HHV WORLD

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Editorial

The pan India COVID-19 lockdown has had a significant impact on the manufacturing industry in the country.

We continue to have situations where the conditions to operate are highly restricted. All this has meant that we have had to be more innovative to remain relevant and meaningful to our customers. Even in these tough times the HHV group continues to innovate and bring high-technology indigenous products to the market and support our existing customers with tele-support and offline service and troubleshooting.

Space research is expanding its manufacturing base and a significant amount of product development and manufacturing is moving to the private sector. To simulate space conditions and provide a reliable test capability HHV designed and developed Thermo-Vac chambers have just demonstrated their ability to meet the best standards in the world.

Thin film coating applications continue to become popular. HHV is able to meet the needs of the aerospace industry with its new Ion Vapor Deposition System. The custom-built system has the ability to coat small metallic parts at a high frequency with consistent thickness to replace existing cadmium plating process. HHV has also developed a Controlled Evaporation Source for organic materials. This ingenuous product finds uses in organic LED, conductors and new solar cell research.

HHV's optics facility has now started producing precision prisms for the defense industry. A full integrated facility is fully operational to meet critical requirements in large quantity. Working towards India's commitment for self-reliance.

Thin film coating on plastics has always been a challenge to achieve precision due to the constraints of temperature and performance of the plastics. HHV has developed new ion assisted coating capability to do various types of coatings on plastics for various applications. With installation of another large volume coating facility it has created a significantly large capacity for contract supply.

From being the largest vacuum pump manufacturer in India, HHV Pumps continues to innovate and keep providing new solutions to the Pharma and chemical industry with their dry pumps.

HHV continues on its journey to develop and build high quality state of art equipment for diverse applications involving vacuum and thin film technology. HHV with its international reach through its wide network of highly trained and committed distributors is able to provide service and support to all its installations.

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High Current Cathode Test Facility

In recent years, high power electric propulsion systems have been developed to reduce launch vehicle sizes and enable transportation of large payloads for space mission demands. A number of high power thrusters have been designed and tested for this purpose and the mission using these thrusters demands long life and higher current cathode assemblies.

A vacuum facility has been used to access these high current cathode assemblies to determine the plasma properties in the near-field plume region. The facility creates specific operating conditions to determine xenon plasma properties and relative keeper erosion. HHV recently designed, developed and demonstrated with the support of the user a high vacuum test facility to test high current cathodes. The high vacuum test facility consists of vacuum chamber, vacuum pumping system and control system.

This facility is 1500 mm in diameter with the length of 3000 mm. A set of mechanical, turbo and cryo-pumps based vacuum systems enables to create an ultimate vacuum level in the range of 5 x10-7 mbar. A rough vacuum pumping system to achieve 2 x 10-2 mbar from atmospheric pressure using oil free vacuum pumps, high vacuum system to achieve 5 x 10-7 mbar or better using two-stage cryogenic pump operated without LN2, and a Xenon pumping system with a cryo cold head to achieve operating vacuum of 2 x 10-5 mbar in combination with the two stage cryogenic pump.

A set of cryogenic panels placed inside the top walls of this chamber absorbs xenon ions to maintain the operational vacuum of 2 x10-5mbar. A residual gas analyser located inside this chamber measures the partial pressure of gases. The pressure in the chamber during operation is monitored using hot cathode ionization gauge.

A Programmable Logic Controller along with HMI and Industrial PC are being used for complete automation of the vacuum cycle and thermal heating and cooling cycles, and measuring and control instrumentations, etc. for user friendly operation.

Thermo Vacuum Chamber

Thermo vacuum systems are being used to simulate conditions found in the upper atmosphere and outer space, exposing components and systems to vacuum and extreme temperature variations. These facilities are being used for conducting long period life-cycle tests on components used in spacecraft and satellites.

HHV has designed and manufactured thermo vacuum chambers since 1975 for TERLS (VSSC) with the capability to produce vacuum 1 x 10 -6 mbar, heating and cooling facility for producing temperatures ranging from +150° C to - 80° C.

The thermo vacuum facility is a horizontally mounted single walled cylindrical chamber of size 1500 mm inner diameter x 1200 mm cylindrical length, has two thermal circulator for heating and cooling of the base plate and shroud.

This vacuum chamber designed with three job heating systems for producing temperatures ranges upto +120° C, one is by circulating the heated thermal fluid through the job holding plate, another is by IR lamps, and the third is by sheathed tubular heaters embedded in the job holding plate.

The thermal system has a cylindrical type shroud of size 1350 mm ID and 1200 mm length and is fixed with 2 numbers of flat shrouds in the front and at the rear side respectively. A twin turbo pump based pumping system enables to achieve a high vacuum of 5 x 10-6 mbar.

A Programmable Logic Controller along with HMI and Industrial PC are being used for complete automation of the vacuum cycle and thermal heating and cooling cycles, SCADA, and measuring and control instrumentations, etc. for user friendly operation.

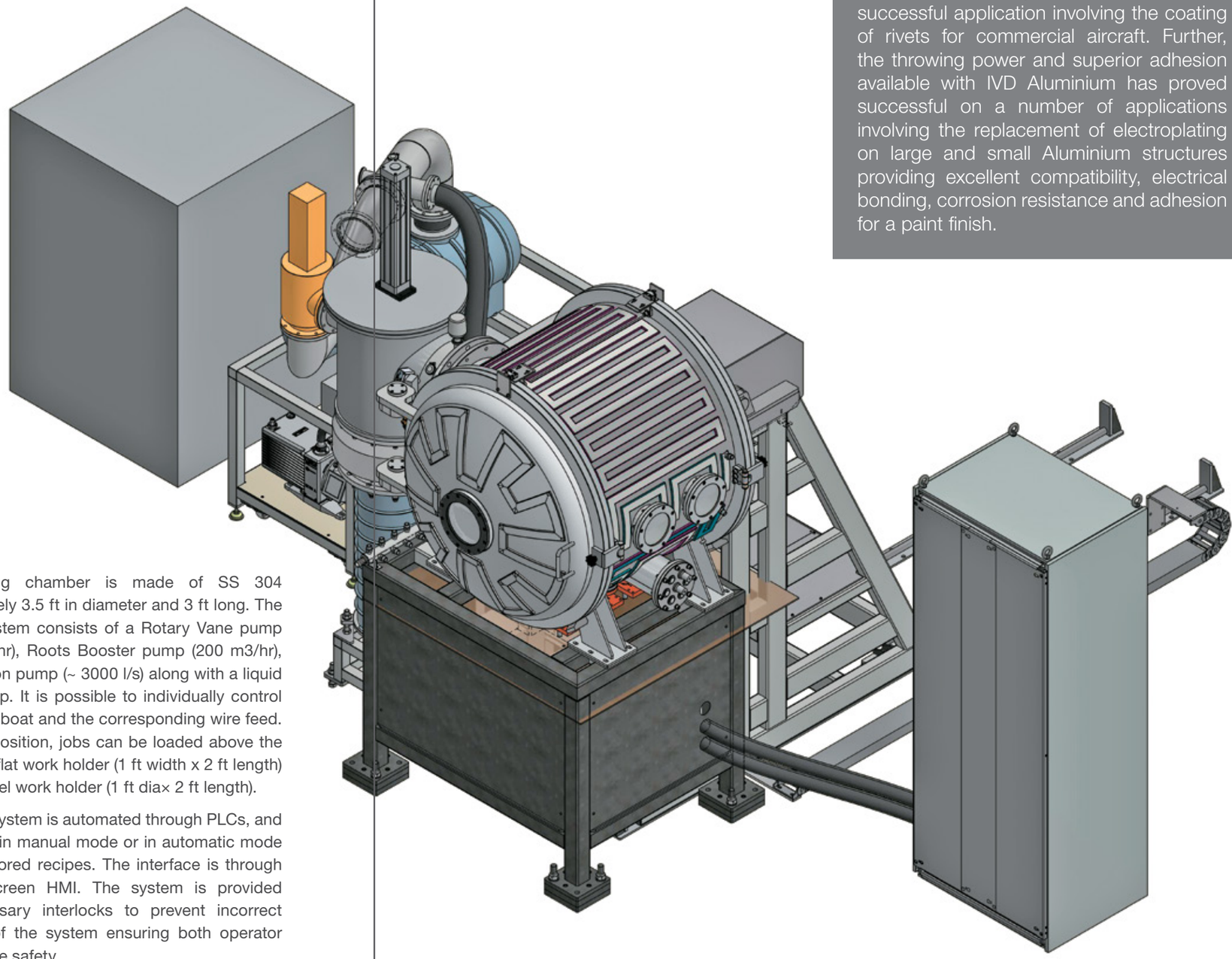
Ion Vapor Deposition (IVD) System

Ion Vapor Deposition (IVD) is a vacuum coating process for applying pure coatings to various small components like fasteners, bolts, pins, nuts, rivets, etc. and for larger machined components mainly for corrosion protection. IVD Aluminium has been in service for over three decades in the aerospace industry where substrate materials have typically been High Strength Steels, Aluminium and Titanium alloys.

This technology has been developed as an alternate for Cadmium Electroplating due to the challenges involved in handling and safe disposal of Cadmium. The same technology can be adopted for applications involving other electroplating processes as well. The main advantage of using this technology in place of electroplating is the ability to have a nontoxic and environmentally clean process.

In the system that is being built by HHV, Aluminium is evaporated from five resistively heated elements called “boats” placed at regular intervals along the length of the coater. A continuous feed of high purity Aluminium wire is maintained onto the boat till the required coating thickness is evaporated onto the jobs. Each boat is made from a special composite material having the proper electrical characteristics to get sufficiently hot with current flowing through it, yet not erode rapidly or create hot spots. Also, the boat has sufficient strength to withstand stresses imposed on it at operating temperature. The Aluminium evaporated from the boat spreads out into the vacuum vessel coating the jobs and the walls of the vacuum vessel in the vicinity of the boat.

A negative bias is applied to the work holder. This is used to generate plasma that aids in pre-cleaning of jobs prior to coating, and for providing ion assistance during the coating process. In order to generate this plasma, the process itself is carried out in the range of 10-2 mbar pressure. Due to the decreased mean free path of the metal vapour in this pressure range as compared to traditional evaporation processes, the spacing between the jobs and the boats is much lesser and maintained within ~ 10 inches (250 mm). The enhanced scattering between the metal vapour and the gas molecules results in spreading of the material all around the jobs resulting in good thickness uniformity and all round coating of most complex of shapes in one coating operation.



The coating chamber is made of SS 304 approximately 3.5 ft in diameter and 3 ft long. The vacuum system consists of a Rotary Vane pump (~ 200 m3/hr), Roots Booster pump (200 m3/hr), and Diffusion pump (~ 3000 l/s) along with a liquid nitrogen trap. It is possible to individually control each of the boat and the corresponding wire feed. For the deposition, jobs can be loaded above the boats on a flat work holder (1 ft width x 2 ft length) or on a barrel work holder (1 ft dia× 2 ft length).

The entire system is automated through PLCs, and can be run in manual mode or in automatic mode from pre-stored recipes. The interface is through a touch screen HMI. The system is provided with necessary interlocks to prevent incorrect operation of the system ensuring both operator and machine safety.

The greatest advantage of the IVD Aluminium process is the ability to coat small parts in high volume with consistent thickness results in the range of 10 - 15 microns. This has proved to be the most successful application involving the coating of rivets for commercial aircraft. Further, the throwing power and superior adhesion available with IVD Aluminium has proved successful on a number of applications involving the replacement of electroplating on large and small Aluminium structures providing excellent compatibility, electrical bonding, corrosion resistance and adhesion for a paint finish.

Thin Film Coating System with Controlled Evaporation Source (CES)

Coating methods on the basis of vacuum evaporation have been known for already over one hundred years

Evaporation of organic substances

Evaporation under vacuum is also increasingly used for organic materials. Currently the development is focused particularly on the use of organic substances for organic light emitting components (OLEDs), organic solar cells, and organic conductors. Although organic substances have many properties in common with organic substances in vacuum evaporation, they require a higher degree of process control. This is related to the properties of these organic substances and has to be taken into account in the development of evaporators or vacuum coaters.

Evaporation of organic substances requires precise control of the process temperature to prevent decomposition of materials. Organic material deposition requires uniform and precise heating with excellent temperature and deposition rate control.

Controlled Evaporation Source (CES)

Controlled Evaporation Source (CES) is a specialized thermal evaporation source offering precise temperature control for deposition of organic films and to dope electronic devices with organic materials in high and ultra-high vacuum environment.

Robust, reliable, and affordable solution for a wide range of deposition needs. By selecting the proper combination of crucible, crucible liner, thermocouple type, and other furnace options, CES are an ideal source for applications ranging from low temperature organics and metals.

HHV has demonstrated thin film deposition process in a well-engineered optimized thin film deposition system of depositing organic materials on the substrate with a proven CES to the research community.

The process automated thin film deposition system comprises of a vacuum chamber, a compact temperature-controlled source, rotatilt work holder, film thickness monitor and with a turbo pump based vacuum system to create high vacuum in the chamber.

OPERATING FEATURES

- Repeatable and reliable deposition
- Accurately control temperatures to 600°C
- Internally mounted thermocouple monitors source temperature without exposure to deposition materials
- Rapid source material change with less cross contamination
- Easy access to crucible for cleaning and source replenishment
- Thermally shielded to minimize chamber heating
- Easily controlled using low voltage power supply
- Easy installation for new system design or retrofitting existing systems

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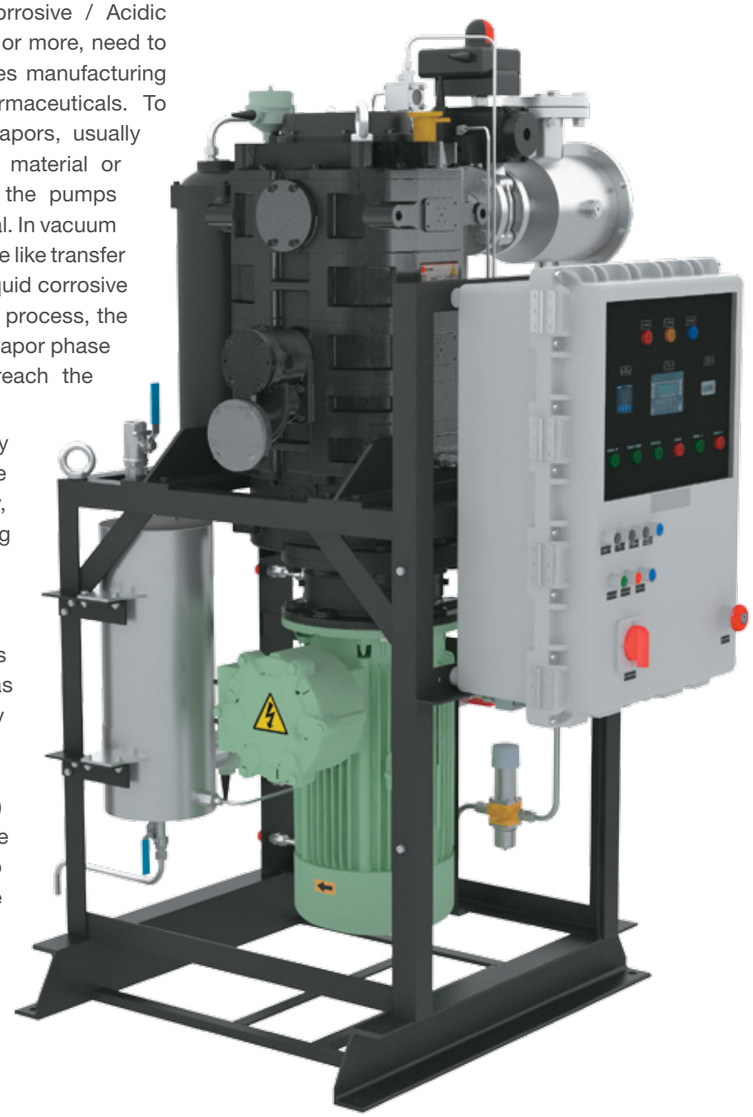
Features

Thin Film Deposition System	
Chamber	Front opening chamber
Chamber Size	400mm diameter
Vacuum System	Turbo pump based pumping system
Automation	PLC based auto control system
Work holder	Drive with adjustable rotation and tilting mechanism
Source shutter	Electromagnetic Source Shutter
Quartz crystal film thickness monitor	Resolution : 0.15 Angstroms
Controlled Evaporation Source	
Crucible Charge Capacity	2.0 cc
Maximum Temperature	600°C
Dual Channel	To control 2 organic material source

Major benefits of DP250T/DP400T

Handling corrosive vapors

Handling corrosive vapors Corrosive / Acidic chemical vapors from 5 to 1 pH or more, need to be distilled at chemical industries manufacturing dye, thinner, additives to pharmaceuticals. To handle such highly corrosive vapors, usually people tend to choose SS316 material or suitable protective coating for the pumps suitable in handling those material. In vacuum distillation, this is not exactly same like transfer pump type where it is more of liquid corrosive chemicals. In vacuum distillation process, the chemicals are predominantly in vapor phase passing the condensers and reach the vacuum pump.



DP250T/ DP400T technology allow us to increase or control the internal temperature precisely, helping to retain the incoming corrosive vapors in the gaseous form instead of change in phase. This will help us to keep the vapor in the gaseous (Incondensable) state and gas particles will have high velocity inside the vacuum pump. Resident time of the gas particle will be very low (short duration) inside the pump helping reduce corrosion with vacuum pump internal parts. This is one of the key feature to handle corrosive vapor without any anticorrosive material coating. HHV Pumps understand that Physics behind this chemicals vapors and its reactivity to tackle the problem in an intelligent way.

Winter issues

Winter imposes a new problem through fast cooling during power failures. Incoming chemical vapor will stay and condense in mean-time which leads to deposition between the clearance area of stator and rotor. Rapid cooling of the pump internal bodies will make the deposited material to settle down and form flakes within making them harder to dilute through solvent flushing. These issues are commonly observed more during winter season, especially in Northern parts of the country.

New feature in the T series will help us to retain the pump temperature for longer duration by not allowing the chemical vapor to change its phase (vapor to liquid or solid). With the help of T series, we are able to tackle this problem efficiently. Our customers now acknowledge this benefit.

Anti-Reflection Coatings on Plastics

What is AR/VR

Augmented reality (AR) adds digital elements to a live view often by using the camera on a smartphone. Examples of augmented reality experiences include Snapchat lenses and the game Pokemon Go.

Virtual reality (VR) implies a complete immersion experience that shuts out the physical world. Using VR devices such as HTC Vive, Oculus Rift or Google Cardboard, users can be transported into a number of real-world and imagined environments such as the middle of a squawking penguin colony or even the back of a dragon.

As more and more augmented reality (AR) and virtual reality (VR) headsets have become widely available at affordable price points, the global market for AR/VR technology has grown significantly; estimates from 2017 peg the market as being worth around US$11 billion by 2025.

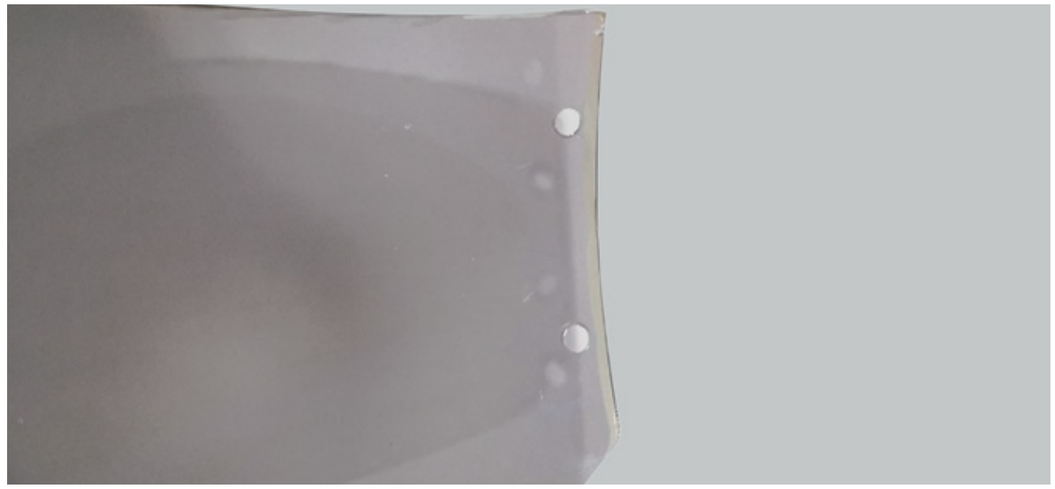
Although AR/VR systems were primarily thought of as technologies for entertainment purposes such as gaming, their use is now being seen more and more in an ever-growing list of industries and fields such as healthcare, transportation, retail, education, and transportation.

In response to the COVID-19 outbreak in late 2019, The AR-VR glasses come equipped with an infrared sensor that measures nearby temperatures with the help of a camera, and communicates that information in real-time to the display.

Why we use plastics?

Weight, cost, and durability are the three most common reasons to design an optic in plastic. Plastic is 1/10th the weight of glass, yet offers comparable transmittance. It can also be inexpensively moulded in volume, often in configurations that simplify mounting and system assembly. Though more sensitive to scratching, plastic offers greater impact resistance than glass, and tends to break into fewer, less dangerous fragments rather than splintering.

We frequently work with customers who want to transition a design from glass to plastic due to damage or weight, but without compromising optical performance or the ability to meet a specific MIL-SPEC standard. The conditions that must be met can be very severe including extreme temperature cycling, shock, and chemical resistance to materials like insect repellent, antifreeze, and rifle bore cleaning compound. In new optical designs, the basic needs are the same a coating that performs well optically and is durable.



AR Coatings

An air-plastic interface reflects approximately 4% of light, which can easily be reduced to below 0.5% with an AR coating, and even down to 0.25% at a single wavelength on a high-quality substrate like (Poly carbonate {PC}, PMMA). Wide angle AR coatings are often needed for lenses and elements with a high degree of curvature.

Beam Splitters

HHV's beam splitter coating offerings include standard splitting ratios from 50/50 to 60/40, as well as polarizing beam splitters. We routinely work hand-in-hand with vendors to create finished plastic beam splitter cubes. The beam splitter deposition processes we've developed are designed to maintain prism flatness without compromising optical performance, and are gentle enough to enable the application of AR coatings.

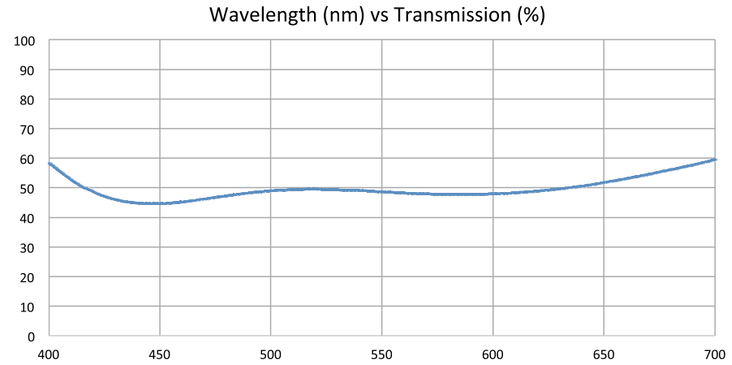
Coating Technology

Ion Assisted Deposition is a variation of standard e-beam technology that adds a high-energy ion beam directed at the substrate. The ions released by this beam make the evaporated film denser. The higher-density coating results in greater moisture resistance (better environmental stability), better mechanical durability, and lower scatter. In addition, the ion beam can also be used for pre-cleaning or to etch the substrate.

What can be achieved?

- Independent control of ion current density and ion energy to optimize film properties
- Long-term operation with 100% O2 or N2 reactive gases for stable operation with no process drift for extended runs

Results



Precision Prisms

Prism, in optics, is a piece of glass or other transparent material cut with precise angles and plane faces, useful for analysing and reflecting light. An ordinary triangular prism can separate white light into its constituent colours, called a spectrum.

Each colour, or wavelength, making up the white light is bent, or refracted, a different amount; the shorter wavelengths (those toward the violet end of the spectrum) are bent the most, and the longer wavelengths (those toward the red end of the spectrum) are bent the least.

Prisms are made in many different forms and shapes, depending on the application such as telescopes, Periscope, binoculars, surveying equipment, and host of others. Prisms of this kind are used in certain spectroscopes, instruments for analysing light and for determining the identity and structure of materials that emit or absorb light. The precision prism, for example consists of different shapes and sizes such as right angle, octa angle etc. The material used for manufacturing a prism are Borofloat and BK-7. These precision prims are used as head mirrors for defense applications.

HHV has the capability of manufacturing several 100's of prisms of size 150mm of dimeter per month. The finished products go through rigorous quality checks with equipment's such as Zygo interferometers with transmission spheres to measure surface figures to 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 has the capability to manufacture the prisms close to 10 microns in terms of tolerance, and has achieved the flatness less than λ/10 for the entire 100mm diameter with parallelism less than 5 seconds and angle accuracy of <10 Seconds.

The prisms are fabricated in HHV's fully fledge inhouse optics division laboratory, where a plain glass is converted in to a prism using ultra-high precision machines.

CUTTING → MILLING → LAPPING → CHAMFERING → BLOCKING → POLISHING

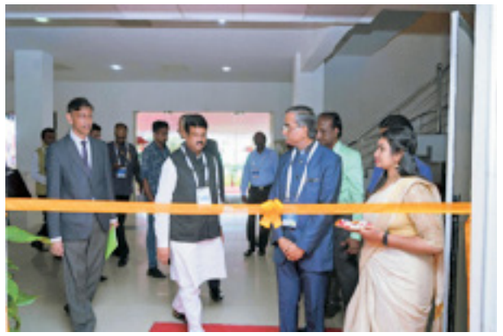
Prism Type	Dimensions
1	134.5x99x30mm, 43^0 Angle ±20 minutes
2	135x78x30mm, 43^0 Angle ±20 minutes
3	230x87x33mm, 43^0 Angle ±20 minutes
4	242x123x46mm, 43^0 Angle ±20 minutes
5	34mm thickness, V-HT 42mm, Angle 45^0 ±30 Seconds and 90^0 ±30 Seconds
6	20mm thickness, V-HT 13mm, Angle 90^0 ±30 Seconds, 60^0 ±30 Seconds, 30^0 ±30 Seconds

Plasma 2019
Chennai, India

HHV participated at the 34th National Symposium on Plasma Science and Technology (PLASMA-2019) was organized by VIT Chennai in association with Plasma Science Society of India (PSSI) during December 3-6, 2019. HHV displayed its capability in the manufacture of a range of Thin Film Equipment for various applications.

NCE-21, 2020
Karaikudi, India

HHV participated at the Twenty First National Convention of Electrochemists (NCE-21) 30-31 January, 2020, organized by Society for Advancement of Electrochemical Science and Technology (SAEST). SAEST, in association with VIT, and CECRI, organized at VIT, Chennai Campus during 30-31 January, 2020.



HT&SE, 2020
Chennai, India

HHV Participated at the Sixth Asian Conference on Heat Treatment and Surface Engineering Organized by ASM International Chennai Chapter In association with International Federation of Heat Treatment and Surface Engineering (IFHTSE) on March 05 – 07, 2020 at Chennai Trade Centre, Chennai, India. HHV showcased its range of heat treatment furnace for metallurgical applications.

SPIE Photonics West 2020
San Francisco, USA

HHV participated in SPIE photonics west -2020 during 4-6 February 2019, at San Francisco, USA and showcased its range of thin films and optics products. It was well received by the visitors. There were several enquiries for the thin films and optics products forecasting bright chances for its future business growth.

SIDM MSME Conclave 2020

HHV participated in SIDM MSME CONCLAVE 2020 which was a virtual exhibition, SIDM MSME CONCLAVE 2020, “A Digital Exhibition and Conference of MSMEs in Defence & Aerospace” 18 May – 3 June 2020. It was organized by the Society of Indian Defence Manufacturers (SIDM), in partnership with Confederation of Indian Industry (CII). HHV showcased its innovative and unique product range to the users of Army personnel, Army Base Work Shops, Ordnance factories and other PSUs. HHV gained popularity among the industry over its precision optical components manufacturing in support of Prime Minister’s Make in India & building Atmanirbhar Bharat.

Bangalore Nano 2020
Bengaluru, India

HHV participated in the 11th Edition of Bangalore India Nano Conference and Exhibition held from the 2nd to 4th of March 2020 in Bangalore. This annual event is organized by the Department of Information Technology, Biotechnology and Science & Technology, Government of Karnataka in association with Karnataka’s Vision Group on Nanotechnology, chaired by Prof. C N R Rao, to foster a business environment for the development of Nanoscience and Nanotechnology Industry in India.

HHV show cased its Bench Top Coater at the event along with its range of thin film equipment. The details of the various PVD and CVD based deposition tools manufactured by the Thin Film and Equipment division were displayed in the stall. Also, on display were the various optical and thin film components manufactured by the Thin Films and Optics Division . The stall drew a lot of attention of the visitors from the academic and industry circuits. The stall won the Best Exhibitor Award for the Content and Information which was presented to the team by Prof. C N R Rao.

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