CAPABILITIES GUIDE

THIN FILMS AND OPTICS

HHV ADVANCED Technologies

Thin Film Equipment | Precision Optics

THE COMPANY

HHV Advanced Technologies (HHV AT) is India's premier thin film and vacuum technology company with over 60 years of expertise in the design and manufacture of high vacuum equipment for optical, decorative, functional coatings and astronomical telescope mirrors and special purpose vacuum equipment.

Our Thin Films and Optics division is a leading manufacturer of high precision optical components and thin film coatings. It's manufacturing unit includes facilities for optical polishing, high end metrology, thin film coatings and testing capabilities.

We manufactures dichroic coated optics, laser filters, narrow band interference filters, hybrid micro circuits, periscope prisms, thin film heaters and infrared optics for variety of applications in industrial, space and defence technologies.

WHY HHV AT

We have multiple manufacturing facilities in Bengaluru, India. These manufacturing facilities are equipped with ISO 7, ISO 8 clean rooms to manufacture and coat high precision optical components.

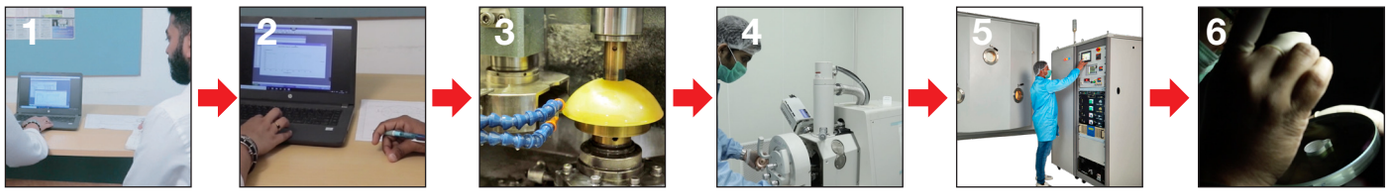
HHV AT produces over 100,000 optical components every year for domestic and international markets. With sales offices in the United Kingdom and global distributor presence HHV AT exports its products to the USA, UK, Germany, Italy, Turkey, Switzerland, South Korea, Singapore and China.

We maintain close collaborative links with premier research institutions such as the Indian Institute of Science, the Indian Institutes of Technology, National University of Singapore, Northwestern University and the University of Oxford. HHV AT has extensive working experience with India's premier defence & space institutions such as ADA, BEL, RCI, DRDL, BARC, and ISRO.

We are an ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 certified company.

HHV AT awarded a 'Certification of Qualification' by the Indian Space Application Center, ISRO for its Thin Film Metalized substrates, and also received the prestigious National R&D award for the same.

DESIGN TO PRODUCTION



Customer Specification Review | Design and Development | Optical Fabrication | Metrology | Thin Film Coating | Quality Assurance

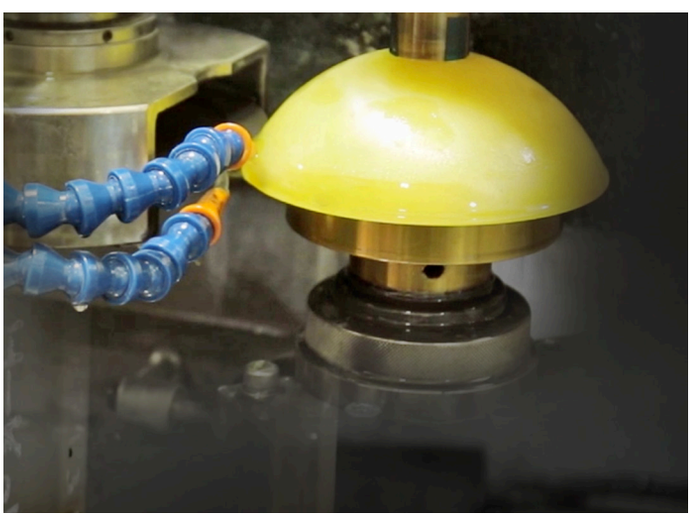
RESEARCH AND DEVELOPMENT

Our Research and Development team consists of scientists and engineers who are uniquely qualified to provide a variety of application integration services to customers. Our R&D team is equipped to develop products through our extensive design and manufacturing resources to create products that meet customer needs. We utilize several software programs including Essential Macleod, TF-Calc and CODE for design, optimization and sensitivity analysis of thin film coatings.

OPTICS FABRICATION

Our precision Optics Fabrication Lab is equipped with state-of-the-art technology and machinery to fabricate high precision optical components in the visible and infrared spectrum. We have expertise in delivering complex optical component requirements for space and defence applications using high precision machines.

Processes	Specifications
Curve generation	To generate radius of curvatures up to 200 mm diameter
Single side Polishing with Optical Contact	For polishing of optical components up to 500 mm diameter with flatness up to λ/10 over 100 Ø
Double side Lapping Machines	For lapping of optical components up to 180 mm diameter and up to 0.5 mm thickness with parallelism of 10 arc seconds
Double side Polishing Machines	For polishing of optical components up to 180 mm diameter and up to 0.4 mm thickness with parallelism of 10 arc seconds
Centring and Edging for Spherical and Optics	Centering of lenses within 2-micron accuracy and OD turning up to 200 mm diameter using a diamond wheel
Aspheric Generation	High precision SPDT systems to generate aspheric upto 250 mm in diameter diffractive capability of 25± 4 microns



To learn more visit www.hhvadvancedtech.com

OPTICS MATERIAL AND PRECISION

HHV AT has extensive knowledge on handling materials such as Quartz, Fused Silica, Zerodur, BK7, Crown and Flint Glasses for the UV-Visible Spectrum and Silicon, Germanium, Zinc Sulphide for the Infra-Red spectrum.

Specifications	Plano Windows	Prisms and Wedges	Spherical Lenses	Domes	Visible/IR Aspherics
Flatness	Up to λ/8	Upto λ/4	Upto λ/6	Upto λ/6	Upto λ/4
Surface Quality (S/D)	10-5	40-20	10-5	60-40	20-10
Parallelism	10 arc sec	-	<30 arc sec	1 arc min	<30 arc sec
Maximum size	Ø300 mm	300 mm	Ø200 mm	Ø 200 mm	Ø 250 mm
Minimum size	Ø 5 mm	10mm	Ø10 mm	-	Ø 5 mm
Minimum Thickness	0.5 mm	-	1 mm	3 mm	0.5 mm
Centering	-	-	<1 arc min	-	-
Radius Tolerance	-	-	±0.03 mm	±0.03 mm	±0.02 mm

OPTICS METROLOGY

1. ZYGO, Apre Interferometer with transmission spheres to measure surface figures up to 1/10th lambda
2. Trioptics Spherometer to measure the radius of curvature of various components to an accuracy of one micron
3. Davidson Autocollimator to measure the surface angles and parallelism to an accuracy of less than one arc second
4. Talysurf PGI Freeform allows for high resolution measurement of high precision freeform optics with measurement accuracy from 100 nm (PV), and resolution down to 0.8 nm
5. Kyoritsu Electric CS-A1100, used to measure eccentricity of lenses in transmission mode
6. Rapid-I-Precision measuring non contact CMM
7. Nikon optical profile projector

OPTICAL COATINGS

Our Thin Films production facility has over twenty five systems with accessories and processes that are clean room compliant. HHV AT can handle substrate sizes of upto 600 mm for thermal evaporation and 1000 mm for sputtering deposition processes.

COATING TECHNOLOGY

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

COATING	SUBSTRATE MATERIAL	SPECTRAL RANGE	SPECTRAL PERFORMANCE (T is Avg, R is per surface)	SUBSTRATE SIZE
UV Coatings	Borofloat, Quartz	220 – 400 nm	R ≥ 90%	Up to 1200 mm
	Stainless Steel, aluminium	220-400 nm	R ≥ 90%	
UV Transmitter Coatings	Quartz	220-400 nm	T ≥ 84%	Up to 600 mm
		580 nm	T < 45%	
		600-1100 nm	T ≤ 85%	
AR Coatings	BK7, UVFS, Quartz	400-700 nm	R ≤ 1.0%	Up to Ø 280 mm
		600 – 900 nm	R ≤ 0.5%	
		Single Wavelength ARC Coating in the 400 – 1100 nm range	R ≤ 0.3%	
		1500 – 1700 nm	R ≤ 0.5%	
	Sapphire	450 – 1700 nm	R ≤ 1.5%	
		420 – 680 nm	R ≤ 0.5%	
Laser Safety Coatings	Borofloat KG5	Bands within 400 - 1200 nm range	Optical Density up to OD 8; VLT: 30-70% (depending on blocking wavelength)	Up to Ø 230 mm
High Reflective Coatings	UVFS, Quartz, BK7	532, 632, 915 and 1064 nm	R ≥ 99.0 %	Up to Ø 230 mm
Infrared Coatings	Silicon	3600 - 4900 nm	R < 2%; T > 94% (HEAR)	Up to Ø 230 mm
	Germanium, Sapphire	3600 - 4900 nm	R < 2%; T > 94% (HEAR)	
		8000 - 12000 nm	R < 0.5%; T > 98% (HEAR)	
	Zinc Sulphide	3600 - 4900 nm	R < 1%; T ≥ 97% (HEAR)	
		8000 - 12000 nm	R < 0.5%; T > 90% (HEAR)	
	Zinc Selenide	3600 - 4900 nm	R < 1%; T > 97% (HEAR)	
		7500 - 10500 nm	R < 1%; T > 95% (HEAR)	
	Chalcogenide glass	8000 - 12000 nm	R < 1%; T > 95% (HEAR)	
DLC Coating	Silicon, Germanium	3600 - 4900 nm	R < 3%; T > 92%	Up to Ø 230 mm
		8000 - 12000 nm	R < 3%; T > 90%	
Silver Coatings	Borofloat	480 - 900 nm	R ≥ 97%	Up to Ø 250 mm
ITO Coatings	BK7, Borofloat, Polycarbonate, Acrylic	400 - 700 nm	Sheet resistance: 5-100 Ω/sq	Up to Ø 300 mm
			T ≥ 80% (varies according to sheet resistance)	
		1535 +/- 20 nm	< 30 Ω/sq; T ≥ 85% (with ARC coating)	
EMI Shielding	Plastics		Sheet resistance of 2 Ω/sq	Flats upto 1m x 1m

HYBRID MICRO CIRCUITS

Our Hybrid Micro Circuit (HMC) Lab is approved by the Indian Space Research Organisation for the production of Flight Mode components. HHV AT develops and produces metallized and patterned alumina substrates for space and defence applications. The HMC Lab produces multi-layer metallization using Chromium, Copper, Gold, Nickel, TiW, Pt and NiCr.

HHV AT is equipped with a laser writer for mask fabrication, UV exposure systems, an etching room with a chemical wet bench, dicing machines to cut metallized substrates to required sizes and high-performance microscopes and profile projectors for inspection and measurement of the plain and patterned substrates. The HMC Lab has ISO 7, ISO 8 clean rooms and ISO 5 laminar flow stations that allow us to achieve resolutions up to 40 microns.

Processes	Specifications
Metallization	Substrate size up to 2.25” with thickness up to 25 mil / 10 mil
Lithography	Can achieve line resolutions of up to 40 µm
Spin Coating	Maximum substrate size of 6” in diameter
UV Exposure	Line resolution up to 1µm with a maximum substrate size of 3” in diameter
Laser Writing	Line resolution up to 6 µm with a maximum substrate size of 3”x 3”
Chromium Mask Patterning	Pattern up to 3”x 3” in size
Dicing	Minimum substrate size of 0.07” to a maximum substrate size of 6” in diameter

To learn more visit www.hhvadvancedtech.com

COATING METROLOGY

1. Scratch-dig comparator
2. PerkinElmer - Spectrophotometer - wavelength range of 190-3300 nm
3. PerkinElmer - Fourier Transform Infrared (FTIR) Spectrophotometer - wavelength range of 1.3 µm-30 µm
4. Agilent - Cary 6000 Spectrophotometer - wavelength range 0.175 µm - 1.8 µm can measure up to optical densities OD8 with UMA.
5. Veeco - Stylus Profiler to measure the thickness and roughness of films using a diamond tip of 12.5 micron radius
6. Hitachi - SEM (Scanning Electron Microscope) with an EDX module for composition analysis of samples up to 160 mm diameter and resolution of 3 nm
7. Leica optical microscope with 100 X magnification
8. ESPEC - Environmental chamber - temperature range from -40°C to +150°C and humidity from 30% to 95% RH
9. Korrox-III - Salt spray chamber to analyze corrosion resistance
10. Nagy-Instrument – Sheet Resistivity meter

QUALITY ASSURANCE

HHV AT performs a wide variety of testing and measurements to ensure products are compliant with all applicable customer specifications, as well as military and aerospace standards. Spectrophotometers and optical measuring instruments are tested, controlled, calibrated and maintained to meet the requirements of our Quality System.

MIL Standards:

MIL-C-48497A, MIL-C-675C, MIL-STD-810E, TS-1888, MIL-STD-810F, MIL-C-675A, MIL-M-13508C

CERTIFICATION

ISO Standards:

ISO 14001:2015, ISO 9001: 2015, ISO 45001 2018


SO4473

LIDARIS

LASER-INDUCED DAMAGE THRESHOLD (LIDT) MEASUREMENT REPORT

DAMAGE CERTIFICATION (ISO 21254-3) TEST PROCEDURE

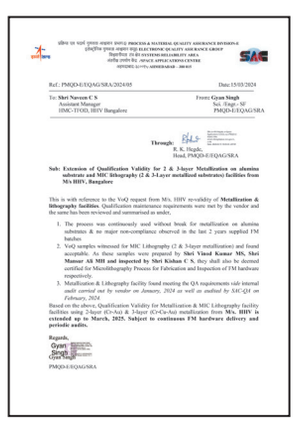
SAMPLE: 1

COMPARISON OF DAMAGE CERTIFICATION RESULTS

Laser Damage Certification


Certificate of Qualification

Space Qualification for Lithography


Space Qualification for Metallization (2 and 3 Layers)

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ADVANCED
Technologies

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CONTACT US FOR YOUR THIN FILMS AND OPTICS NEEDS TODAY

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