HHV WORLD

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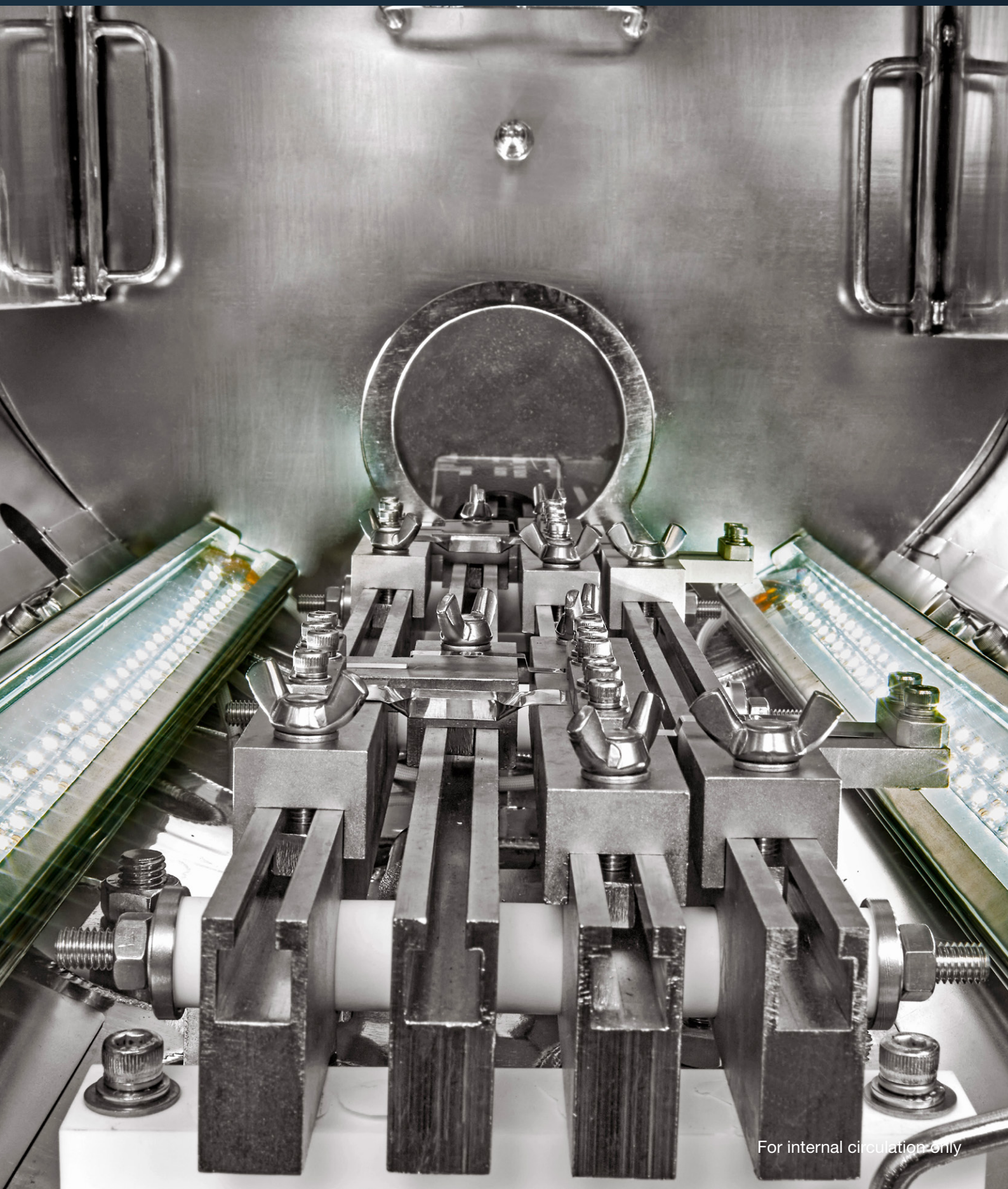


Editorial

Two quarters of the financial year are over. HHV has developed new technology in the last six months and aims to increase market share and sales through its innovative high technology products.

Our equipment division both in thermal and thin films process are experiencing a large overload of orders. We are enhancing capabilities and capacities in place to ensure that more deliveries happen at the committed time. In the last quarter we developed and launched new products which are highlighted in this issue and also entered into new areas of work through exciting relationships with domestic and international partners on the industry and scientific front.

A new large automotive metallisation system has been developed and supplied with sputtering and shutter capabilities. New designs of glove box sintering furnaces for various applications have been supplied from HHV.

In the thin films area new products have been developed in defence and space sectors. HHV's peep sight reticles use two reticle manufacturing technologies to enhance starlight and block selective light spectrums. The reticles are used for a multitude of applications from sights to encoders. The HHV team also release a thought piece on laser safety coatings for medical and industrial applications.

Our special thin film equipment uses for various coating processes developed collaborations with industrial leaders to build large area telescopes. The world of forensics has undergone a major change in the detection of fingerprints using techniques of vacuum metal deposition. HHV has been a leader in this field and released a fresh set of models covering the full range of equipment required for getting high quality solutions for the process of crime detection. HHV has also developed a reactive ion etching tool for electronics applications.

HHV Crystals is our newest member is meeting the requirement of the watch crystal market by producing the best in class product for the watch industry.

HHV continues to attend and host multiple exhibitions both virtual and in person. We have webinars to enhance our technological presence in building state of art capacity in vacuum and thin film technology. We will be participating in the DEF EXPO show in October and have been awarded the Innovation Award for the Open Challenge 3 from IDEX. We were part of the 7th Space Expo held at BIEC in Bangalore and will be attending SPIE in San Francisco in January 2023.

Our international reach through our wide network of distributors anchored through HHV Ltd based in UK continue to provide global support and superior services to all our customers globally. We have moved location to meet with the growing business and needs.

CONTENTS

Twin Door Vacuum Sputter Coater with Shutter Mechanism

The high productivity twin door sputtering system is designed to deposit suitable material, utilizing sputtering technique, which enhances the quality, reliability and durability and offers dense and thick coating, adding strength to withstand environment conditions.

HHV as leaders in supplying vacuum metallizer across the globe has recently introduced a twin door vacuum sputtering system with shutter mechanism.

Sputter Coater with Shutter Mechanism

The twin door vacuum sputtering system with shutter mechanism has been specially designed and developed to evaporate two different materials/alloys to sputter on the substrate. The shutter mechanism design facilitates to avoid contamination on the substrate while evaporation of source materials. This enables to have multi-layer semi-transparent coating on the substrate used in automobile industry parts like dash-board.

High Productivity

Base-coated front substrate of surface size from 50 mm x 50 mm to 200 mm x 900 mm and depth from 2.0mm to 100 mm, the twin door mechanism reduces the cycle time and hence increases productivity.

This Twin Door Sputtering system can accommodate 710 mm diameter satellite with two planar magnetrons using a 30KW DC power supply for one magnetron and a 30KW Pulsed DC power supply for another magnetron.

The system has been designed with a vertically mounted chamber of size 866 mm (ID) x 1146 (Depth) x 1580 mm (height) and two numbers of power, water cooled, rectangular magnetron sources to hold a metal target of size 173 mm (Width) x 1392 mm (height) on either side.

The metalizing system is suitable for coating parts made of (1) Thermoplastics (PC, ABS, ABS+PC, PC-HT, PBT.), (2) Thermosets (UP-BMC), (3) Varnished base-coated metals(Al, Mg, and SST).

Flexible Process Cycle

The system has unique features of inbuilt process cycle parameters which can be selected as required and they are;

- Plasma pre-treatment of substrates using Argon gas (Glow Discharge)
- Plasma CVD pre-treatment of substrates using HMDSO (Base Coat)
- Metallization/ Reactive Metallization process by sputtering technique
- Plasma CVD protective coating of substrates using HMDSO (Top coat)

All the above processes in any order as required for dedicated recipes. This polymerization guarantees a protection of the substrate by preventing deterioration / Corrosion.

The cryo-refrigerator extracts the moisture condensed on the substrate which enhances the reflectivity of the reflector. The dual pumping system helps to enhance the productivity of the equipment.

The drive mechanism is located on the bottom plate of the chamber and consists of a Ferro fluidic type vacuum shaft seal with shaft which is attached to a servo motor with encoder. Rotation can be controlled between 2 – 10 rpm.

User friendly operations and safety

There are two independent gas inlet systems, one for air / Oxygen / Nitrogen / Argon to carryout glow discharge cleaning processes and another for the monomer to carryout plasma polymerization process for base coat and top coat of the reflectors.

A dual pumping system has been provided. The high vacuum system enables to achieve a ultimate

vacuum of 10-4 mbar. Rotary work holders of size 710 mm (ID) x 1220 mm (Ht.) located one in each door, rotate during the process. A glow discharge cleaning system has been provided for plasma pre-treatment.

A HMI enables complete automation of vacuum and sputtering cycle. Necessary safety, alarm and control systems have been provided to ensure safety and ease of operations. On the whole, the twin door metallization system with sputtering technique enhances the value of the product, increases productivity by reducing cycle time with user friendly and safety-enhanced operation processes.

High Temperature, High Vacuum Sintering Furnace Integrated with Glove Box

A glove box is a sealed container that is used to manipulate materials where a separate atmosphere is desired. It is either used to protect the user from hazardous materials or to protect chemicals and materials that may be sensitive to air or water vapor.

Glove boxes integrated with vacuum heat treatment and vacuum sintering furnaces are being widely used in metallurgical, powder metallurgical applications and various magnetic material applications. The atmospheric controlled environment provides a reliable guarantee to produce high-performance products, by decreasing the material oxidation. As a leader in vacuum science and technology in India, HHV is known for its design and engineering of customized high vacuum furnaces for various applications.

Recently, HHV has designed, manufactured and developed a high vacuum sintering furnace for vacuum synthesis and sintering of fuel pellets. Sintering of pellets is carried in vacuum or inert (Argon) atmosphere under slight over pressure (50 – 100 mbar) above atmospheric pressure.

Furnace details

The double walled vacuum furnace chamber of size 500 mm diameter x 500 mm height has been designed with guided baffles for effective water circulation to cool the chamber. The maximum rise in skin temperature can be restricted to about 15ºC above ambient at the highest operating temperature.

The cylindrical graphite heating element facilitates heating the job to a maximum temperature of 1800°C. The gas (Argon) inlet system has flow control and pressuring measuring instrumentation to continuously monitor the furnace chamber pressure. The booster pump based vacuum system enables to achieve an ultimate vacuum of 5 x 10-6 mbar.

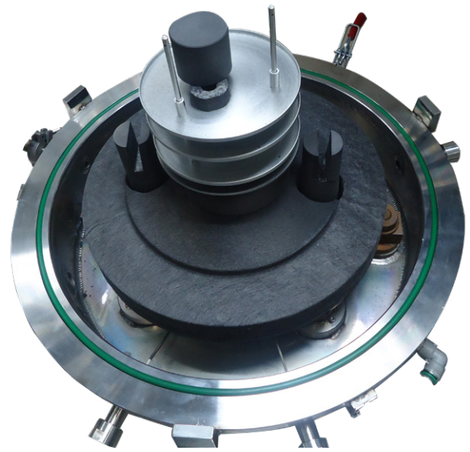
Glove box chamber

The glove box chamber of size 1200 mm (W) x 1250 mm (H) x 1200 mm (D) has been integrated with the high temperature resistance heating furnace that has three sides of laminated glass. The front of the chamber has multiple nitride gloves that allow the user to handle materials.

Controls and automation

The furnace has a manual/automatic control system. The accurate Control and high degree of entire operation is automated with PLC and measuring instrumentations. The user friendly operation of the furnace has been provided with range of safety and warning system.

This furnace is an indigenously developed technology by HHV which enables the manufacturing of advanced structural and high-performance materials in India for different applications.



Vacuum Metal Deposition for Finger Print Detection

The fingerprints which are being found in the scene of occurrence can be classified into three categories as latent, patent, and impressed. Latent fingerprints are the ones which are invisible to the naked eyes. Patent fingerprints are the ones which are visible to human eyes as they can be formed with any contact from blood, grease, dirt or ink. Impressed fingerprints are also visible to naked eyes and they are formed by pressing fingers on tar, soap, wax or any other fresh liquid.

The most difficult to detect amongst these is the latent fingerprints as they are invisible. Some of the commonly used techniques for detection of latent fingerprints worldwide are the Superglue or Cyanoacrylate fuming, Iodine fuming, radioactive Sulphur dioxide, Small Particle Reagent, Crystal Violet, Physical Developer, and Vacuum Metal Deposition (VMD).

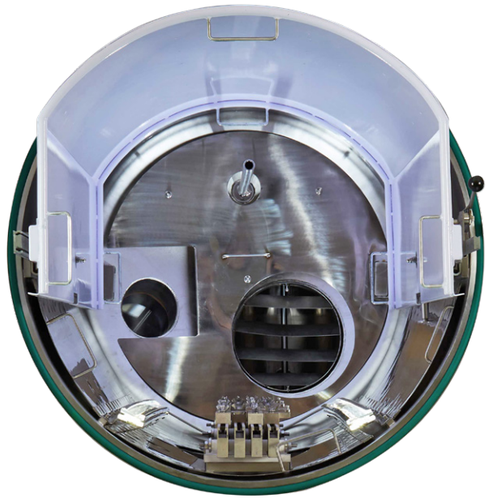
Amongst these, the VMD process is an extremely sensitive technique which is known to develop fingerprints in a more even manner than the non-vacuum based techniques. The technique has the following specific advantages:

- VMD can develop finger marks on 70 % of articles processed
- Older finger marks (20 + years) are developed as effectively as new ones
- Develops finger marks that have been exposed to water
- Does not prevent firearm mechanisms from operating post development
- Processed finger marks are ready to photograph, and no further treatments are required

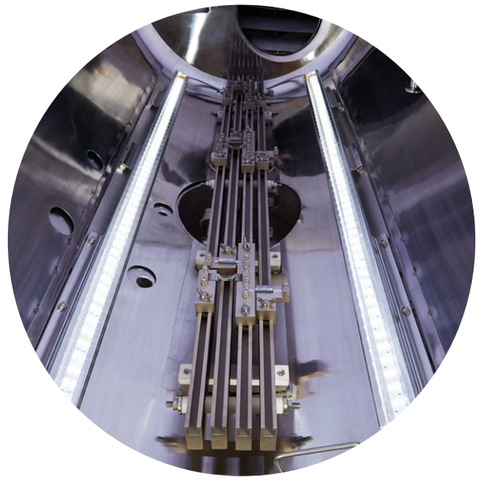
The VMD is essentially metal evaporation technique that is used to apply very thin metal films in a wide range of everyday applications such as watches, toys, packaging materials, automobile reflectors, and so on. The process takes place in a specially-constructed vacuum chamber into which the articles to be coated are placed. The air in the chamber is pumped away by a set of vacuum pumps. The metal is melted and evaporated in an electrically-heated 'boat'. The metal vapour is free to travel through the vacuum inside the chamber. The vapour condenses on any object in its path and forms a thin film.

The bare surface and the areas in the surface where fingerprints are present differ in the following ways:

- Presence of thin films of grease
- Local differences in chemical composition
- Local differences in Oxidation State
- Abrasion of the surface



Internal chamber view



Evaporation source layout

This is what is exploited by the VMD technique. The metal that is evaporated adheres differently to the bare surface, and the areas where finger prints are present, thereby forming a visual image of the latent fingerprints. The application of metal evaporation to forensic science is termed as Vacuum Metal Deposition or VMD.

HHV has been producing a range of VMD machines to cater to these applications for the past 15 + years and has been supplying to Police departments in various European and Asian nations. These machines are built upon designs that carry a legacy of close to four decades.

Touchscreen for ease of operation

VMD was developed in the 1960s/70s by the UK Home Office and Edwards High Vacuum leading to the first Edwards Identicoat-series VMD systems from the 1970s onwards. The original UK Home Office specification for VMD systems for UK Police forces was written around that early work. HHV has the exclusive licence to build and supply the former Edwards VMD systems since 2008.

More recently, HHV has revamped it's range of offerings to bring out the Ultra and Smart series of Identicoat machines consisting of the ID 750 Ultra, ID 500 Ultra, and ID Smart. ID 750 Ultra is designed for the rapid processing of larger batch quantities of evidence in regional or national forensic laboratories. ID 500 Ultra is a mid-sized coater for use for small volume samples. ID 360 Ultra is a compact and economical system designed for research applications and for introducing the process into the mainstream.

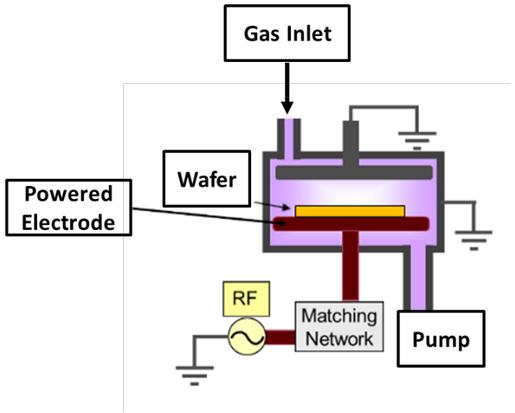
The area of VMD is being continually upgraded by various research groups to include the ability to improve results with cling film, fabrics, polymer banknotes, etc., and the offerings from HHV can be upgraded to keep in line with the state of the art technology in this area.

For more information, please visit our website: https://hhv.in/thin-film-equipment/thin-film-equipment-products-production-id-series

SAARA RIE: Reactive Ion Etching for Semiconductor Micro and Nano-Fabrication

HHV's SAARA RIE is built for etch process commonly used in the manufacturing of printed circuit boards and other micro-nano fabrication procedures as in semiconductors and MEMS technologies; the process uses a chemically reactive plasma in a vacuum chamber to aggressively etch in a vertical direction (down).

Horizontal etching is purposefully minimized in order to leave clean, accurate corners. This has led to many technologically significant and enabling process advances in patterning technology for the most part, matching the lithography roadmap. With the development of plasma etching sub-micron and nanoscale structures could be realized with true critical dimension replication in the etched structures.



Reactive Ion Etching (RIE) is the simplest configuration of a dry etching process that has evolved over the wet etching, where the chemical species are not directional and lead to isotropic etching in most cases. In some specific cases, anisotropic etching is made possible because of preferential etching along crystal planes or defects. But such schemes do not hold good when the device architecture requires faithful reproduction of the mask patterns. The isotropic etching undercuts the masking material and seriously constrains the feature sizes that can be created. The limitation is a result of etching in the lateral direction. As a result, there was motivation to find alternative approaches that provide anisotropic (unequal) etching that reduced or eliminated the lateral component. This led to using plasma-based processes rather than wet chemistry.

HHV has been building RIE systems since 2000s with Fluorine and Chlorine chemistry for applications in Si, SiO2, SiN, and Al metal etching. HHV's RIE systems are based on capacitively coupled discharge plasma (CCP) that is generated between two parallel plates. The substrate is placed on a biased lower electrode (the cathode) facing a grounded upper electrode.

HHV's has recently introduced the RIE system on its SAARA platform, that consists of a process chamber fabricated from single block Aluminum with approximate dimensions of 400 mm diameter and height of 200 mm with the baking facility up to 150 °C. A substrate size of maximum 6" diameter can be loaded directly into the etching chamber or through a load-lock with telescopic transfer arm. A gas shower head ensures uniform gas distribution, and the substrate holder is provided with a dark space shield to confine the plasma around the 6" diameter substrate. The distance between the gas shower head to substrate is fixed at 50 mm. The geometrically circular substrate platen is made of non-corrosive material with backside cooling.

The mass flow controllers are suitably integrated to permit a range of gases such as Argon (Ar), Oxygen (O2), SF6, CHF3, CF4, BCl3 and N2 into the chamber as per the etching process requirement. RIE processes can also be used for surface preparation prior to deposition or other process steps. The gas introduced are activated by a 13.56 MHz RF power supply of 600 W to create plasma inside the process chamber.

This plasma consists of reactive species (radicals and electrons) and ions. The ions are accelerated by the bias towards the wafer. In this configuration etching can occur either with a combination of reactive species (for the chemical component) and ions (for the physical component) or with ions alone (with the choice of using inert gases such as Ar). Since both reactive species and ions are used, the specific configuration is often referred to as a Reactive Ion Etching.

A turbo based pumping system with suitable control accessories enables to achieve base pressure of 10-7 mbar. A special motorized throttle valve is used for fine controlling of the process pressure to 10-2 mbar. RIE processes are known for higher pressure operating regimes. The system is completely automated and is PC controlled. A wet abatement system facilitates neutralizing of the processed gases before it is exhausted to atmosphere. These systems are part of the plasma processing system portfolio and are used throughout the semiconductor industry.

Astronomical Telescope Mirror Coaters

Advanced astronomical telescopes are designed to peer deeper into space and expand the boundaries of the universe as we know it. The mirrors of the telescopes are amongst the most important components for sensing radiations from distant sources. These need to be coated with a reflective thin film that aids efficient light collection..

The reflective coating consists of either Aluminium or Silver thin films. Since these films are prone to environmental degradation, a subsequent protective layer of nitride or oxide materials is provided which prolongs the life of the reflective layer. Even so, over a period ranging from a few months to a few years, the reflectivity of the coated thin film degrades, which necessitates a re-coating. The existing coatings are stripped clean, and a fresh coating is then applied. These coatings are applied by vacuum deposition process to obtain the best properties in terms of reflectivity and durability. As the mirrors are sensitive, and one of the most expensive components in the telescope assembly, the coatings are carried out on-site. Thus a vacuum coater is stationed on-site astronomical observatories for coating of the mirror at regular intervals.

Astronomical telescopic mirrors coaters require a technologically advanced high vacuum equipment design, engineering, and manufacturing. HHV has been globally recognized as a trusted supplier for coaters for telescopic mirrors, and has commissioned and demonstrated its coaters at various locations including demanding high altitudes going up to ~ 14,800 feet. The telescope mirrors size of up to 3700 mm diameter and weighing in excess of 4000 kg can be accommodated in HHV coating chambers with a maximum overall dimension of 4000 × 2100 mm. HHV also offers smaller telescope mirrors diameter in 5 different chamber dimension configurations and other customized solutions to suit the requirement.

HHV's telescopic mirror coaters are based on proven chamber designs and deposition methods. The coaters offer an automated and highly reliable process for coating mirrors with aluminium, protected aluminium with dielectric layers (SiO2 or NiCrNx/SiNx), protective silver coatings with dielectric layers (SiO2 or NiCrNx/SiNx). Some of HHV's capabilities in this area include:

- Design, construction, and commissioning across the globe.
- Evaporation and sputtering technologies for coating mirrors.
- Standard and customized engineering deposition tools.
- Uniformity of better than ±5% over the surface of the mirror.
- Conceptual design and process development.

HHV is proud to be a part of several astronomical programs requiring supply of telescopic mirror coaters in India and across the world. Some of the supplied coaters are for Indian Institute of Astrophysics (IIAP), Inter-University Centre for Astronomy and Astrophysics (IUCAA), Aryabhatta Research Institute of Observational Sciences (ARIES), Observatory of the Sternberg Astronomical Institute, Moscow State University (Russian Federation), and Physical Research Laboratory (PRL), Udaipur.

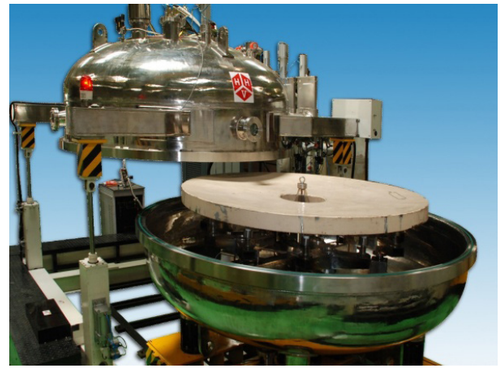
Astronomical Telescope Mirror Coaters

Sputter Coater for 2.2 m diameter Telescope Mirror for IUCAA.

Evaporation coater for 2.1m diameter Telescope Mirror for IIAP.

Sputter coater for 3.7 m diameter telescope mirror for ARIES.

HHV astronomical telescope mirror sputter coating system installed at Caucasus Mountain observatory, Sternberg Astronomical Institute, Russia.



2.1 m diameter mirror coater with PC SCADA control for IIAP.

Mirror coater based on thermal and electron beam evaporation sources for Solar Observatory, PRL Udaipur. This system is being built with a special mirror handling tool integrated with the box coater platform.

Based on the past track-record in the build of telescopic mirror coaters, and its proven competency in the design and development of optical coatings, HHV was short-listed by the Thirty Meter Telescope (TMT) International Observatory (TIO), and India TMT Co-ordination Committee (ITCC) to develop the conceptual design of the coater for secondary and tertiary mirrors of their upcoming telescope. TMT is a joint venture between scientific institutions in Canada, China, India, Japan, and the US to build a 30 m diameter optical-infra-red telescope which will be one of the largest optical telescopes ever built.

Artist's rendering of the proposed telescope as part of TMT program (Courtesy: https://en.wikipedia.org/wiki/Thirty_Meter_Telescope)

HHV was able to meet the objectives of the activity despite various technical challenges given the project requirements, and non-technical challenges imposed by covid. The TMT team was highly appreciative of the efforts put in by HHV in developing the conceptual design for the coater:

भारतीय ताराभौतिकी संस्थान, बेंगलुरु
INDIAN INSTITUTE OF ASTROPHYSICS
भारत टीएमटी समन्वय केंद्र
INDIA TMT CO-ORDINATION CENTRE

From

Prof. Eswar Reddy
Programme Director
India TMT Coordination Centre (ITCC)
Bangalore, India

To

Prasanth Sakhamuri
Managing Director,
Hind High Vacuum Company Pvt. Ltd
Bangalore, India, 560058

Date : 23 August, 2021
Bengaluru

Dear Mr. Prasanth Sakhamuri,

I wish to congratulate the members of the design team from the **Hind High Vacuum (HHV) Company Pvt. Ltd**, Bangalore, who successfully completed a work to develop a design at conceptual level for a coating plant to deposit coating on the secondary and tertiary mirrors of the Thirty Meter Telescope (TMT).

The ITCC is very much pleased with the delivery of the work. I received a rare and appreciative feedback from the TMT project post the review. I really appreciate HHV for the hard work and carrying out this work during the most challenging times due to the COVID-19 pandemic and could complete it to the satisfaction of all those involved.

This is indeed a moment of pride that an Indian company is involved in the initial conceptual design of such an important and complex instrument for the TMT. I am confident that the HHV would successfully progress to the next level of the final design, fabrication, installation, and commissioning phases of the project and would deliver a highly efficient coating plant for the TMT.

I wish you all the best.

With regards,
Eswar Reddy

Artist's rendering of the proposed telescope as part of TMT program (Courtesy: https://en.wikipedia.org/wiki/Thirty_Meter_Telescope)

HHV has recently won an order for the build of a telescopic mirror coater for PRL's Mount Abu Observatory for coating mirrors up to a diameter of 2.56 m. The system is meant for coating the mirrors with Aluminum by downward thermal evaporation using multi-filament array. The build of this coater is currently underway.

HHV is continually undertaking internal development activities in this area to integrate its coaters with proven process recipes for the deposition of highly reflective and durable thin film coating stacks, and is looking forward to being a part of various such projects in the future.

A strategic alliance between C-MET and HHV

Hind High Vacuum Company private (HHV), a leading supplier of equipment in vacuum science, thin film technology and optical applications for high-tech electronics and machines, and Center for Materials for Electronics Technology (C-MET), Pune has announced a strategic alliance to develop, manufacture and delivery of next-generation technologies within the first National Center for Quantum Material Technology (NCQMT), initiated at C-MET, Pune and funded by the Ministry of Electronics and Information Technology (MeitY), Government of India.

The direct connection between HHV's design, in-house vacuum equipment manufacturing, process development and C-MET Pune's scientific expertise enables rapid product design optimization through rapid design, simulation cycles and system development with specific processes builtin. The instruments considered for development are advanced niche technologies for culturing 'quantum materials', such as microwave plasma-enhanced chemical vapor deposition, low-pressure thermal chemical vapor deposition, metal-organic chemical vapor deposition, and inductively coupled plasma-reactive ion etching.

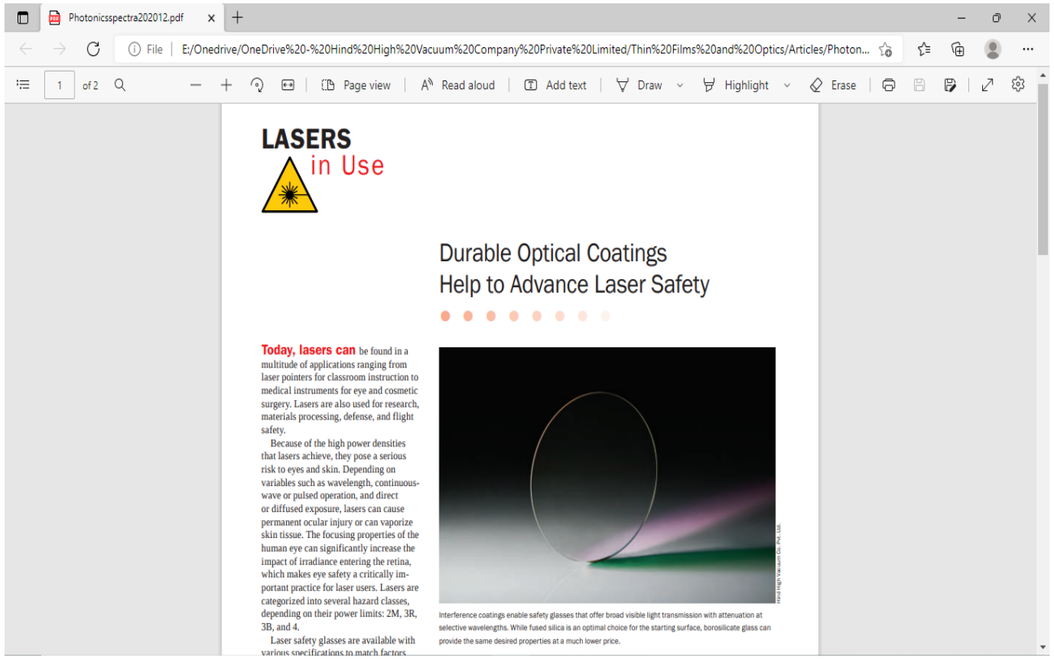
"We are thrilled to partner with C-MET, Pune for the NCQMT, further highlighting and amplifying HHV's relentless thrust on the development of world-class indigenous technology since its inception," said Prasanth Sakhamuri, Managing Director, HHV "The alliance between HHV and C-MET, Pune, allows easy exchange of information so that design and simulation run in parallel. Thus, this results in unique associations for the development of next-generation indigenous technology as part of 'Make in India' with 'Made in India' products, which is one step closer to Atmanirbhar Bharat."

"C-MET is a pioneer in materials technologies working with industries to advance the ecosystem. Collaboration with HHV in the NCQMT will bring the materials technology to commercialization. The alliance will mutually cooperate in all aspects of materials technology for vibrant applications in the near future," said Dr. Bharath Kale, Director General of C-MET.

Quantum materials include materials that exhibit strong electronic correlations, electronic ordering such as superconducting states, magnetic ordering, topological effects and unconventional band dispersion. At the microscopic level, these materials exhibit exotic electronic properties as a result of the alteration of the four basic degrees of freedom, namely charge, spin, orbit and lattice. In materials research, quantum materials challenge current theory and have a level of complexity that requires sophisticated, powerful tools and methods to synthesize, understand and manipulate them. The potential benefits of quantum materials for energy, quality of life and economy are enormous.

Durable Optical Coatings Help to Advance Laser Safety

Today, lasers can be found in a multitude of applications ranging from laser pointers for classroom instruction to medical instruments for eye and cosmetic surgery. Lasers are also used for research, materials processing, defense, and flight safety.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LASERS in Use

Durable Optical Coatings Help to Advance Laser Safety

Today, lasers can be found in a multitude of applications ranging from laser pointers for classroom instruction to medical instruments for eye and cosmetic surgery. Lasers are also used for research, materials processing, defense, and flight safety.

Because of the high power densities that lasers achieve, they pose a serious risk to eyes and skin. Depending on variables such as wavelength, continuous-wave or pulsed operation, and direct or diffused exposure, lasers can cause permanent ocular injury or can vaporize skin tissue. The focusing properties of the human eye can significantly increase the impact of irradiance entering the retina, which makes eye safety a critically important practice for laser users. Lasers are categorized into several hazard classes, depending on their power limits: 2M, 3R, 3B, and 4.

Laser safety glasses are available with various specifications to match factors

Interference coatings enable safety glasses that offer broad visible light transmission with attenuation at selective wavelengths. While fused silica is an optimal choice for the starting surface, borosilicate glass can provide the same desired properties at a much lower price.

As published in Manufacturing Today HHV's thought piece on the "Future of Lasers and Laser Protection'. The piece is written by Dr. MG. Sreenivasan, Dr. TS Gokul Raj, Ms. Krithika Upadhya and Ms. Smriti Sakhamuri. Special thanks to Dr. Arindam Sarker for his input!

Because of the high power densities that lasers achieve, they pose a serious risk to eyes and skin. Depending on variables such as wavelength, continuouswave or pulsed operation, and direct or diffused exposure, lasers can cause permanent ocular injury or can vaporize skin tissue. The focusing properties of the human eye can significantly increase the impact of irradiance entering the retina, which makes eye safety a critically important practice for laser users. Lasers are categorized into several hazard classes, depending on their power limits: 2M, 3R, 3B, and 4.

Laser safety glasses are available with various specifications to match factors such as the laser's operating wavelength and power and the user's environment. These specifications define key attributes, such as optical density (OD), visible light transmission (VLT), and color vision. OD defines how much safety glasses attenuate laser wavelengths. VLT measures the amount of light the eyeglasses transmit in relation to the spectral sensitivity of the eye. At lower levels of transmission, the eye response shifts to lower wavelengths and goes into a nightvision mode with restricted color vision.

OD defines how much safety glasses attenuate laser wavelengths. VLT measures the amount of light the eyeglasses transmit in relation to the spectral sensitivity of the eye. At lower levels of transmission, the eye response shifts to lower wavelengths and goes into a nightvision mode with restricted color vision. Reduced color vision can lead to situations in which warning signs or nearby equipment may not be easily perceived.

The three main types of filters used in the production of laser safety glasses are polycarbonate, absorption glass, and thin-film-coated filters. Polycarbonate filters are lightweight and impact-resistant but are less durable given their construction. In addition, polycarbonate filters exhibit lower OD and VLT, which restricts their use to laser applications characterized by low to middle power densities.

Absorption glass filters typically allow more visible light to be transmitted through the lens compared to polycarbonate filters, making them more suited for use with mid- to high-power-density lasers. In instances where multiple laser wavelengths need attenuation, two or more absorption glass filters can be laminated together. This makes them less robust in high-powered applications due to the possibility of delamination, or breakage, in the mounting caused by mechanical stress.

Applications involving high-power lasers require glasses that offer high VLT and high attenuation. Thin-film interference coatings best suit these requirements. Attenuation at multiple wavelengths can also be achieved while preserving other advantages. Thin-film deposition methods are typically costlier compared to polycarbonate and absorption glass filters. But e-beam deposition methods with ion assistance offer a good balance between cost and performance

Interference coatings are produced by depositing a predetermined series of alternating layers of high- and low-index materials to meet the desired spectral performance. The more complex the performance requirement, the more stringent the coating parameters must be. The type of coatings required for laser safety glasses are called reflective notch filters, which reflect a laser's wavelength while transmitting the rest of the spectrum. For a coating to maintain performance over more than the normal incidence, it needs to have a high refractive index. A series of thick high-index and thin low-index layers helps to minimize shift in performance caused by angle. An antireflection coating is applied to the back side of the glasses to minimize secondary reflections

Fused silica glass is an optimal choice for the starting surface, but borosilicate glass can provide the same desired properties at a much lower price. Borosilicate glass has low defects, such as pitting, low internal absorption, and a uniform refractive index. Sleeks on the glass must be avoided during manufacturing because they will cause laser light to scatter. Coating materials with very low absorption are necessary to achieve a high laser damage threshold as well as good VLT. Additionally, low internal stress is key. Tantalum pentoxide (Ta2 O5) and silicon dioxide (SiO2) are widely chosen for highand low-index materials, respectively, given their low intrinsic absorption and stress.

Extreme control of the deposition process during each coating cycle is required to maintain the properties of each layer. Ion assistance during this process promotes high density of layers to achieve bulk-material-like properties for the high- and low-index materials. Highdensity layers ensure that the coatings can withstand long-term changes in environmental conditions such as temperature and humidity. An advantage of thin-film based filters is their ability to attenuate a narrow wavelength range to gain high VLT. Steep slopes of the transition region from reflection to transmission further aid in improving VLT while maximizing manufacturing tolerances. Spectrophotometers with high photometric linearity and accuracy are required to precisely measure and qualify the characteristics of the coating manufactured.

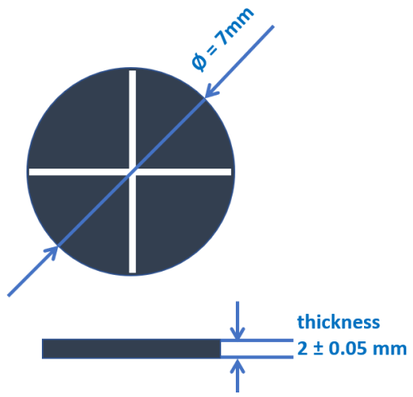
E-beam ion-assisted deposition manufacturing methods provide a favorable combination of durability and lower cost of operation compared to other coating techniques, and they offer a versatile solution for laser safety glasses. Future challenges include producing coatings capable of protecting against even higher optical densities for use with extremely high-power lasers. Another important goal to achieve is the capability to deposit coatings evenly on curved eyepieces to maintain their performance over wider angles of incidence.

High-Precision Peep-Sight Reticles

Reticles are the optics components that are designed for insertion in the eyepiece of an imaging system that superimpose with a crosshair pattern on the target object. The crosshair pattern provides a reference location and allows the imaged object to be centered on the target.

The reticles are prepared on optical glass (NBK7) substrates that are manufactured in HHV's own high-precision optics fabrication unit and patterned at in-house photolithographic design and production facility. To remove the organic and inorganic contamination from the substrate, the glasses are first thoroughly cleaned in an ultrasonic bath. Thereafter, the glass substrates are loaded in high-vacuum chambers under a class 100 laminar flow station where they are chromium coated via sputtering. HHV's complete lithography facility includes a laser writer to make the standard chromium masks, etching stations which includes a Laurell Spin Coater and SUSS MJB3 UV exposure systems. These reticles are critically examined and qualified by our state-of-the-art rigorous quality check department and submitted to the customer.

These peep sight reticles find their application in state-of-the-art, high-resolution night vision capable sight scopes under moonlight, starlight, and sky glow conditions. As shown in the images, these peep sights have patterns in form of crosshair; negative (visible light transmit through crosshair, whereas in other area it is blocked (opaque) and positive (visible light blocked by crosshair, whereas in other area it transmits (transparent)). HHV has the capability to achieve line resolutions of 7±3µm on reticles up to 80±5µm and has the ability to produce different types of reticles such as cross hairs, concentric circles, linear and cross hair scales.

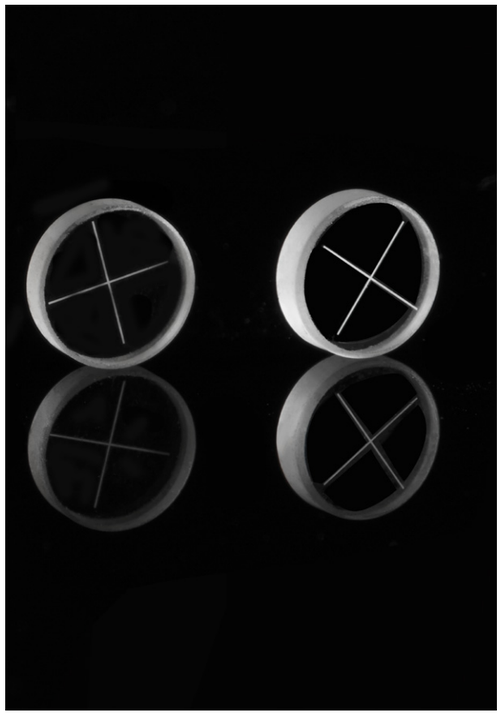


Features

- Positive and Negative Cross hair
- Sizes: Ø5.0 mm; Ø7.0 mm; upto Ø25.0 mm
- Borofloat, BK7 and UVFS glass substrates
- Anti Reflection coating on face – A or B or both
- Line resolutions of 7±3µm to 80±5µm

Applications

- Night Vision Weapon sight in Rifle scopes
- Range finders
- Surveillance instruments
- Eye piece reticles
- Stage micrometres
- Optical encoders



High Precision Bino Prisms for Binoculars

Bino prisms are used in binoculars for better image resolution. Each set of binoculars requires a left and right set of prisms. Each side of the bino prism is made up of two prisms that are cemented together.

The set of prisms is also coated with an anti-reflection coating that reduces stray light reflection and avoids refraction distortion. The prism flisp the image and allows the user to view a 3D image and shortens the optical path of the beam

The advantages prism in binoculars are:

- Brighter images due to greater transmission of light
- Fast focusing capabilities
- Close focusing capabilities
- Wider field of view

With its expertise in manufacturing high precision, complex optical components required for defence and space applications in India, HHV has fabricated a cemented binocular prism sub-assembly with 5-10 scratch-dig quality.

Bino-prisms are tested for its;

- Stringent flatness
- Surface quality
- Beam deviation
- Optical alignment and pyramidical errors after cementing

Our Bino-prisms are well received and qualified for the end use. Currently, HHV mass produces Bino-prisms in our precision optics fabrication lab equipped with state-of-the-art technology and machinery.

A Joint venture between ASM-HHV and HHV

ASM-HHV Engineering Pvt. Ltd., a joint venture between ASM Technologies Ltd, a Global Technology Engineering provider focused on semiconductor engineering and related industries and Hind High Vacuum (HHV), a leading vacuum technology manufacturer, has announced that it has joined the Industry Affiliate Program (IAP) of the Centre for Nano Science and Engineering (CeNSE), Indian Institute of Science (IISc), Bengaluru.

The Centre for Nano Science and Engineering (CeNSE), IISc, Bengaluru believes in taking "Science to Systems to Society". CeNSE aims at developing products from their cutting-edge interdisciplinary research and technological innovations, and finally, help commercialize them successfully. The Industry Affiliate Program (IAP) at CeNSE helps establish collaborations between faculty and industry for skill development, student recruitment, and access to research facilities at CeNSE.

"The relationship between ASM-HHV Engineering and CeNSE, IISc Bengaluru will be the harbinger of many engineering ecosystems that will be built up to provide indigenous capability in semiconductor and sub-system manufacturing environment. We at ASM-HHV Engineering are highly enthusiastic with this relationship and look forward to this support from CeNSE," said Prasanth Sakhamuri, Director, ASM-HHV Engineering.

"We are excited to join hands with ASM-HHV Engineering Pvt. Ltd., as our Industry Affiliate. This partnership will provide an ideal opportunity to exchange expertise and knowledge that could aid in expanding the growing Indian semiconductor ecosystem. This affiliation will enable ASM-HHV Engineering with facility usage, training, and student hiring," said Prof. Srinivasan Raghavan, Chairperson, CeNSE, IISc.

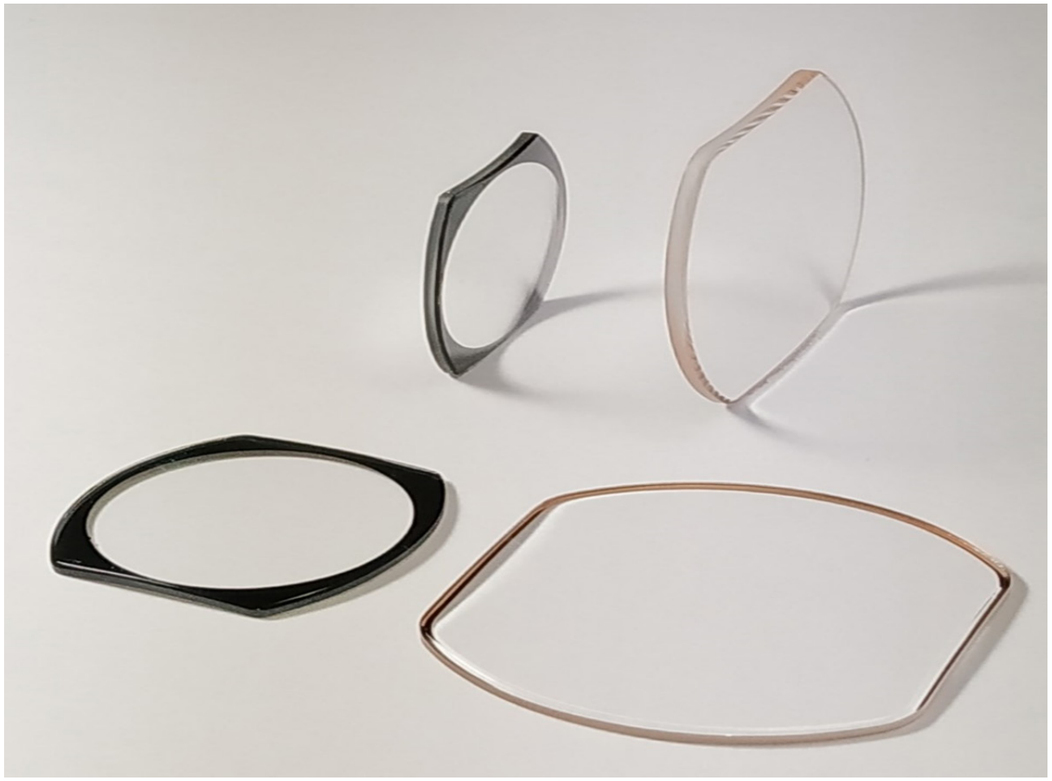
Shaped Dome Glasses for the Horological Industry

HHV Crystals is India's premier watch crystal manufacturing company with over 25 years of expertise in manufacturing intricate and complex watch crystals at global quality standards.

By leveraging over five decades of HHV's expertise in vacuum science and technology development and manufacturing, HHV Crystals has established state-of-the-art machinery and operations that ensure repeatability for mass production.

One of HHV Crystal's recent innovations is a double domed glass. To this we have been able to generate shaped domed glasses. The challenge in producing this profile consistently is to maintain radii on both sides of the glass without sagging and maintaining an optically superior finish. The item has to go through multiple stages of contouring and curve generation to ensure the radii is not compromised.

The double dome glass is also known as concavo-convex glass. Double dome glasses go through many steps for production starting with glass cutting, curve generation, beveling, toughening and cleaning. HHV Crystals has developed Concavo-convex glasses in multiple radii. We can metallize and print on the curved surface without compromising on clarity. HHV Crystals has the capacity to produce 1.2 Lakh crystals per annum.



58th Foundation Day Bengaluru, 2022

HHV celebrated its 58th foundation day on 12th April 2022. The function started with the traditional lighting of the lamp and prayer. New products development of the previous year of each division and HHV crystals were presented and was enthusiastically received

Managing Directors – Mr. Nagarjun Sakhamuri, and Mr. Prasanth Sakhamuri in their speeches indicated that the company is growing and with the encouragement of scientists, institutions and young team of employees guided by their respective seniors will become a leading global competitor in the field of vacuum science and technology.

A tribute for the chairman was presented by Ms. Smriti Sakhamuri – General Manager – HHV.

The event ended with the awards to the best performers, long service employees, sales and service recognition and life time achievements. This year the Sakhamuri family gave out over Rs. 10 lakhs in scholarships to employee's children's to promote education.

Forensic Euro Expo London, 2022

HHV Ltd attended the Forensic Expo Europe in London presenting the latest range ID750 Utra and ID500 Ultra Vacuum metal deposition systems

Air & Missile Defence India 2022 New Delhi, India

HHV participated at the international seminar at the "8th Edition of Air & Missile Defence India 2022" organised by IMR on 15th July, 2022. HHV presented its entire range of capability in thin film technology and optics was well received by the participants. HHV also had a stall that showcased the organizations entire capabilities to all the attendees of the show.

CII India Innoverge 2022 Bengaluru, India

Managing Director Mr. Prasanth Sakhamuri was a panel member at the 18th Edition of the India Innovation Summit held from 25-27 August 2022. As a panellist in the Session on Innovation and opportunities in ESDM sector – Semiconductor, Solar, Electronics he spoke about policy, infrastructure and the ecosystem needed for this sector to thrive in India.

Defense and Security 2022 Bangkok, Thailand

HHV participated at Defense & Security 2022 in Bangkok, Thailand held from 29th August to 1st September 2022. We demonstrated our globally accepted range of thin films and optics products as well as range of thin film equipment. It was well appreciated by the visitors and there were several demands for its future business growth.

Space Expo 2022 Bengaluru, India

HHV has participated in 7th Bengaluru Space Expo 2022 held from 5th to 7th September 2022 organised by CII. It has showcased the HHV group capability and its range of products for the applications of space, defence applications. The VSSC director visited the stall to view the company's capabilities.

MOU with JNCSAR Bengaluru, India

HHV Managing Director, Mr. Prasanth Sakhamuri signed and MOU with President JNCSAR Prof. Kulkarni for the project titled "Scalable coating of metal oxides on hybrid transparent electrodes and fabrication of smart window devices". The MOU highlights and propagates a long term engagement between HHV and JNCSAR.

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