HHV WORLD

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Editorial

Stepping into the last quarter of the financial year, HHV has developed new technology aims to increase market share and sales through its innovative high technology products.

We have formally demerged into two organizations last year: HHV Thermal Technologies for our furnaces and carbon composite businesses and HHV Advanced Technologies for our thin films and optics businesses. All companies are held under the HHV group as subsidiaries. The equipment companies 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 entered into new areas of work through exciting relationships with domestic and international partners on the industry and scientific front.

We installed a 2.5m Telescopic Mirror Coater at Gurushikhar Peak, Mount Abu, Rajasthan, for the Physical Research Laboratory (PRL), a unit of the Department of Space, Government of India. It efficiently applies aluminium coating for crucial telescope mirrors and require a technologically advanced high vacuum equipment design.

HHV is honoured in being associated with ISRO for the last five decades and our pride in this connection is immeasurable. India is the first country to land on the dark side of the moon, so does a part of HHV. With a successful moon landing, India is now listed in an elite group of countries that have done so.

In thermal systems, we have designed and manufactured Low Pressure Carburizing (LPC) furnace with High pressure gas quenching facility, meant for diffusion heat treatment process/ case depth hardening of steels and various alloys under vacuum at elevated temperatures and high-pressure gas quenching for enhancing the surface hardness.

Our Ion Beam Sputtering (IBS) is ideal for applications where durability and reliability are critical like anti reflection coatings, high reflection coatings, laser bar coatings. Etc. and our Quartz tube reflectors are used for pumping of xenon flash lamp used in laser Sources. We have also developed process solutions for the deposition of conductive ARCs. CSIR-NIIST inks MoU with HHV Advanced Technologies, Bangalore for jointly developing perovskite solar cells and modules. This is part of our continuous programme to ‘Make in India’ and focus on cutting-edge development and collaboration with research institutes in the country.

HHV Crystals continues to meet 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 have participated in SAMPE Colloquium & Exhibition on Composites (ICEC 2023) at ISRO, Trivandrum, 4th International Forensic Science Conference in Delhi, in Microwave, Antennas, and Propagation Conference (MAPCON) held at Ahmedabad, and also participated in the SPIE Photonics West Expo 2024-San Francisco. 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.

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Vacuum Heat Treatment Furnace with Oil and Gas Quenching Facility

A workpiece which is heat treated in a vacuum heat treatment furnace has absolutely no decarbonization or oxidization.

There are two quenching methods after heating the workpiece:

- Oil quenching in an oil tank in vacuum
- Gas quenching by circulating inert gas for rapid cooling.

HHV TT's recent heat treatment furnace consists of hot chamber, vacuum pumping system, Charging basket, Digital Temperature Controller, Gas Circulating System, Oil Quenching System & Gas Quenching System at 2 bar pressure. Gas Purging arrangements include Regulator, Pressure Chamber, Control System, sensors, Water Cooling System, Heat exchanger etc.

Figure 1: Vacuum Heat Treatment Furnace with Oil and Gas Quenching Facility

HHV TT assures the appearance of components is bright & deformation within 0.1mm after heat treat it in this furnace.

The charge along with its support weight of approx. 70kgs is firmly fixed on the guided arms of the forklift which has Electrically operated up/ down motion, to and fro motion.

Non-oxidation heating represents a prominent trend in the advancement of modern heat treatment technology. With vacuum gas / Oil quenching technology this equipment stands out to be as one of its primary manifestations.

The heating and temperature control system adopts the voltage regulator control mode, which has precise control, reliable operation, and low cost.

This heat treatment furnace is designed with effective hot zones of 300mm (W) x 300mm (H) x 450mm (D) (±10mm), maximum design temperature of 1400°C and working temperature of 1350°C.

The maximum charge weight excluding fixtures is 70 Kgs, and the temperature stability in the working chamber at rated temperature in thermal steady state is ± 5°C with control accuracy of 0.10°C.

Applications & Advantages:

- Excellent heat treatment for automotive parts and machinery parts.
- Excellent for quenching, tempering, brazing, annealing, solution treatment, and ageing processes.
- Possible to cool thick parts rapidly because of higher heat exchanger efficiency during pressurized gas circulation.
- Minimize distortion from heat treatment. The distortion from heat treatment is minimized by even heating and cooling.
- Ease of maintenance of Heating chamber, easy to load and unload, User friendly operation.

Low Pressure Carburizing (LPC) Furnace with High Pressure Gas Quenching Facility

As industrial modernization surges forward, the heat treatment industry strives for lower pollution, reduced oxidation and defects, minimized waste, and automatization.

The HHV Thermal Technologies (HHVTT) has designed and manufactured Low Pressure Carburizing (LPC) furnace with High pressure gas quenching facility, meant for diffusion heat treatment process/ case depth hardening of steels and various alloys under vacuum at elevated temperatures and high-pressure gas quenching for enhancing the surface hardness. This treatment is used to increase the wear resistance and fatigue life of components.

Advantages

LPC and high-pressure gas quenching technology, is one of the highly efficient, energy-saving, and clean heat treatment technology which has been a hot topic in the development of heat treatment technology in recent decades.

Compared to traditional oil quenching and salt bath quenching, LPC & high-pressure gas quenching technology offers several advantages

- No oxidation or decarburization occurs during vacuum heating, resulting in clean surfaces without a metamorphic layer. The distortion of the workpiece is small, and its comprehensive performance is excellent.
- It does not pollute the environment, eliminating the need for waste treatment.
- It enables precise control of heating and cooling thanks to Precise furnace temperature measurement and control.
- It has a high degree of automation, significantly reducing operator's labour intensity.

HHVTT's LPC cum gas quenching furnace is a horizontal double wall, water cooled chamber, composed of vacuum pumping system, hot zone, Heat insulation, hearth plate, heat exchanger, blower fan motor, cooling system, nitrogen gas storage chamber, gas inlet system and Industrial PC with SCADA system for automation.

After initial vacuum, the workpiece is heated to the process temperature under partial pressure of

Figure 1: Low Pressure Carburizing (LPC) Furnace with High Pressure Gas Quenching Facility

Hydrocarbon gases to achieve the required case depth carburizing hardening. Further the chamber is filled with inert gas at very high pressure for rapid cooling. High speed blower is used for a high flow rate of gas circulation to meet the requirements of the microstructure and performance after quenching. It has been provided with graphite heaters and hard graphite felt for heat insulation. Operation and process sequence which are carefully interlocked with various safeties and recipes programmed and controlled by PLC, IPC and SCADA which offers less interference by operators.

LPC process prevents particle oxidation through degassing, ensuring excellent surface quality without the need for post-quenching treatment. This process is environment friendly as it avoids the use of harmful gases, when the workpiece is subjected to LPC, it exhibits enhanced mechanical properties. It can greatly reduce the hydrogen content and other gas content of high-strength steel prone to hydrogen embrittlement so that the ability of steel to resist brittle fracture has been improved. At the same time, the service life after LPC is longer than that of conventional heat treatment.

Aluminum Downward Thermal Evaporation of 2.5m Telescopic Mirror

The process of downward thermal evaporation of aluminum (Al) is unconventional to the classical evaporation technique.

Figure 1: Al coated Ø 2.5m telescopic mirror

This demands a critical design of the thermal source (in this case, a filament) relative to the position of the substrate (in this case Ø2.5m telescopic mirror) ensuring uniform wetting of Al across the filament and flash evaporation. HHV Advanced Technologies has successfully demonstrated Al downward thermal evaporation across the Ø2.5m telescopic mirror in the recently installed vacuum coater in Gurushikhar Peak of Mount Abu, Rajasthan, India for Physical Research Laboratory (PRL), a unit of Department of Space, Government of India.

Coating telescopic mirrors is a crucial aspect of telescope design, impacting reflectivity, durability, and overall performance. Downward thermal evaporation stands out as one of the most effective methods for coating telescope mirrors without compromising mirror safety. To facilitate a seamless evaporation process without material leakage, Al is integrated into the Tungsten filament, as shown in figure 2. Each filament carries a specific quantity of material, determined by the required coating thickness. An array of such filaments is strategically designed and positioned to achieve a drop-less, pin-hole free, and uniform Al coating over the Ø2.5 m telescopic mirror. The developed Al downward thermal evaporation process on Ø2.5m telescopic mirror resulted in a thickness non-uniformity of <±5% with a overall reflectivity of >90% in the wavelength band of 350 to 1800nm. The developed process offers great adhesion, superior durability and long-term stability even in the absence of a protective layer.

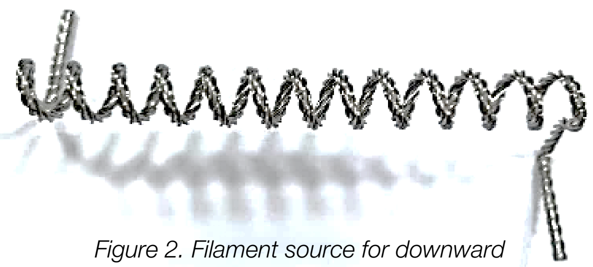


Figure 2. Filament source for downward thermal evaporation

Electrostatic chuck with He-backside cooling in RIE

There has been continuous development in microelectronics fabrication single-wafer processing. Plasma etching or reactive ion etching (RIE) is one of the most important process steps in the microelectronics fabrication.

However, RIE involves high ion-bombardment on the substrate thus generating large amount of heat resulting in a high substrate temperature that causes photoresist reticulation. One essential requirement of the design of the single-wafer chambers is securing the wafer on the electrostatic chuck, while at the same time controlling the temperature and temperature uniformity across the surface of the wafer. To achieve homogenous film processing over the entire wafer area, a uniform wafer temperature must be maintained at the surface of the wafer. The etch rate and selectivity can be affected by the temperature of the wafer during plasma etching process.

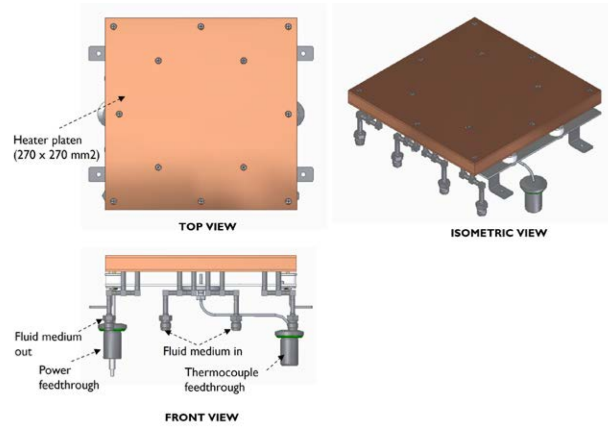


Figure 1. Helium Back Cooled Substrate Holder

The control of the temperature of the wafer is not an easy task in plasma chambers, which operate at low pressure and have RF sources applied to the wafer. In high temperature applications, the wafer is heated to 200-400°C by the electrostatic chuck. Thermal energy is transferred to the wafer surface through plasma load as a heat flux and the chuck is required to remove excessive heat accumulated on the wafer while maintaining a stable and uniform temperature at the wafer surface. The electrostatic force generated between wafer and electrostatic chuck enhances the solid-to-solid contact thermal conduction enabling the heat to flow through the interface to the cooling base attached to the electrostatic chuck. In high temperature chucks the interface is filled with gas, usually Helium (He), to aid in the removal of the heat from the wafer owing to its high thermal conductivity.

He- backside cooled substrate chuck is an integral part of the RIE system. He backside injection improves the thermal contact between the wafer and the electrode. Two solid surfaces will only be in 3-point contact resulting in a very ineffective cooling, especially in vacuum. Effectively, the only way that the substrate will lose heat is by radiation. At normal plasma etch temperatures, this is very inefficient. If a thin layer of He is injected between the wafer and the electrode, this will provide a much better heat path than the three points. A thin (few microns) layer of Helium is quite good at conducting heat.

It becomes very critical when the photoresist as masks is present. Without He backside cooling, polymer deformation and scattering are critical issues (with increase in temperature) with debris all over the place and non-sharp edges with higher surface roughness resulting in higher etch non-uniformities.

HHV has recently introduced a chuck that incorporates advanced features such as He-back cooling, and a heater. This innovative design is tailored for applications in semiconductor processing. Operating within a temperature range of 400 ˚C to –150 ˚C, the chuck has a temperature accuracy of less than 3 ˚C across the wafer area. This has been feasible with multiple simulation data ensuring a robust system design.

Ion Beam Sputtering System

Ion beam sputtering (IBS) is a direct method for forming high-purity solid films on a substrate by irradiating a low-energy, mass-separated ion beam (ions of solid materials) in a high-vacuum environment.

By this method, we can easily obtain isotopically enriched high-purity metal or semiconductor films. Furthermore, we can control the film properties by selecting the ion irradiation energy.

The basic IBS chamber set up, comprises a deposition source that accurately focuses a neutralised ion beam onto a target with minimal overspill to avoid contamination of depositing films. This enables materials such as Au, Cr, Ti, Pt for metal tracks, magnetic materials such as Fe, Co, Ni, etc. or dielectrics such as SiO_2, Al_2O_3, etc. to be deposited (the list is non-exhaustive). It also comprises an assist/etch source that can fulfil various functions: it can be used to etch (or ion mill) the substrate; it can provide "assistance" to the deposition process by bombarding the depositing film with energetic ions which can improve or modify the film properties or stoichiometry by physical and/or chemical effects; it can also be used as a low-energy pre-clean of the substrate prior to deposition. Sometimes, this source is used without grids as a plasma source of 'thermal' activated radicals for chemical modification of the depositing material while minimising physical bombardment of the substrate.

The process gives control over several parameters to control the film quality, including ion current density, ion beam potential, ion beam divergence, etc. Controlling these variables independently leads to the most precise coatings, making them ideal for precision optics or semiconductor production where high-quality films are a necessity.

HHV Advanced Technologies recently introduced a dual IBS system comprising of ion-beam and ion-assist source to focus on the 100 mm diameter target depositing high quality films over a 100 mm diameter substrate. The ion beam reaches the target at an incident angle of ~ 45°, in its normal geometry. The water-cooled target carousel system can hold 4 different targets, enabling multilayer deposition, without breaking the vacuum. The target carousel system has provision to vary the angle of ion beam incidence at the target and separately, oscillate between user-defined angles and speeds, during the deposition process. The sputtered material reaches the 100mm substrate holder at an angle of ~ 23°, whose temperature can be controlled from RT to 500 °C. Additionally, system allows the substrate to be rotated and moved 25mm on either side relative to the sputter flux direction enabling further 'tuning' of film growth/properties as well as step coverage control for deposition onto surface topology. Deposition rates will be lower than evaporation, but this does allow much more control with a much more reproducible and predictable deposition rate allowing very precise thickness control simply by timing. The material is also sputtered and deposited in a much lower temperature environment than evaporation. The system has provisions to introduce argon, oxygen, or a mixture of both gases through both the ion guns. The pumping system in IBS allows the ion beam deposition to run in a much lower pressure environment (in the 10-4 mbar range or lower) than standard magnetron sputtering, so any sputter gas (e.g. Ar) inclusion in the film is much less of a problem. The mean free path of ions and sputtered material is accordingly greatly increased which also inhibits thermalisation of sputtered material as well, resulting in depositing atom kinetic energies (typically between 1 to 100 eV) or much higher.

Figure 1: Ion Beam Sputtering System

Applications:

Owing to the collimated monoenergetic deposition inherent to IBD, the coatings produced are usually extremely uniform and very dense, with excellent adhesion to the substrate. This makes the coatings highly stable and durable, so they are ideal for applications where durability and reliability are critical. The IBS process finds applications in developing anti-reflection coatings, high-reflection coatings, beam splitter coatings, extreme UV mirrors, laser bar coatings, single-cavity filters, three cavities mirror, ring laser gyroscope, and transparent conductive oxides, to name a few.

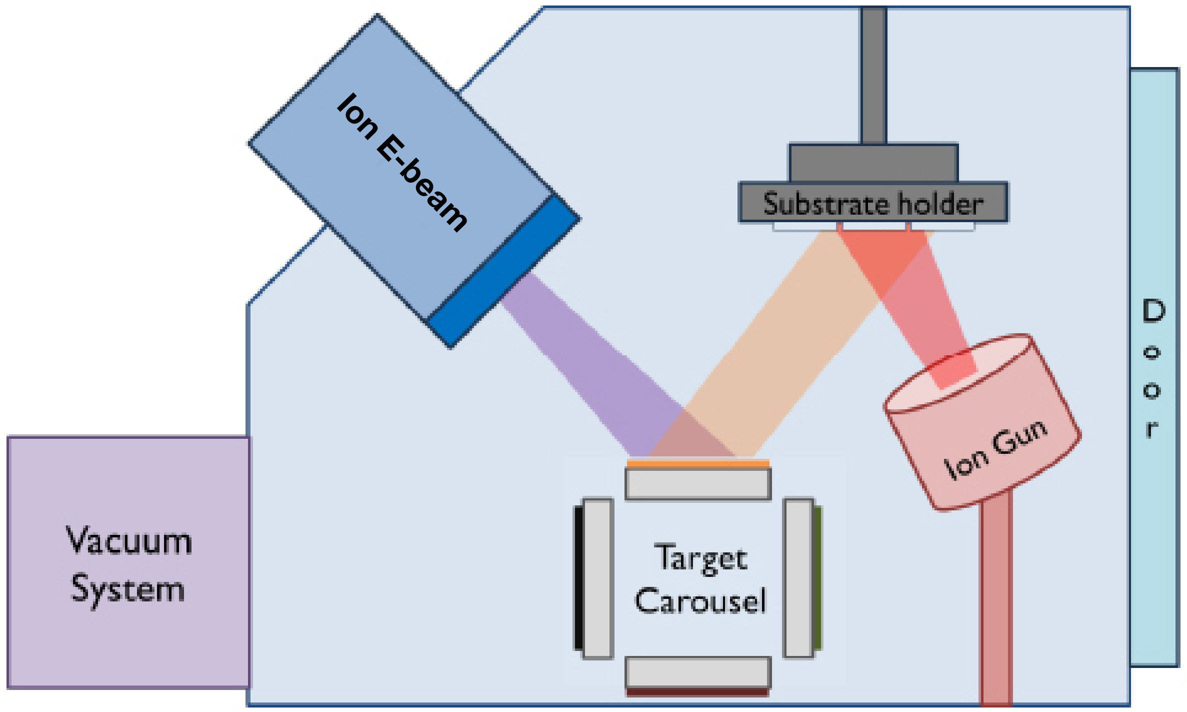


Figure 2: Schematic of the Ion Beam Sputtering system

Quartz Tube reflectors

Quartz tube reflectors consist of quartz tubes that have a reflective coating to reflect the light back in order to concentrate the energy within. These are used for pumping of Xenon flash lamp used in laser sources.

Silver is the material of choice due to it's superior reflection in the visible, NIR (Near Infra Red) and MWIR (Mid Wave Infra Red) wavelength regions. Since Silver has the tendency to get tarnished, it is overcoated with protective layers.

HHV has developed a process for the deposition of the protective silver stack onto the quartz tube by the PVD route and can supply these tubes on custom sizes as per the customer's requirements.

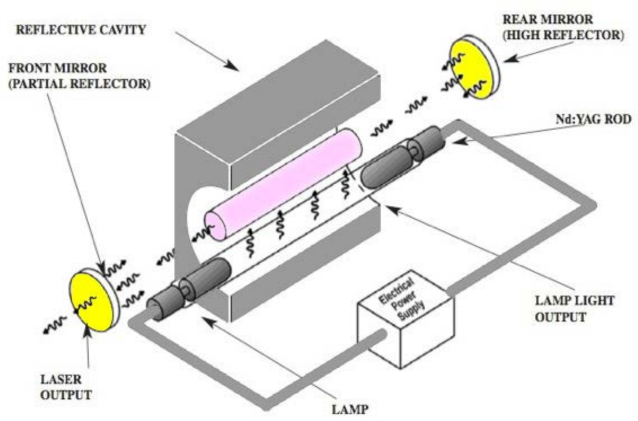


Figure 1: Quartz tube

Conductive ARC on Temperature sensitive substrates

Anti-reflecting coatings (ARC) are an integral part of all optical components be it consumer goods such as ophthalmic glasses and cameras, or optical assemblies used in scientific and defence equipments.

For those components used in defence equipments, there is an additional requirement to add EMI shielding functionality into the coatings in order to protect the assemblies from external interferences. These EMI shielding coatings need to be transparent and conducting, and hence the coating material will need to be chosen from the family of transparent conductive oxides (TCOs). Amongst the TCOs, the material of choice with the best combination of electrical and optical properties is Indium Tin Oxide (ITO), and hence is the go to material for such applications. Due to this addition, the conductive ARC stack is to be designed taking into account the refractive index of the ITO layer.

The deposition of both the ARC as well as the ITO layers require deposition temperatures in the range of 150 – 300 °C to get films of high quality. This makes it quite challenging to deposit such stacks onto temperature sensitive substrates, especially those having dimensions of above 100 mm, without affecting the optics specifications.

HHV has developed process solutions for the deposition of conductive ARCs by combining different PVD techniques to ensure that the optical specifications of temperature sensitive glasses such as SLAH66 and other similar materials are retained intact after the coatings.

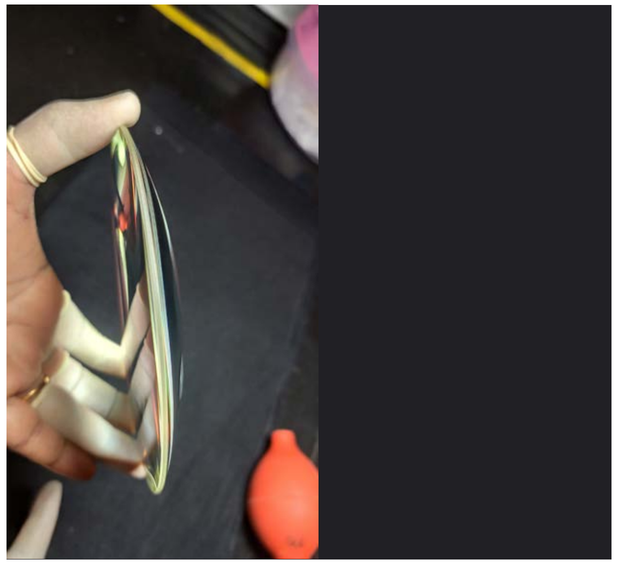


Figure 1: View of optics with ARC side

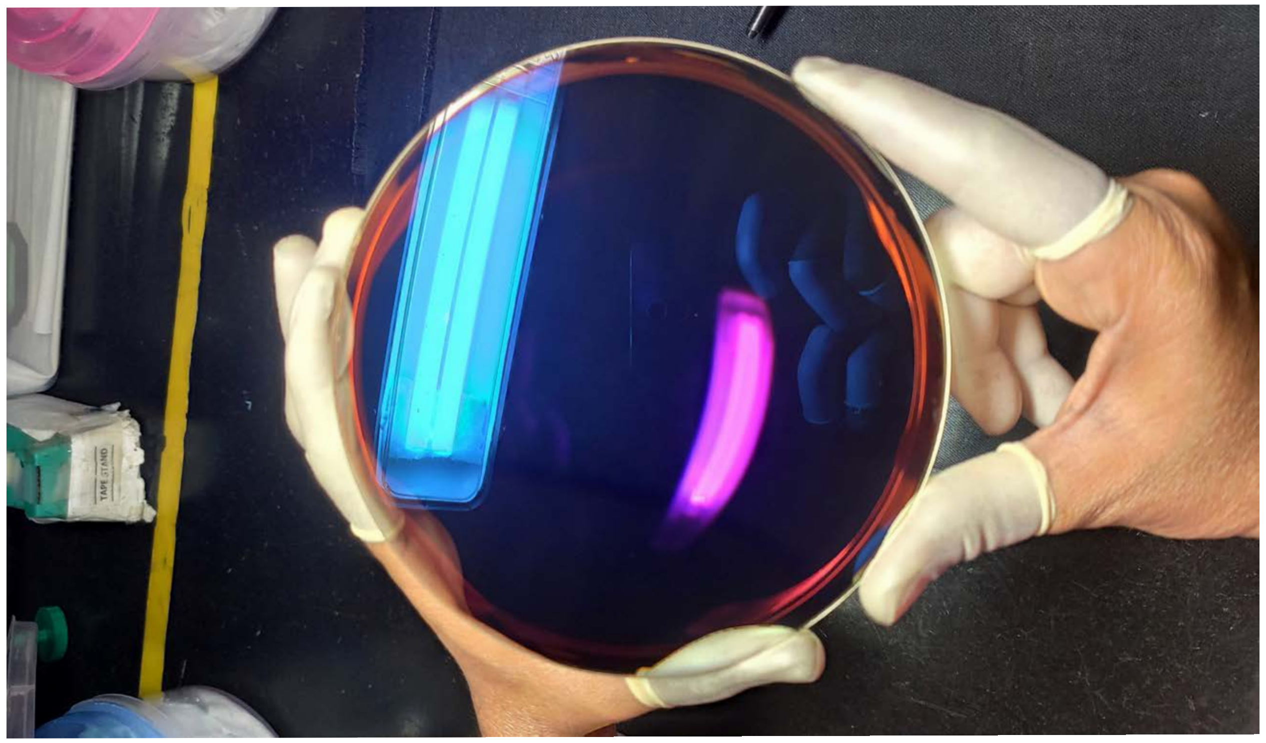


Figure 2: View of Optics with ARC top

Beam Combiner for Rifle Sights

Beam combiners are used in optical assemblies to combine the spectrum coming in from different components.

Figure 1: Beam Combiner

In order to accomplish this, the design of the beam combiners are such that they will need to be transmitting in a certain wavelength range, and reflecting in another wavelength range, and they are usually angled at 45 degrees to provide for enough spacing for the components associated with the 2 sources.

In order to accomplish this behaviour of selectively transmitting in a certain wavelength range, and selectively reflecting in another wavelength range, multi-layer coatings are designed and deposited onto a suitable substrate surface.

The beam combiner for sights are more challenging as there is a need to enclose the beam combiner surface within the optical component, while the flatness and the parallality of the 2 faces of the components needs to be maintained to a high level of accuracy.

Hence, the component is made in two halves. The beam combiner face of the component is machined to the required precision after which the coating of the beam combiner multi-layer stack is taken up. Post this, the two halves are cemented together to make a single component.

Optical machining is taken up again to ensure that this component achieves the required flatness and the parallality. Post this, the faces exposed are coated with broadband anti-reflection coatings that encompasses the band including sources 1 and 2 to improve the performance of the overall component.

HHV has the optics and coatings capability to design and fabricate beam combiners for rifle sight applications for custom requirements.

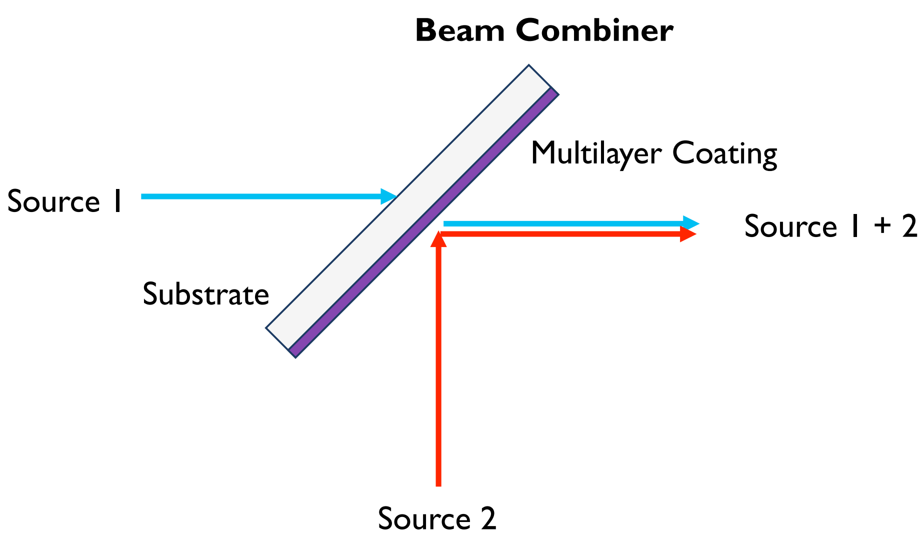


Figure 2: Beam Combiner Schematics

HHV Contribution – ISRO Chandrayan Mission

HHV (Hind High Vacuum Company) is incredibly proud of being associated with ISRO for over five decades.

With the successful landing of Chandrayan - 3 on moon, India has come a long way since the inception of its space program. Not only is India on the moon but so is a little part of HHV and its contribution towards Make in India and self-sustainability of high technology in the country!

The moon landing pushes India into an elite group of countries that have successfully landed rovers on the moon. India is the first country to land on the dark side of the moon. This is no small feat!

In fact, HHV started its journey with the Indian Space program by supplying a High-Altitude Test Chamber in 1960s. From then to now, it has contributed a range of technical machinery, expertise and components to ISRO's program.

A few important vacuum technology-based equipment to be mentioned are:

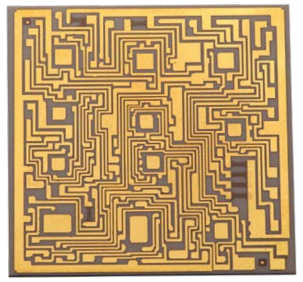
- High vacuum furnaces for heat treatment and brazing applications,
- Equipment for making and testing sensors for Inertial Guidance System
- CVD / CVI furnaces to processes carbon-fibre-carbon products,
- Large Shock tunnel and wind tunnel for high altitude testing,
- Cabin Environment Simulation system
- A large rotary vacuum brazing furnace for rotary brazing of nozzle cones
- Integrated test facility to measure the thrust of Xenon thruster propulsion engine.

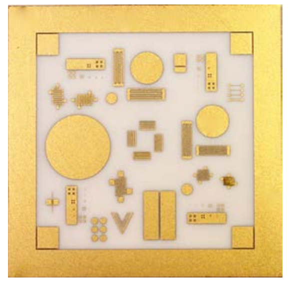
In 2017, HHV was awarded a 'Certification of Qualification' by the Space Application Centre, ISRO for thin film metalized substrates. Circuits are designed on these multi-layered metallised substrates and used in ISRO's space and satellite program. This indigenously developed technology, as a part of HHV's 'Make in India' initiative, was recognized by the Government of India and the company was conferred with the prestigious National Research & Development Award in May, 2018.

As a part of ISRO's technology transfer program and as a forward integration of this award-winning technology, HHV now produces the entire thin film metallised circuit (TFMC) for ISRO's 40-micron accuracy line, in its new technology production line known as 'Photo Lithography'.

HHV has established a new Photo Lithography Lab at its Dabaspet plant to develop TFMCs on alumina substrates that first need to be metallised in a vacuum chamber. HHV's Photo Lithography Lab has ISO 7 and ISO 8 clean rooms as well as class 100 laminar flow stations that allow us to achieve resolutions of up to 40 microns.

All these contributions are part of HHV's philosophy of "Make in India" and make for India. We are proud to be a part of this successful journey of ISRO and India's landing on the moon.





HHV Demerger 2023

The revised structure will have two separate entities for vacuum systems and thin film-focused businesses respectively.

Bengaluru-based Hind High Vacuum Co. Pvt. Ltd. (HHV), a thin film and vacuum technology company, has announced a demerger plan to create a simplified corporate structure.

The revised structure will have two separate entities for vacuum systems and thin film-focused businesses respectively. This restructuring aims to unlock growth potential of each of its businesses, the company said in a statement.

The Regional Director, South-Eastern Region, Ministry of Corporate Affairs, Hyderabad has approved the demerger of the Vacuum Systems business into HHV Thermal Technologies Private Limited and Thin Films business into HHV Advanced Technologies Private Limited. Both are 100% subsidiaries of HHV.

Accordingly, the Vacuum Systems division which manufactures vacuum furnaces and carbon-carbon composites within HHV has been transferred to HHV Thermal Technologies including the design, manufacturing rights, employees, customers, and suppliers.

Similarly, the Thin Films division which manufactures PVD and other technology-based thin film deposition equipment and the thin Film coatings division which manufactures optical components from flats to lenses covering the UV, Visible and Infra-Red space within HHV has been transferred to HHV Advanced Technologies.

HHV's consolidated revenues were ₹1.43 billion in FY2022, with over 25 per cent of revenues generated from outside India.

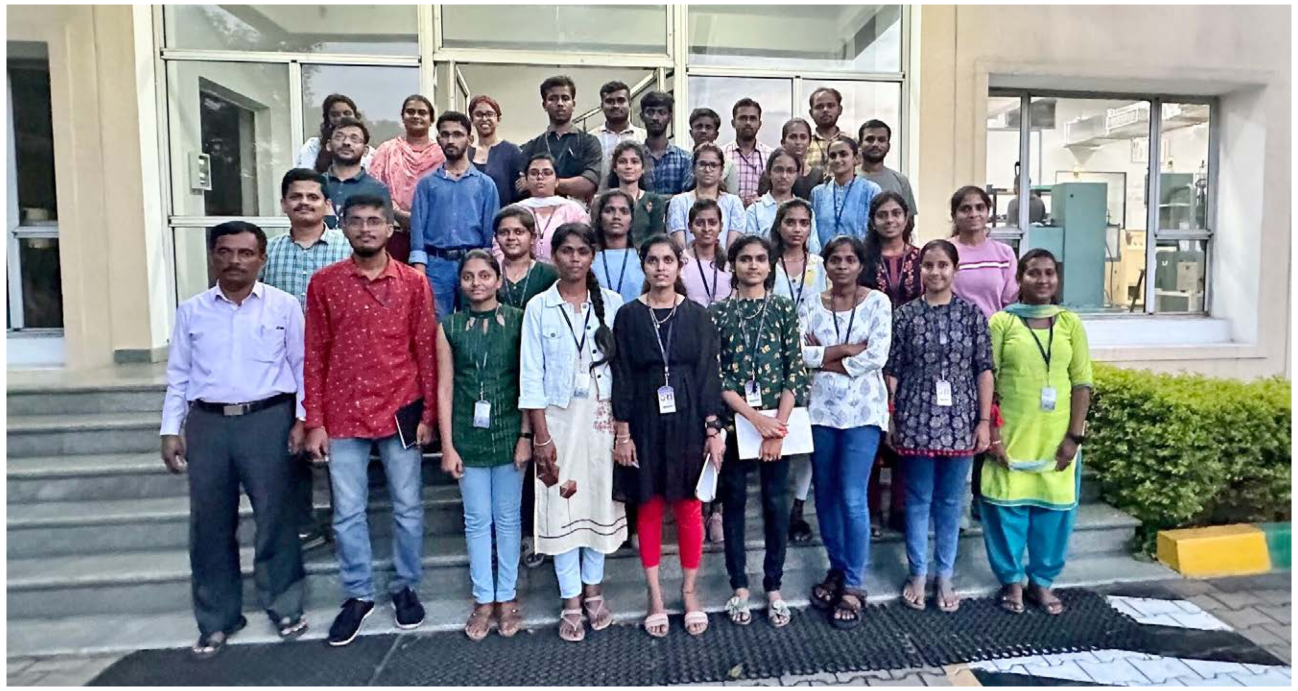
ICEC 2023 - Thiruvananthapuram - India

HHV Thermal Technologies participated in ISAMPE Colloquium & Exhibition on Composites (ICEC 2023) hosted by Thiruvananthapuram Chapter of Indian Society of Advancement of Materials and Process Engineering at Vikram Sarabhai Space Centre / ISRO, Trivandrum on 11th August 2023

MOU - CSIR NIIST 2023 - India

CSIR-NIIST inks MoU with HHV Advanced Technologies, Bangalore for jointly developing perovskite solar cells and modules. This is part of our continuous programme to 'Make In India' and focus on cutting-edge development and collaboration with research institutes in the country.

Tumkur University Students at HHV AT 2023 - Bengaluru, India



Students of Physics from Tumkur University visited HHV AT for an Industrial visit. We have always had strong collaborative ties with universities and research institutions within India and internationally. The visit included a brief overview of the company plus a tour of the facilities. We also invited students to apply for the annual internship for 2024.

Ayudhapooja 2023 - Bengaluru, India

At HHV Ayudha puja was celebrated at all the manufacturing units in October.

During the puja office, machines and tools are typically cleaned and appreciated. HHV believes that it is a powerful symbol of acknowledging the significance of these machines and tools in everyone’s lives.

HHV Annual Sports Day 2023 - Bengaluru, India

HHV organised annual sports meet at Aditya cricket ground Nagamangala, Bangalore on 7th -Oct,2023.

Sports and games have always been an integral part of the culture of HHV and is a fantastic team building event.

Cricket and Fun and enjoyable game for kids and family members like musical chair, lemon and spoon race, sack race and biscuit eating game are the highlight of the event.

All the HHV group employees were participated with their family members enthusiastically. The participants were encouraged with their family members and made it a memorable event.

Japanese Vacuum Industry Association at HHV AT 2023 - Bengaluru, India

HHV had the pleasure of hosting the Japan Vacuum Industry Association at our facility. The team of 22 members spoke about further collaboration between HHV and the Japanese vacuum technology ecosystem. The team comprised of leadership from companies like Ebara, Shincron, Optorun and ULVAC to name a few.

MAPCON 2023 - Ahmedabad, India

HHV Advanced Technologies participated in Microwave, Antennas, and Propagation Conference (MAPCON) held from December 10-14, 2023, at Ahmedabad, India.

4th International Forensic Science Conference 2023 - Delhi, India.

HHV AT participated in the 4th International Forensic Science Conference in Delhi, from 1st to 3rd December 2023, organized by SIFS India and Clue4Evidence. HHV also demonstrated the capability of the Identicoater for the detection of finger marks on various exhibits such as plastic cups, paper sheets, leaf, etc that are difficult to handle using conventional techniques.

SIMS Students at HHV Crystals 2024 - Bengaluru, India

Students of Shrushruti Institute of Management Studies - Bangalore visited HHV Crystals Private Limited on 31st January 2024 as an Industrial visit. HHV has always had strong collaborative ties with universities and research institutions within India and internationally.

32nd DAE – BRNS National Laser Symposium 2024 - Indore, India

HHV Advanced Technologies (HHVAT)is at the 32nd National Laser Symposium at Raja Ramanna Centre for Advanced Technology (RRCAT)from the 29th of January to the 1st of February! The symposium is organized by the Indian Laser Association. HHVAT has made great strides in laser coatings for defence applications.

SPIE Photonics West Expo 2024 - San Francisco, USA

HHV Advanced Technologies participated in SPIE Photonics West Expo 2024-San Francisco, USA at Moscone Centre from 30th January to 1st February 2024, the largest annual photonics conference at USA to demonstrate globally accepted range of HHV's Thin Films and Optics products. It was well received, and it paved the way to enhance the business growth of HHV thermal technologies.

ICPEH 2024 - Ahmedabad, India

HHV Advanced Technologies (HHVAT) participated in the International Conference on Planets, Exoplanets and Habitability on 5-9 February 2024 at Physical Research Laboratory, Ahmedabad. The conference participants consisted of space enthusiasts, astrophysicists, and eminent scientists in space & planet research from across the globe. Representing HHVAT, Dr. Pramod M. Rajanna, Sr. Technical Manager discussed on the organization's capabilities and contribution in space & planet research by highlighting the indigenous telescopic mirror coating systems for M1 and M2 with integrated processes.

New Year 2024 - Bangalore, India

HHV celebrated new year 2024 with keynote that "As we step into 2024, we have large and many plans for growth and diversification and let us carry forward the spirit of innovation, sustainability, and collaboration that defines HHV. The road ahead may present challenges, but with a team as resilient and dedicated as ours, we are confident that we will turn every challenge into an opportunity for growth."

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