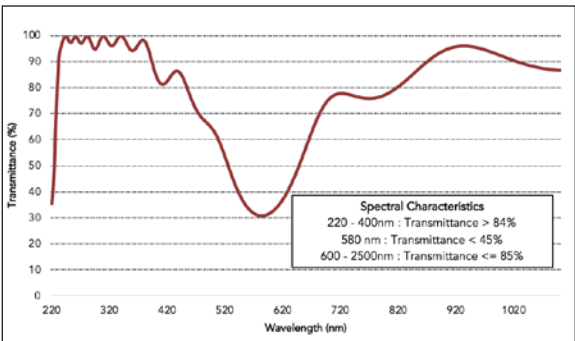
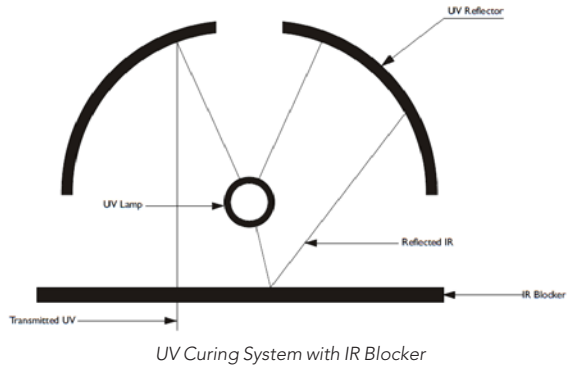
HHV's IR blocker coatings are deposited on quartz glass substrates and selectively filter ultra-violet energy from the source, while blocking unwanted visible and infra-red energy. IR blockers are used in conjunction with UV reflectors, and the entire system acts as a UV filter. IR blockers are placed in front of a UV lamp source and function as a hot mirror, thus keeping the UV system cool by protecting heat-sensitive materials, lamps and reflectors from ink evaporants. Our IR blocker coatings have thermal stability up to 400 °C and high transmission in the UV range.

PRODUCT FEATURES

- Substrate: Quartz
- Dimension: Lengths up to 600 mm
Thickness: 2 to 3 mm
- Durability: MIL-C-48497A
- Custom profiles and designs available upon request

APPLICATIONS

- UV curing systems for temperature-sensitive materials



Spectral Graph : IR Blocker



IR Blocker

4. RETICLES

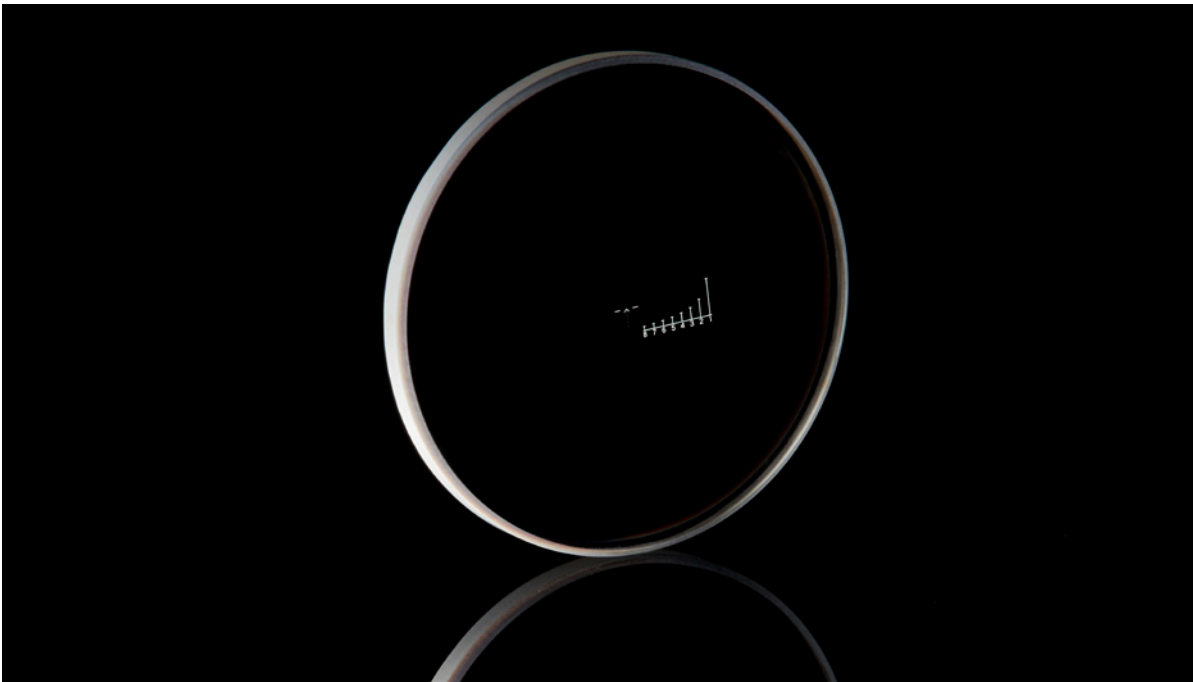
Reticles are optics designed to insert into eyepieces of an imaging system that superimposes either a crosshair or concentric circle pattern on the imaged object. The reticle pattern provides a reference location and allows the imaged object to be centered. HHV has a complete lithography facility to make reticles with chrome patterns or etch and fill technology. HHV's facility is equipped with laser writers, etching stations, Laurell Spin coaters and SUSS MJB3 UV exposure systems.

FEATURES

- Substrate: Borofloat, BK7 and UVFS glass substrates
- Dimension: Diameter upto 50mm
- Patterns: Positive, negative crosshair, Concentric circles
- Line Resolution: $5 \pm 2 \mu$

APPLICATIONS

- Rifle scopes
- Range finders
- Surveillance instruments
- Optical encoders
- Stage micrometers



Reticles

5. LASER SAFETY GLASSES

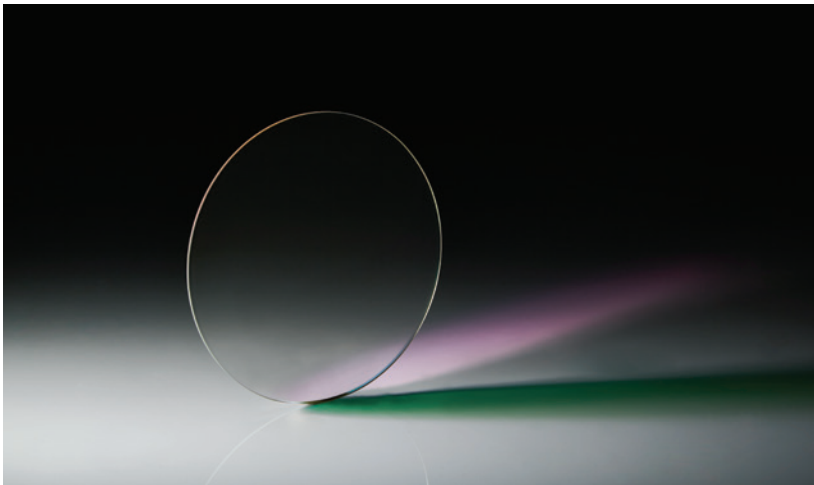
HHV continues to lead the way in technologically advanced laser safety glasses that adhere to international laser safety standards. Laser safety eyewear is designed to reduce hazardous laser eye exposure to safe and permissible levels by providing an optical density (OD) that attenuates the laser that is being used, while allowing enough visible light transmission (VLT) for comfortable visibility.

HHV offers the highest quality laser safety glasses with ODs suitable for most photonics applications. Our coatings cover visible to near-infrared wavelengths. HHV's thin film laser glasses have multi-layer coatings with high ODs and VLT.

Our laser glasses offer safety against Class 3R, Class 3B and Class 4 lasers

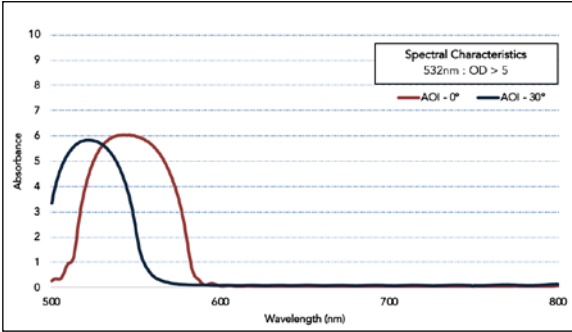
- PRODUCT FEATURES
- Substrate: Borofloat, KG5
 - Dimension: Diameter upto 200 mm
 - Durability: MIL-C-675C
 - Custom filters can be designed and produced upon request
 - Optical Density: Upto OD 7+

- APPLICATIONS
- Laser safety eyewear in the medical industry
 - Laser safety eyewear in the military

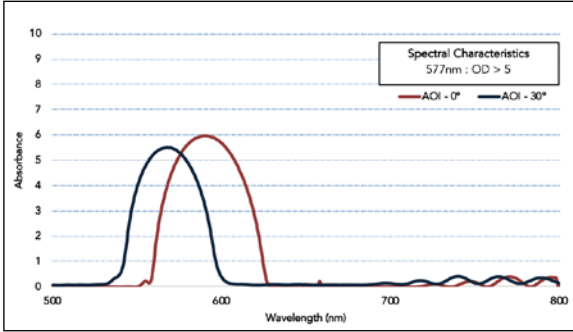


Laser Safety Glass

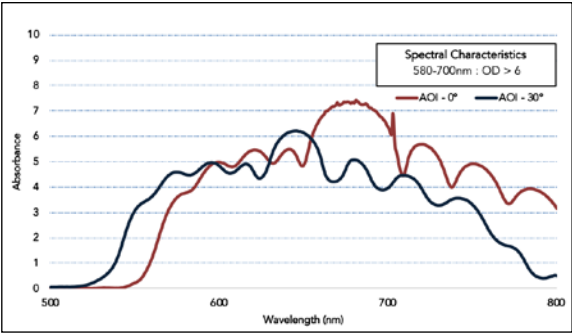
Spectral Graphs



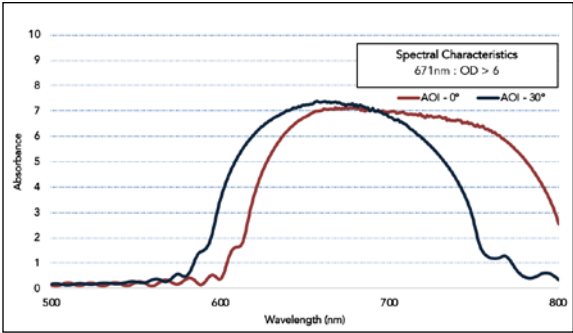
Laser Safety Glasses 532 nm



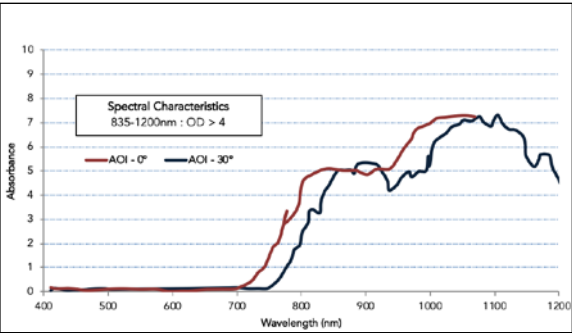
Laser Safety Glasses 577 nm



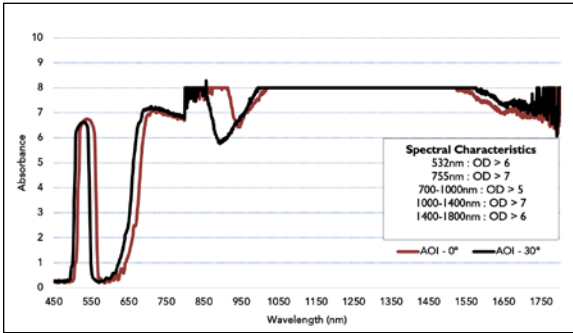
Laser Safety Glasses 580 - 700 nm



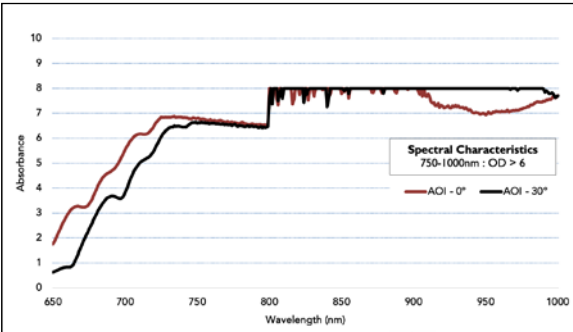
Laser Safety Glasses 671 nm



Laser Safety Glasses 835 - 1200 nm



Laser Safety Glasses: Multi Band



Laser Safety Glasses : 750 - 830 nm

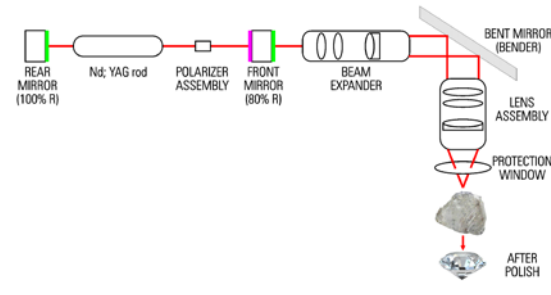
6. LASER OPTICS

High reflective laser mirrors are used in laser resonators to increase the intensity of the beam. HHV's multilayer coatings ensure high reflection, durability and high Laser Induced Damage Thresholds (LIDT).

HHV has proven expertise in designing laser mirrors that offer high damage threshold. Beam steering mirrors are used outside the laser cavity and are used to fold the laser beam. These mirrors are mounted at a 45° angle to the beam direction.

Our laser mirror coatings are hard and durable, have achieved more than 99.95% reflectance and can withstand damage thresholds up to 20 J/cm2.

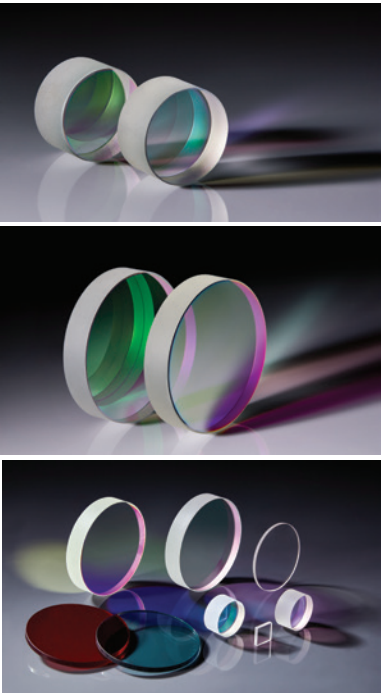
Our cavity laser mirrors for diamond cutting achieve more than 99.5% reflectance and can be used in laser cavities that are designed for single line, multi-line or broadband sources.



Diamond Laser Cutting setup

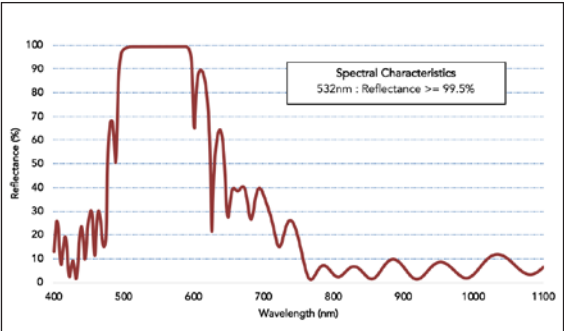
- PRODUCT FEATURES
- Substrate: UV Fused Silica, Quartz, BK7
 - Dimension: Diameter from 6 to 50 mm
 - Durability: MIL-C-675C
 - Custom coating designs are available upon request

- APPLICATIONS
- Lasers for diamond cutting
 - High reflection mirrors in laser gyros
 - Industrial lasers for cutting
 - Medical lasers for various operations

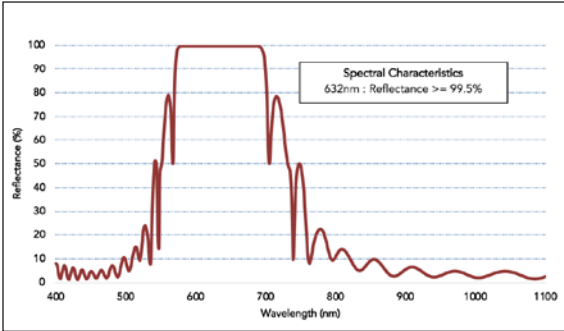


Laser optics

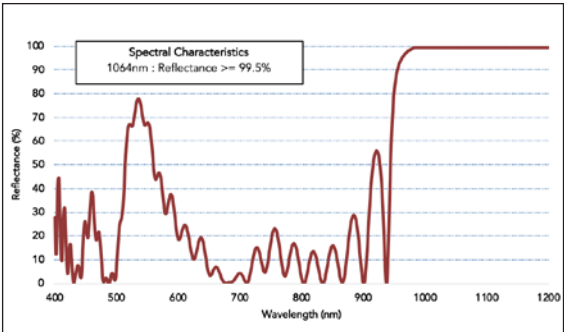
Spectral Graphs



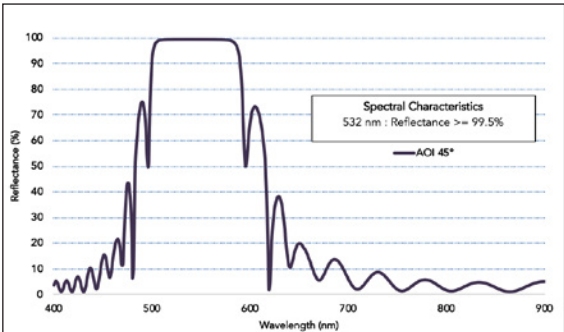
HR Mirror 532 nm



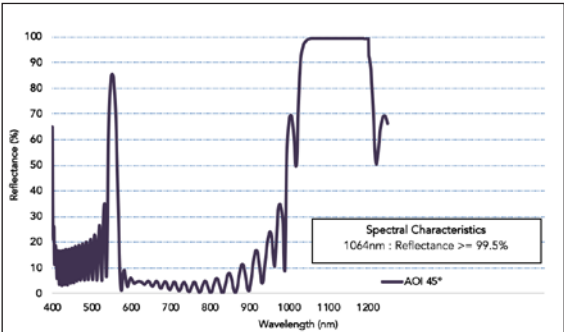
HR Mirror 632 nm



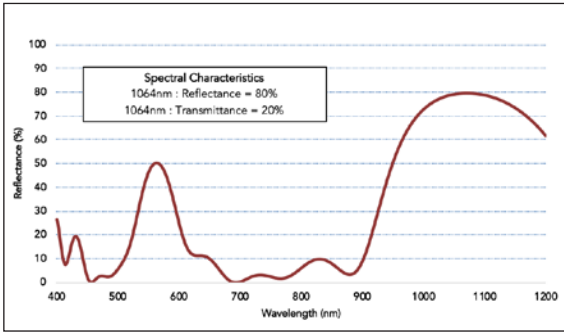
HR Mirror 1064 nm



Beam Bender 532 nm



Beam Bender 1064 nm



Output Coupler 1064 nm

7. NIGHT VISION OPTICS

Night vision technology uses infrared radiation for imaging in a dark environment. The three main classes of night vision technology are NIR, low-light and thermal imaging. NIR imaging uses an infrared illuminator to provide grey-scale images. Low-light imaging uses an image intensifier tube to amplify available light.

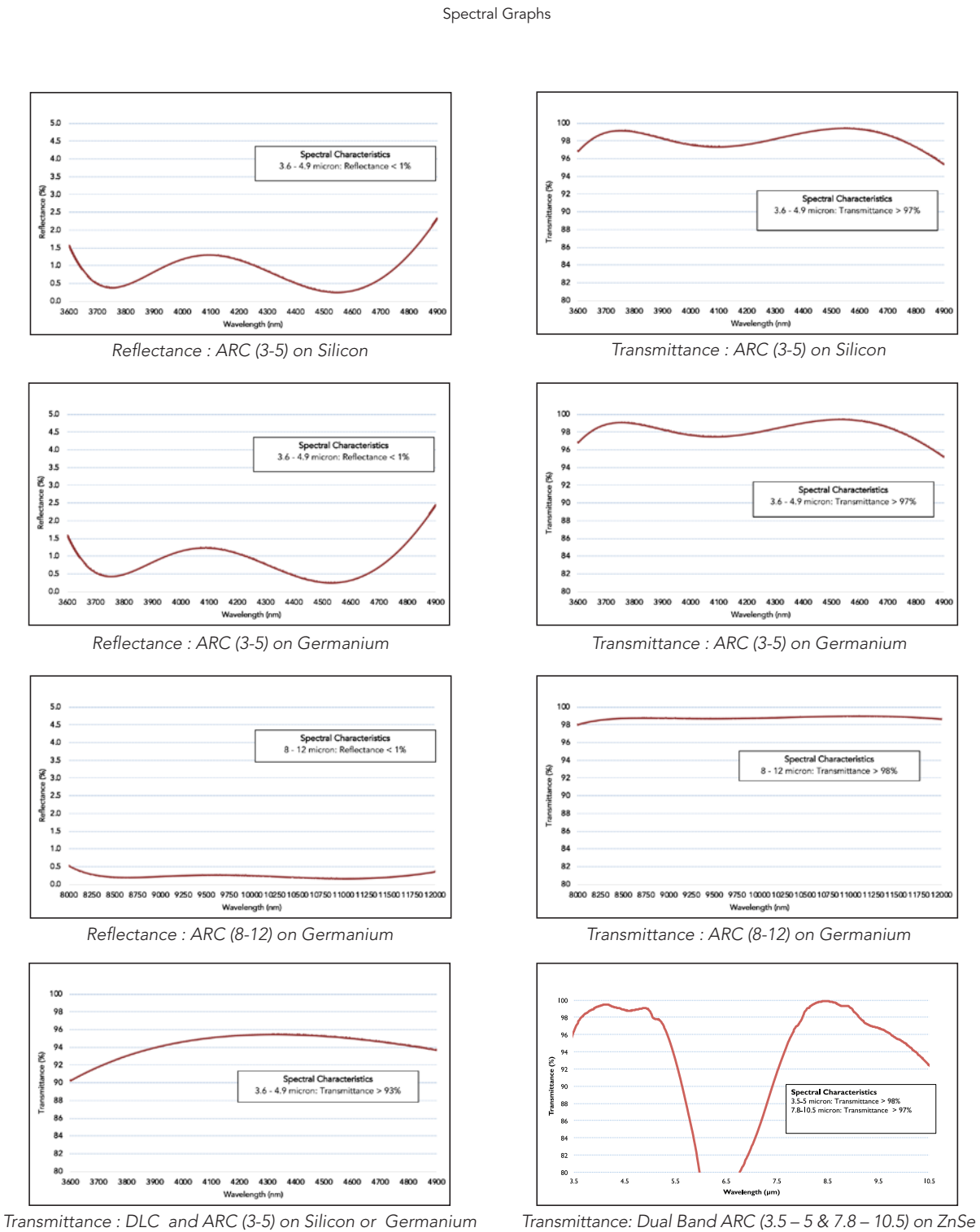
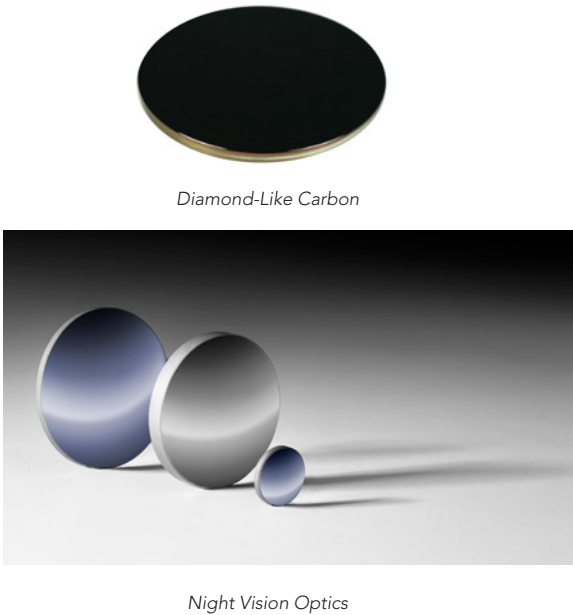
Thermal imaging creates an electronic image from an object's heat signature. HHV offers a variety of coatings for Night Vision Devices (NVD) on silicon and germanium. For applications such as thermal windows, a high efficiency and high durability anti-reflection coating is coupled with a hard and adherent Diamond-Like Carbon (DLC) coating to provide superior properties in terms of transmission and hardness.

Our AR coatings contain no radioactive materials and have a high transmission in the MWIR band for Silicon and LWIR and MWIR bands for Germanium.

The DLC coatings possess high hardness and high transmission in the MWIR band for Silicon and LWIR and MWIR bands for Germanium.

- PRODUCT FEATURES
- Substrate: Silicon, Germanium, Zinc Sulphide and Chalcogenide
 - Dimension: Diameter up to 250mm
 - Durability:
 - ARC: MIL-C-48497
 - DLC: MIL-C-48497A, TS-1888 (Windshield Wiper)
 - Custom coating designs are available upon request

- APPLICATIONS
- Thermal imaging
 - Pyrometers

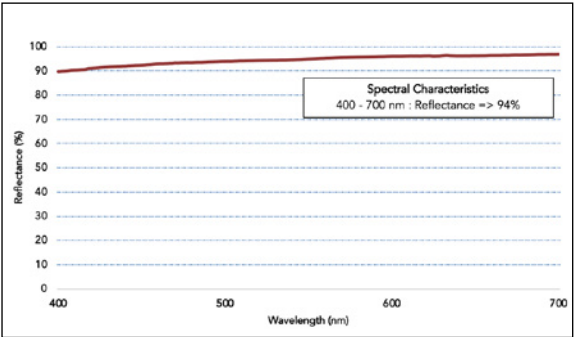


8. PERISCOPE PRISMS

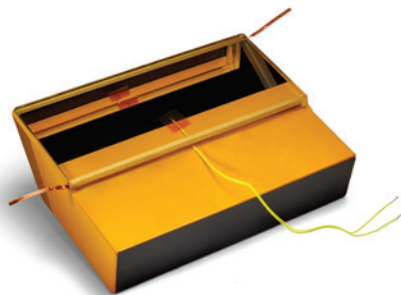
Periscope prisms consist of ITO coated heater plates that are laminated with a prism through an autoclave process for sealing and encapsulation.

A periscope makes use of two triangular prisms to change the direction of light by 90°. The reflective portion of the prism consists of a silver coating that is deposited directly on the prism.

Our reflective coatings are finished with protective paint to prevent it from atmospheric degradation. The entire assembly is bullet-proof and chemically inert.



Spectral Graph : Silver Coating



Periscope Prisms

PRODUCT FEATURES

- Substrate: Radiation-resistant glass
- Dimension: Lengths up to 300 mm
- Durability: Temperatures: -40 °C to +60 °C, Relative humidity of 95%
- Custom prisms can be designed and produced upon request
- Periscopicity: 225
- Total field of view, Horizontal up to 110° and Vertical up to: 30°

APPLICATIONS

- Periscopes in submarines for defense
- Periscopes in battle tanks for defense



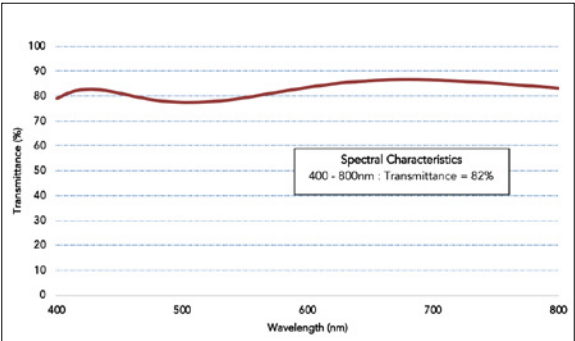
Periscope

9. TRANSPARENT HEATERS

Transparent heaters are substrates coated with transparent and electrically conductive ITO coatings. Controlling the sheet resistance of the film and the resistance of the heating element allows us to control the attainable temperature of the heater. The shape or pattern of the resistor circuit can be fine-tuned for optimum performance.

Bus bars are provided at the edge of the heater for integration with an external power source. ITO coatings can be applied on glass, plastics such as acrylic and polycarbonate and flexible substrates such as PET and Kapton which are widely used in flat panel displays, scientific research and LCD / OLED manufacturing processes.

Additionally, ITO coatings can be index-matched (IMITO) along with an anti-reflective coating to reduce reflectance at various interfaces. ITO glasses are laminated and autoclaved for higher strengths.



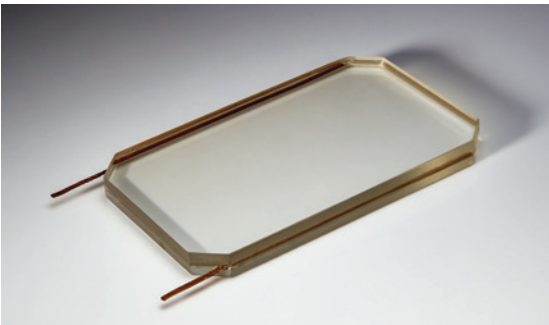
Spectral Graph : ITO Coating

PRODUCT FEATURES

- Substrate: Glass, Polycarbonate, Acrylic, Kapton, PET
- Dimension: Lengths up to 1000 mm
- Durability:
 - Autoclaved heaters: -40 °C to +60 °C, Relative humidity of 95%
 - ITO Coatings on glass and plastic: MIL-STD-810F
- Shapes, profiles and resistance can be tailored to customer requirements

APPLICATIONS

- Defogging windows
- Electronic devices
- LCD panels
- Cockpit displays
- Automobile windshields and headlights
- Slides for microscopes
- Camera security systems



Transparent Heaters

10. THIN FILM
METALLIZED CIRCUITS

HHV's thin film metallization process is carried out through magnetron sputtering. The deposited metal layers show superior adhesion, structural and electrical properties in comparison to non-vacuum methods.

Metallization schemes that we offer:

TiW/Au or TaN/TiW/Au	TiW: 200 - 500 Å Au: 5 - 7 µm TaN: 10 - 250 Ω/□ if resistor layer is required
TiW/Au/NiV/Au	TiW: 200 - 500 Å Au: 3 - 3.5 µm NiV: 0.5 - 1 µm Au: 2 - 2.5 µm
Cr/Cu/Au	Cr: 200 - 800 Å Cu: 4 - 5 µm Au: 1.8 - 2 µm
Cr/Cu/Ni/Au	Cr: 200 - 800 Å Cu: 4 - 5 µm Ni: 0.1 - 0.5 µm Au: 1.8 - 2 µm
NiCr/Cu	NiCr: 200 Ω/□ Cu: 5 - 7 µm
NiCr/Ni/Au	NiCr: 200 Ω/□ Ni: 0.1 - 0.5 µm Au: 3 µm
TiW/Au or Cr/Au	Au: 0.5 - 7 µm TiW: 200 - 500 Å Cr: 200 - 800 Å

The metallization schemes start with a bonding layer of titanium-tungsten or chromium and a conductive layer of gold or copper on a ceramic substrate. For resistor

applications we use tantalum-nitride (TaN) or nickel-chromium (NiCr) layers and for solderable applications nickel or copper is added to the metallization scheme. All the metal layers are deposited in a single cycle without breaking the vacuum process.

The sheet resistance of TaN, NiCr and SiCr layers can be tuned from few ohms per square to several kilohms per square depending on the application.

Subsequent to the metallization, the substrates are patterned in an in-house photolithography facility. We use positive photo resist to produce mask plates, For patterning, the substrates are first coated with a negative photoresist through spin coating and baked.

The patterns are generated using a mask aligner and UV exposure system.

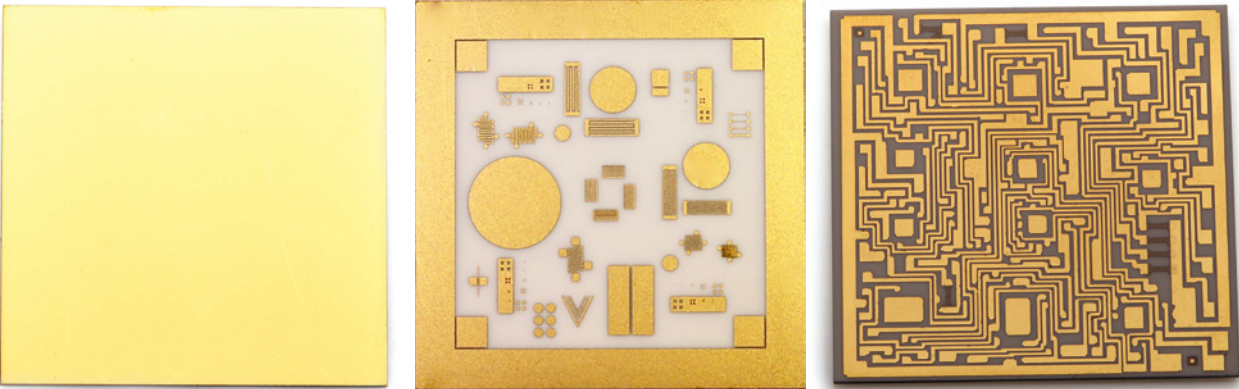
The photoresist is then developed to realize the required pattern. With our in-house direct laser writing facility, we can achieve resolutions of 1 micron on photomasks and our lithography facility is capable of producing patterns with 10 micron linewidths.

PRODUCT FEATURES

- Substrate: Alumina, Zirconia
- Dimension: Up to 2*2 inches
- Durability: Qualified for Space applications
- Custom patterns and metallization schemes can be developed and produced on request

APPLICATIONS

- RF/Microwave integrated circuits
- Hybrid micro circuits
- SAW devices
- RADAR
- Thin film resistors
- Reticules

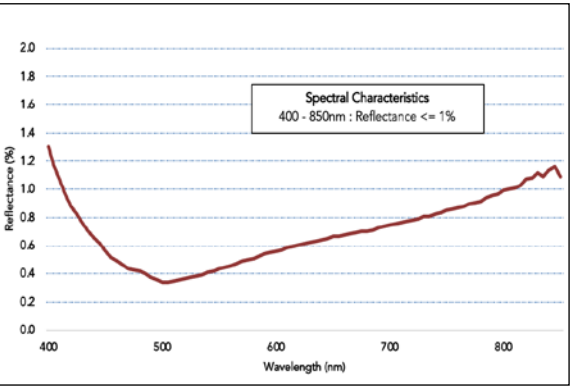


Thin Film Metallized Circuits

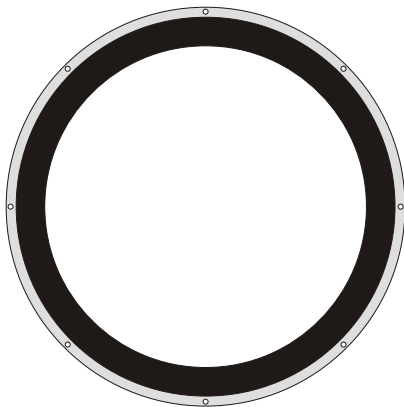
11. BLACK ABSORBER COATINGS

HHV's black absorber coatings are developed using an optimal design of multiple metal-dielectric layers on stainless steel substrates. These coatings are hard and adherent and have an average reflectance of less than 1% in the visible range. They are widely used in space applications.

These high absorbance coatings provide superior stray light suppression and attenuation,therebysignificantlyimproving signal to noise ratio. Coatings are space worthy.



Spectral Graph : Black Absorber Coating



Black Absorber Coating

- PRODUCT FEATURES
- Substrate: SS-304, Glass
- Dimension: Diameter up to 200mm
- Durability: MIL-C-675A, MIL-M-13508C
- Custom coating designs developed and produced on request

- APPLICATIONS
- Used for light trapping applications in lens housings, light baffles, IR sensors and light detectors

12. EMI SHIELDING COATINGS

EMI shielding coatings are used to eliminate interference of stray electromagnetic rays that can damage sensitive devices and components. Both metallic and transparent coatings can be used for EMI shielding. Commonly used metallic coatings include aluminium, copper and nickel.

HHV specializes in offering EMI shielding coatings on metallized plastic enclosures with complex geometries and can also custom make the coatings based on the required frequency and shielding effectiveness.

HHV also offers transparent EMI shielding coatings on glass and plastic substrates by depositing transparent conducting oxides such as ITO or AZO films that have high transmission in the visible range. Shielding effectiveness of our metallic EMI shielding coating is better than 80 dB for frequencies up to 1 GHz.

Shielding effectiveness of our ITO coatings are in the range of 50 to 60 dB. Index-matched ITO (IMITO) coatings can also be developed for enhanced transmission.

- PRODUCT FEATURES
- Substrate: Glass, Plastic
- Dimension: Lengths up to 1000 mm
- Durability: MIL-STD-810F
- Custom requirements for resistance and coating thickness upon request

- APPLICATIONS
- Smoke and fire sensors for industrial purposes
- Communication equipment and display devices for defense
- Ultrasound sensors for medical equipment
- Cockpit windshield for Aerospace



EMI Shielding Coating

13. AR COATED ZINC SULPHIDE DOMES

Zinc Sulphide is used for missile windows due to its broadband optical transparency.

Zinc Sulphide (ZnS) domes are used as impact sensors on seeker missiles. When the missile makes contact with the target, the impact sensor sets off the warhead.

HHV has in-house facilities to fabricate ZnS domes. These domes are coated with a high durability anti-reflection coating suitable for the LWIR and MWIR regions with transmittance of more than 92%.

The coatings are corrosion resistant, have excellent adhesion and coated with a gold band to ensure a resistance of less than 12Ω.



AR Coated Zinc Sulphide Domes

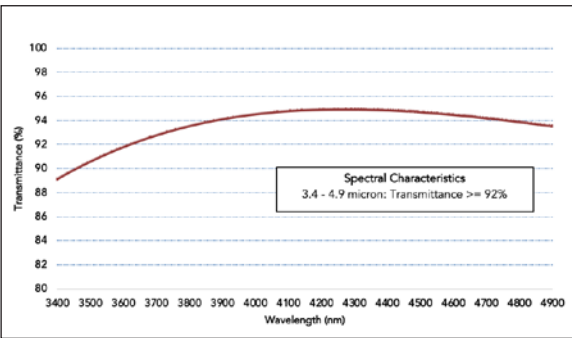
PRODUCT FEATURES

- Substrate: Zinc Sulphide
- Dimension: Diameter up to 200 mm
- Durability: MIL-C-675, MIL-C-48497A
- Custom profiles can be generated upon request

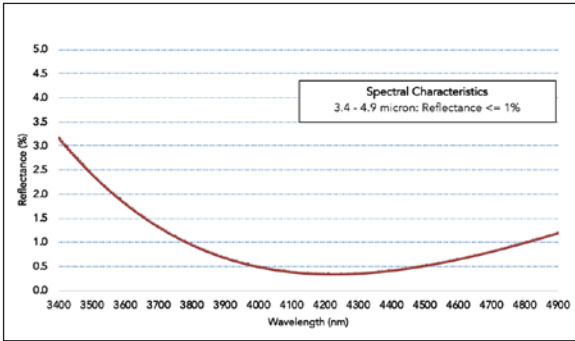
APPLICATIONS

- Seeker missiles for defense

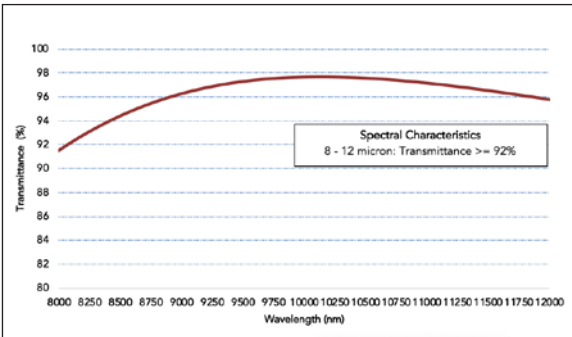
Spectral Graphs



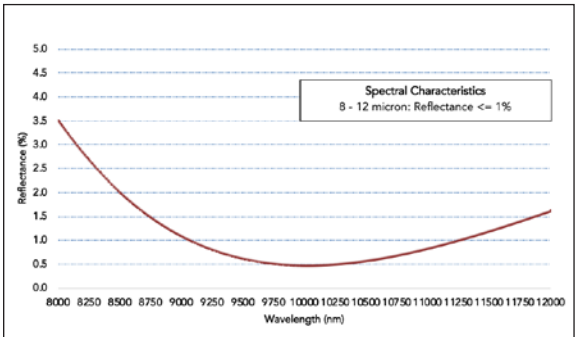
Transmittance : ARC (3-5) on ZnS



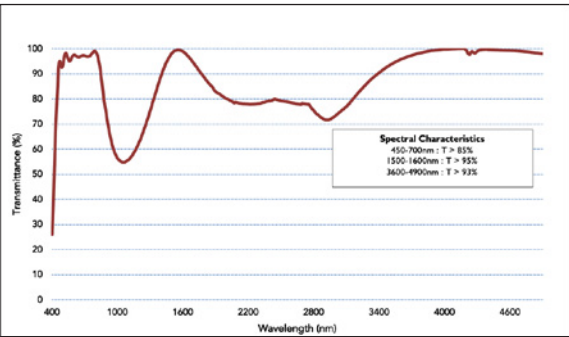
Reflectance : ARC (3-5) on ZnS



Reflectance : ARC (8-12) on ZnS



Reflectance : ARC (8-12) on ZnS



Transmittance : ARC (Triple Band) on ZnS

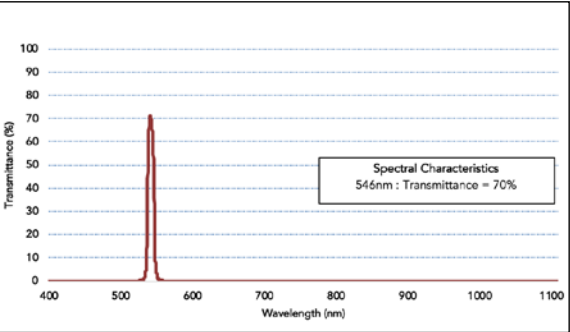
14. OPTICAL FILTERS

An optical filter is a device which selectively transmits light of a specific wavelength. HHV offers a broad range of optical coatings that span the UV, visible and IR spectrum.

HHV produces fluorescence filters, narrow band interference filters, flame photometry filters, neutral density filters, short pass filters, long pass filters, band pass filters, notch filters, edge filters and coloured glasses.

The filters are coated with dielectric coatings and can be tailored to transmission and optical density requirements. HHVs' optical filters offer superior hardness and durability.

Our filter coatings can be deposited on a single substrate or multiple substrates and laminated with optical cement to form a single element.



Spectral Graph : Optical Filters

PRODUCT FEATURES

- Substrates: BK7, Borofloat, UV Fused Silica, Quartz
- Filters are available in standard wavelengths of 340 nm, 405 nm, 450 nm, 492 nm, 505 nm, 546 nm, 578nm, 630 nm and 700 nm
- Dimension: Diameter up to 25mm
- Durability: MIL-STD-810E
- Custom wavelengths can be developed and produced on request

APPLICATIONS

- Determination of Sodium and Potassium levels in body fluids
- Determination of Calcium in milk, beer, fruit juice and biological fluids
- Determination of potassium in soil, fertilizers and plant-derived resins
- Fluorescence microscopy
- Biomedical instrumentation
- Lasers



Optical Filters

CONSUMABLES

HHV offers a wide variety of thin film deposition materials and consumables for high vacuum purposes.

OPTICAL WINDOWS

SPUTTERING TARGETS

Metals	Al, C, Cr, Cu, Ge, Co, Au, Hf, In, Fe, Pd, Mg, Mo, Ni, Nb, Pt Se, Si (multi and mono), Ag, Ta, Ti, Sn, W, Zn, Zr, V
Oxides	Al2O3, CeO2, Cr2O3, CuO, Ga2O3, GeO2, In2O3, La2O3 MgO, MnO2, Nb2O3, SiO2, Ta2O5, TiO2, WO3, ZnO
TCO	ITO (In2O3 : SnO2), AZO (ZnO : Al2O3) GZO (ZnO : Ga2O3), IGZO (In : Ga : ZnO)
Other	Carbides, Fluorides, Nitrides
Other	Alloy, Ag Alloy, Al Alloy, Co Alloy, Cr Alloy, Ni Alloy, Ti Alloy
Forms	Circular (2-12 inches), Rectangular, Cylindrical rotary, Custom designs



EVAPORATION MATERIALS

Metal	Al, Au, Pt, Pd, Ag, Ru
Oxides	Al2O3, CeO2, Gd2O3, HfO2, ITO, MgO, Sc2O3, ZrO2, TiO2, TaO5, SiO, SiO2, Ta2O5, TiO, Ti2O3, Ti3O5, Y2O3
Fluorides	AlF3, BaF2, CaF2, CeF3, NaAlF6, LaF3, PbF3, MgF2, PrF3, YF3
Sulphides and Selenides	ZnS, ZnSe
Forms	Pieces, Granules, Powder, Rods, Wires, Sheets, Slugs, Pellets, Nano powder, Ingots, Custom combinations



LINER, FILAMENTS AND BOATS

Material	W, Mo, Cu, C, Al2O3, BN, Quartz
Crucible Sizes	4cc, 7cc, 15cc, 25cc, 40cc
Equipment manufacturers	All major manufacturers



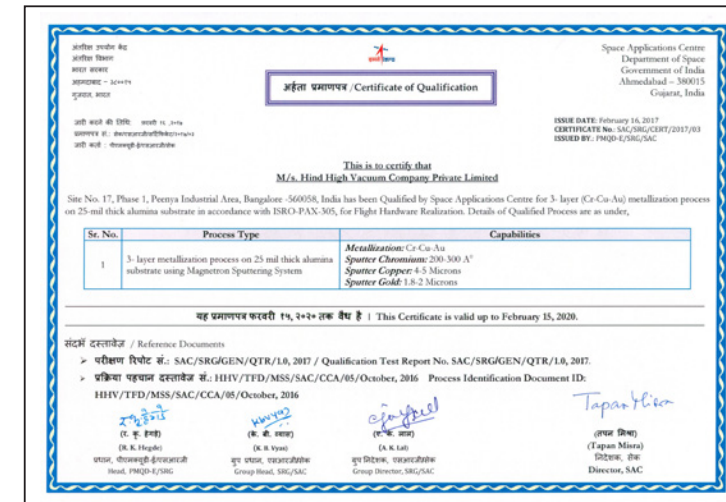
QUARTZ CRYSTALS



CERTIFICATIONS

ISO Certificates

HHV is an ISO certified company. HHV is also qualified by the Space Applications Centre for its metallization process. HHV's laser optics are certified by international testing agencies for laser damage.



Space Qualification for HMC Metallization



Laser Damage Certification



Space Qualification for Lithography

NOTES

NOTES



CONTACT US FOR YOUR THIN FILMS AND OPTICS NEEDS TODAY

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