HHV WORLD

Vol 16, Issue 2, Sep-2024

For internal circulation only

CELEBRATING THE CENTENARY BIRTHDAY YEAR OF OUR FOUNDER

28TH SEPTEMBER 1924 - 8TH OCTOBER, 2021

S. V. NARASAIAH

S. V. NARASAIAH OR SVN WAS THE FOUNDER AND CHAIRMAN OF HIND HIGH VACUUM CO. PVT. LTD (HHV).

INDIA'S LEADING VACUUM TECHNOLOGY COMPANY. IT ALL STARTED IN 1964 IN THE LABS OF IISc FROM WHERE THE IDEA GERMINATED AND WAS INCUBATED.

SVN AS HE WAS CALLED PIONEERED THE DEVELOPMENT OF VACUUM TECHNOLOGY AS AN INDUSTRY AND BUILT THIS CRITICAL CAPABILITY IN THE TECHNOLOGY STARVED AND EMBARGOED COUNTRY WITH GRIT AND COMMITMENT TO MAKE IT ONE OF THE MAIN STAYS TO SUPPORT THE INDIAN SPACE AND ATOMIC ENERGY PROGRAM. SVN WAS BORN ON SEPTEMBER 28TH, 1924 IN TADUVAI IN THE GUNTUR DISTRICT OF ANDHRA PRADESH INDIA. HE MOVED TO CHELLAPALLI TOWN FOR HIS EARLY EDUCATION AND ATTENDED GUNTUR AC COLLEGE FOR HIS HIGHER EDUCATION. S. V. NARASAIAH WAS A VERY MAJOR STUDENT LEADER IN HIS YOUTH AS PART OF THE COMMUNIST PARTY OF INDIA AND WAS AN ACTIVE MEMBER OF THE FREEDOM STRUGGLE. HE WAS A PROTÉGÉ OF THE GREAT P. SUNDARAYYA.

POST INDEPENDENCE AND A STINT AT PHOTO JOURNALISM AND MAKING EDUCATIONAL FILMS SVN MOVED TO BANGALORE IN 1964, TO LOOK FOR AVENUES TO FURTHER HIS PASSION FOR TECHNOLOGY AND CHANCED UPON VACUUM TECHNOLOGY AND OPTICS IN HIS INTERACTIONS WITH PROF. HOBEL AT THE IISC. WITH THE HELP OF HIS FRIENDS AND MENTORS, PROF. RAMAKRISHNA RAO, PROF. SATISH DHAWAN AT THE IISC AND DR. H.N. NANJUNDAIAH, AN EMINENT MANAGEMENT GURU HE ESTABLISHED AND GREW HHV TO BE A PIONEERING VACUUM TECHNOLOGY COMPANY.

THE HHV GROUP, IN THE LAST SIX DECADES, GROWN TO BE A GLOBAL, AWARD-WINNING TECHNOLOGY PIONEER, EMPLOYING NEARLY A THOUSAND PEOPLE. THE HHV GROUP HAS DEVELOPED AND DESIGNED INDIA'S FIRST VACUUM PUMP, VACUUM FURNACE, SPACE SIMULATION SYSTEM AND THIN FILM VACUUM COATING SYSTEM TO NAME A FEW. IN 2018, THE HHV GROUP RECEIVED THE NATIONAL R&D AWARD FOR INNOVATION AND PRODUCTION DEVELOPMENT. SVN AS HE WAS FONDLY CALLED, WAS ACTIVE IN THE DEVELOPMENT OF SMALL-SCALE INDUSTRIES IN KARNATAKA AND AS A DIRECTOR OF THE SMALL-SCALE INDUSTRIES ASSOCIATION HELPED ESTABLISH A STRONG GOVERNMENT AND INDUSTRY LINKAGE IN KARNATAKA. HE WAS THE FOUNDING MEMBER OF THE INDIAN VACUUM SOCIETY.
HE WAS AN ACTIVE MEMBER OF THE AMERICAN SOCIETY OF METALS AND WAS RECOGNIZED FOR HIS SERVICES BY THE INDIA CHAPTER IN 2019.

SVN WAS EXCEPTIONAL IN HIS LEADERSHIP OF HIS TEAM AND DEVELOPED VERY STRONG LOYALTY AND COMMITMENT FROM HIS COLLEAGUES A MAJORITY OF WHO HAVE STOOD WITH HIM THROUGH VERY CHOPPY WATERS OF TECHNOLOGY DEVELOPMENT AND WERE STEADY FAST IN THEIR SUPPORT IN BUILDING THE ORGANIZATION TO ITS CURRENT HEIGHTS.

CONTENTS

HHV Group Marks 60th Anniversary with Expansion Plans and Optics Facility Launch

HHV Group, Bengaluru-based India's premier Vacuum, Optics, and Thin-film technology company announced its 60th anniversary celebrations.

Established in 1965 in the name of Hind High Vacuum Co (HHV) as a small-scale industry in Bangalore by SV Narasaiah, a pioneer of vacuum technology in India, the company, has since made significant contributions to the advancement of vacuum-related technologies in the country.

Founded at the IISc, six decades later, HHV has grown enormously as a Group employing 800 people and with sales and service centers across the globe. It has diversified over its six-decade journey into various fields, including solar module manufacturing, thin film coating services and equipment development, optics fabrication, etc. From developing India's 1st indigenous vacuum coating unit to successfully installing a 3.7 meter Telescopic mirror coater at Mount Abu in January 2024, HHV has contributed to many strategic projects and research in the country.

This noteworthy occasion of 60 years is being celebrated at HHV Peenya (Bengaluru) facility. This includes an exhibition where each company in the Group displayed new products and developments achieved in the year passed. The HHV Group Managing Directors Nagarjun Sakhamuri and Prasanth Sakhamuri, in their addresses to the audience outlined the challenges faced in the areas of high technology development and the way forward for the Group in the years to come.

Every year, HHV rewards the best performers and recognizes long-serving employees. The Sakhamuri Family Foundation also handed out scholarships to support over 50 deserving students in pursuing their education. In 2023, HHV demerged into HHV Thermal Technologies for the furnaces and carbon composite businesses and HHV Advanced Technologies for the thin films and optics businesses. Both operate as 100 percent subsidiaries of the HHV Group.

Not one to rest on their laurels, the HHV Group, going ahead, has major plans for investment and growth coupled with their 'Make in India' push. HHV Advanced Technologies are currently in the process of very soon setting up an optics fabrication and thin film coating facility at Dabaspet, Bengaluru, that will span 40,000 sq ft in clean rooms and have state-of-the-art optics fabrication capability with single-point diamond turning, CNC machining, and super polishing.

This facility syncs into the long-term vision of the HHV Group to enter opto-mechanical assemblies, and the team is currently in discussions with leading lens manufacturers to develop and establish this capability in the country. HHV Thermal Technologies has been leading the way with cutting edge furnaces for metallurgical applications for over 60 years. It also received a very prestigious, super specialty brazing furnace order from Korea this year. HHV Thermal Technologies has also been working on carbon-carbon composites and carbon-silicon composites for space applications.

On its 60th anniversary, the HHV Group has pledged to continue its focus on the development of new technology and processes to aid expansion plans and propagate growth to serve long term vision, mission, and goals.

Courtesy: https://www.mmindia.co.in/article/2323/hhv-group-marks-60th-anniversary-with-expansion-plans-and-optics-facility-launch

Leading the Vacuum Revolution

Prasanth Sakhamuri, Managing Director, Hind High Vacuum (HHV) Group, India's premier vacuum, optics, and thin-film technology company, in the following interview with MMI's Editor-in-Chief, Soumi Mitra, recounts HHV's extensive and dynamic journey, milestones that define it, and junctures that have led to its diversification while celebrating the company's ability to identify market gaps, the several firsts in the list of its achievements, the National R&D award from the President of India and so much more.

"HHV's journey has been extensive and dynamic, and we initially focused on mastering diverse technologies and their applications. Early milestones include building India's first space simulation chamber and thin film coating system."

Prasanth Sakhamuri
Managing Director
Hind High Vacuum (HHV) Group

The Hind High Vacuum (HHV) Group is India's premier Vacuum, Optics, and Thin-film technology company. Could you please provide an overview of your offerings and their applications in various industries, and elaborate how HHV has diversified into fields such as solar module manufacturing, thin film coating services and equipment development, and optics fabrication?

Over its 60-year history, HHV has been a pioneer in the manufacturing of vacuum pumps, solar panels, cryogenic vessels, and vacuum flasks. As the country's first vacuum technology company, HHV has consistently met domestic needs, especially during times of high-tech product shortages. During India's time under technical embargo with the limited flow of high-tech production and severe foreign exchange shortage, many technologies like solar, thin film coating, and optics fabrication had to be homegrown.

The HHV Group operates across several critical sectors, including Space, Aerospace, Automotive, and Defence. It comprises five companies, including HHV Thermal Technologies, with five decades of expertise in vacuum furnace design and manufacturing for heat treatment, brazing, and annealing; and HHV Advanced Technologies, specializing in thin-film coating machinery and optics fabrication for both R&D and production applications.

HHV's one significant early venture was the production of stainless steel vacuum flasks for international markets. It provided valuable insights into international expectations and quality standards.

Founded in 1965, HHV Group has come a long way from being a small-scale business establishment to a global enterprise employing 800 individuals with sales and service centers worldwide and multi-acre plants in Bangalore. Could you briefly take us through the milestones that have led to your current juncture in the industry?

HHV's journey has been extensive and dynamic, and we initially focused on mastering diverse technologies and their applications. Early milestones include building India's first space simulation chamber and thin film coating system.

These initial leaps and risks allowed us to push ourselves to establish technology quickly and for a purpose.

One significant early venture was the production of stainless steel vacuum flasks for international markets. While the business ultimately struggled against cheaper imports due to unfavorable industrial policies, it provided valuable insights into international expectations and quality standards.

We then shifted focus to the Solar industry, initially developing thin-film coating equipment for space-qualified solar cells. This transition led to the creation of India's leading solar module manufacturing facilities, reflecting HHV's growing expertise in renewable energy technologies.

In the early 2000s, HHV began contract manufacturing for Edwards High Vacuum. When Edwards was acquired, HHV seized the opportunity to license and purchase thin-film manufacturing technology, which expanded our international presence.

You have had several firsts in the list of your achievements: developing and manufacturing India's first high vacuum rotary pump in 1968, launching India's first commercial ALD reactor in 2017, and most recently in January 2024, developing India's first Indigenous vacuum coating unit and successfully installing a 3.7 m telescopic mirror coater at Mount Abu, contributing to numerous strategic projects and research initiatives in the country. How do you identify these gaps in the market?

Our ability to identify market gaps stems from our deep expertise and commitment to advancing domestic manufacturing capabilities. We recognize that numerous everyday products, from smartphones to automobiles, rely on components that are coated or heat-treated using vacuum technology.

Our journey began with a dream to fabricate zoom lenses, which required vacuum coating technology. In the 1960s, faced with limited access to materials and knowledge, we developed our own equipment to meet this need, inadvertently expanding into machine building. Today, we manufacture the machines and produce the high-precision zoom lenses we originally envisioned.

With 60 years of experience, we continually adapt to advancements in process technology. Collaborations with institutions, such as IIT Bombay, have led to developments like our ALD (Atomic Layer Deposition) system. Our expertise in developing telescopic mirror coatings has also become highly respected.

Our drive to innovate is fueled by customer demands and the multi-use nature of vacuum technology in critical fields such as defence, atomic energy, and space. Our advancements are fueled by commercial needs, business opportunities, and partnerships with research institutions.

It must be a matter of immense honor to have received the National R&D award from the President of India for establishing the production of thin film metalized substrates. Kindly share the experience and the effort that led to it.

Receiving this award from the President of India was a great honor. Since its inception, HHV has embraced a 'Make in India' attitude. We have been instrumental in the production of thin film metalized substrates, a key component for the Hybrid Micro Circuit (HMC) program. This involves coating thin alumina wafers with metal inside a vacuum chamber, followed by lithography and dicing. These substrates are essential for space flight applications.

This achievement resulted from a collaboration with the Space Applications Centre (SAC) in Ahmedabad, a unit of ISRO. SAC utilized HHV's expertise to create a unique facility that integrates metallization, lithography, and dicing in one lab—making it the only one of its kind in the country.

Our metalized substrates are used in every ISRO satellite launch, including the Chandrayaan Mission, where they even reached the moon. We are incredibly proud that our work supports ISRO's groundbreaking space research and missions.

This award underscores HHV's role in fostering indigenous capabilities and aligns with the Government of India's Aatmanirbhar (self-reliant) program. We are honored to contribute to this national vision and continue supporting advancements in technology and space exploration.

You have made a mark in the space arena with your innovations such as an indigenous space simulation chamber to test leaks in pallets and allied components for rocket thrusters. You also have received Space Qualifications for Lithograpy of HMC substrates. Could you elaborate on your developments in this field?

Our advancements in space technology have been significant. The Lithography HMC substrates were part of a technology transfer from ISRO. While the Space Applications Centre (SAC) could fabricate these substrates in small R&D batches, the growing demand led to the decision to collaborate with HHV to establish a dedicated facility. This partnership reduced SAC's reliance on imports, decreased costs, and provided a reliable domestic production source.

In addition to the lithography facility, HHV has developed specialized capabilities for the Space sector. We pioneered the creation of indigenous space simulation chambers capable of high vacuum and temperature cycling to replicate deep space conditions, which significantly cut costs previously incurred from overseas testing.

We also constructed a hypersonic wind tunnel in Trivandrum for simulating flight and reentry conditions up to 14 times the speed of sound. Additionally, we manufacture equipment for producing carbon-carbon composite components used in spacecraft engines and body shields.

These contributions underscore HHV's role and commitment toward advancing indigenous space technology and supporting the space department's needs.

The award from the President underscores HHV's role in fostering indigenous capabilities and aligns with the Government of India's Aatmanirbhar program. Honored to contribute to this national vision, it commits to continue supporting advancements in technology and space exploration.

The 60th-anniversary celebration at HHV Peenya (Bengaluru) facility featured an exhibition where each company within the group showcased new products and developments achieved in the past year. The Group's Managing Directors also shared the challenges in the high technology department. Our readers would be keen to know the challenges and your plan to overcome them.

> "Our long-term vision for the HHV Group is to become a world-class leader in vacuum science and technology. To realize this vision, we are pursuing investment from both domestic and international private equity and strategic investors to expand our capabilities and global presence."
>
> **Prasanth Sakhamuri**
> **Managing Director**
> **Hind High Vacuum (HHV) Group**

Today's key challenges include a shortage of skilled labor and inadequate infrastructure. Despite having a large potential workforce, there are too few skilled individuals in technical fields. This shortage impacts our operations, as we face higher costs and difficulties in managing the movement of goods, people, and services.

Our supply chain also struggles with the availability of high-tech materials, requiring us to import nearly all critical components for advanced work, such as optics and vacuum technology.

A comprehensive policy is needed to address these issues by aligning national demand with capacity building, both in terms of workforce and materials.

The Production-Linked Incentive (PLI) program should also include equipment manufacturing, as domestic capability in machine building is crucial for sustaining technological advancements and adapting to changes in technology.

The Union Budget's emphasis on 'Make in India' aims to strengthen internal ecosystems and support public sector undertakings. Additionally, the increased allocation for the Department of Science and Technology will further support these goals.

In 2023, HHV underwent a demerger, creating two 100 percent subsidiaries: HHV Thermal Technologies for furnaces and carbon composite businesses, and HHV Advanced Technologies for thin films and optics businesses. Can you elaborate on how it has impacted the operations and strategic focus of each subsidiary?

HHV has a strong track record with successful joint ventures (JVs) and demergers. Demerger strategies allow each entity to develop tailored growth plans based on its specific product line, customer base, and market potential. While the businesses share a common foundation in vacuum technology, they serve different applications and operate on distinct cycles.

This approach also facilitates strategic partnerships and customized business plans, accommodating different growth rates and management styles. In a rapidly evolving business environment, flexibility and focused management are crucial for laying strong foundations and achieving sustained growth.

What are HHV Group's plans for investment and growth, and what is the long-term vision for the Group and its subsidiaries?

Our long-term vision for the HHV Group is to become a world-class leader in vacuum science and technology. To realize this vision, we are pursuing investment from both domestic and international private equity and strategic investors to expand our capabilities and global presence.

Additionally, we are partnering with educational institutes to develop a comprehensive ecosystem for skill development, ensuring a steady pipeline of talented professionals. We are also exploring joint ventures to diversify into semiconductor and solar equipment, aligning with significant investments happening in India. These strategic moves will not only enhance our technological expertise but also support our goal of driving innovation and growth in these critical sectors.

Please share your views on how the Union Budget 2024 will impact the Indian manufacturing sector.

The Union Budget's strong emphasis on 'Make in India' is set to boost the development of our internal ecosystem by encouraging PSUs and other organizations to strengthen domestic manufacturing capabilities. Increased funding for the Department of Science and Technology will drive innovation by supporting R&D, enhancing competitiveness, and helping Indian manufacturers advance up the value chain.

Moreover, investment in skill development and training programs is crucial. By addressing skill gaps through targeted vocational training and educational initiatives, we can improve productivity and better align the workforce with the needs of the Manufacturing sector. This comprehensive approach will not only support current industry demands but also foster long-term growth and competitiveness.

HHV is partnering with educational institutes to develop a comprehensive ecosystem for skill development. It is also exploring joint ventures to diversify into semiconductor and solar equipment, aligning with significant investments happening in India

> "Investment in skill development and training programs is crucial. By addressing skill gaps through targeted vocational training and educational initiatives, we can improve productivity and better align the workforce with the needs of the Manufacturing sector."
>
> **Prasanth Sakhamuri**
> **Managing Director**
> **Hind High Vacuum (HHV) Group**

Courtesy: https://www.mmindia.co.in/article/2527/leading-the-vacuum-revolution
- Ms. SOUMI MITRA

Vacuum Aluminium Brazing Furnace

Vacuum aluminium brazing is a precise process which involves balance of time, temperature, and vacuum level.

These are controlled to maintain the fundamental brazing process parameters –cleaning and loading the parts, heating the parts in high vacuum, melt the brazing filler material, allow it to cool and get the parts out. This is done in a specific controlled work environment utilizing sophisticated controls. The furnace is designed for exceptional temperature uniformity of ± 2^0C at very high vacuum.

Vacuum aluminium brazing minimizes distortion of the part due to uniform heating and cooling as compared to a localized joining process. This type of brazing creates a continuous hermetically sealed bond. Components with large surface areas and numerous joints can be successfully brazed.

Vacuum Brazing has many advantages when compared to other metal-joining processes. Given that brazing does not melt the base metal of the joint, it allows for more precise control of tolerances and provides a clean joint with no need for additional finishing. The meniscus (crescent shaped) formed by the filler metal in the brazed joint is ideally shaped for reducing stress concentrations and improving fatigue properties.

Vacuum aluminium brazed parts often include heat exchangers, thermal radiators, condensers, and evaporators used in automotive, aerospace, nuclear, and energy industries. HHV has recently built a front loading high vacuum aluminium brazing furnace with a job loading & unloading trolley for a charge weight of 600kgs. It has an effective hot zone size of 1200 mm (Width) x 1400 mm (Height) x 2600 mm (Depth). It has been designed as per the latest ASME pressure vessel design code.

A deep vacuum level is an important process parameter, because it ensures a relatively pure environment for brazing. HHV has integrated an adequately sized high vacuum system to achieve very high vacuum in clean, cold, empty, de-gassed condition.

Second to the deep vacuum level, precise temperature control and uniformity are also important process parameters. The furnace chamber has been designed with strip heaters; typically positioned in 10 zones allow the heating of 1 to 10°C per minute with the temperature uniformity during a brazing cycle is ±2°C. The horizontal type double walled cylindrical SS-304L chamber with water guiding channels in annular space for effective water cooling and heat dissipation.

The totally automated HHV vacuum aluminium brazing furnace has been provided with auto-mode facility for complete operation with temperature controller, programmable logic controller (PLC), Desktop PC, HMI with SCADA software, and measuring instrumentations. The furnace is provided with number of safety devices to protect the system and the operator from malfunction and possible operator's errors.

Top Loading Vertical High Temperature Tungsten Vacuum Furnace

The Tungsten Vacuum Furnace is a high-temperature furnace designed for a wide range of applications in materials science and engineering.

The HHV TT top loading vertical high temperature Tungsten Vacuum Furnace features a maximum temperature of 2000^0, and the temperature uniformity of ± 5°C in the effective zone above 600°C to 1100°C.

The furnace chamber has water guiding channels in the annular gap for efficient water cooling and heat dissipation. The maximum rise in skin temperature will be restricted to about 15°C above ambient at the highest operating temperature.

Figure 1: High Temperature Vacuum Furnace

The furnace is equipped with a mature and advanced peripheral and vacuum system design, optimizing the configuration of all-metal hot areas and designed to have a operating vacuum of 1x 10-5 mbar in the hot state of range at 1600°C.

It offers precise temperature control, high vacuum levels, and a user-friendly interface. The 2000^0 Tungsten Vacuum Furnace is an ideal tool for researchers and engineers working with high-temperature materials, such as tungsten, graphene, and silicon carbide.

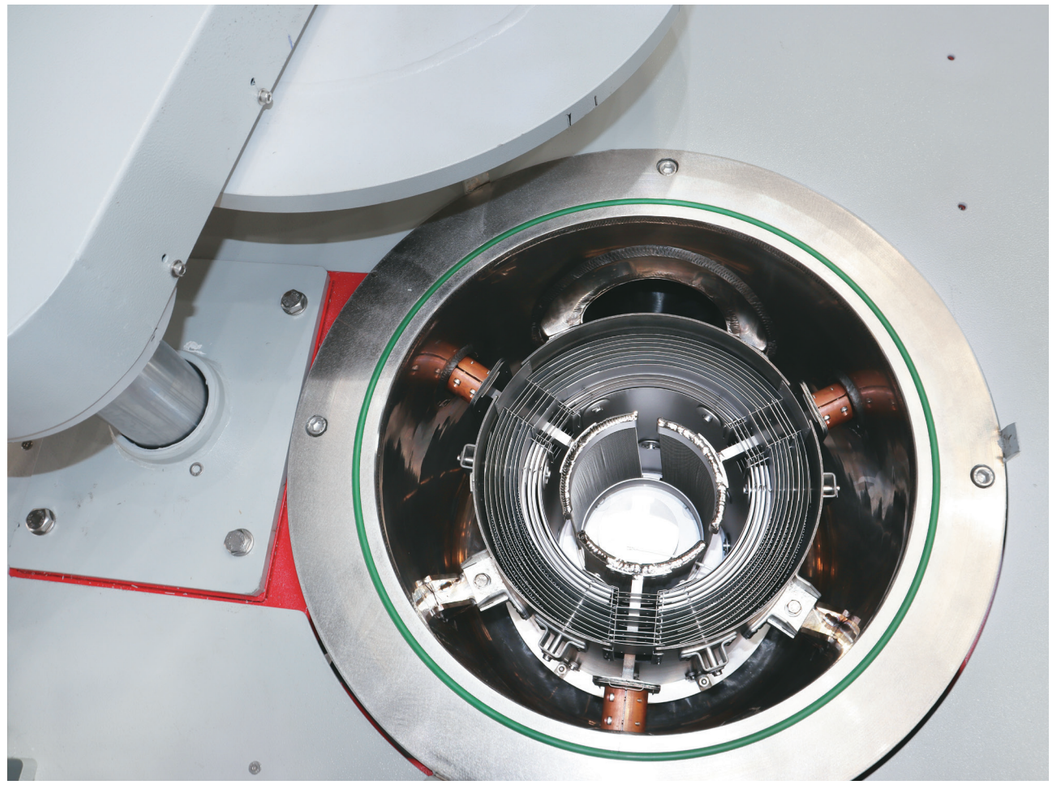


Figure 2: Hot Zone

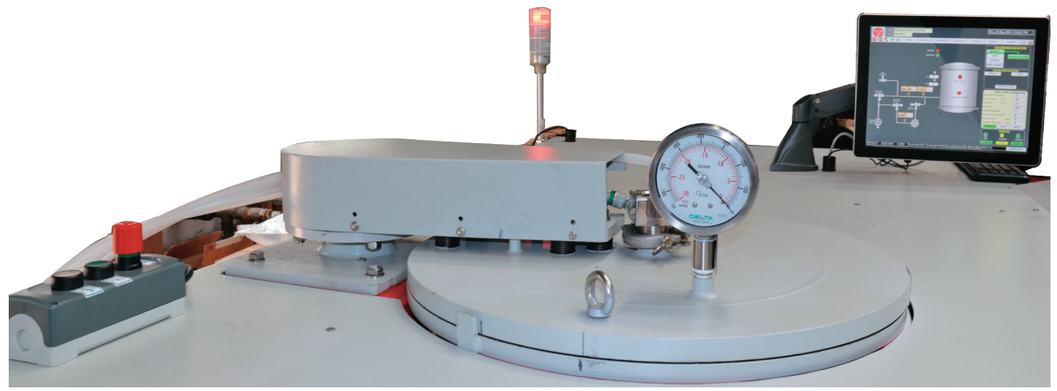


Figure 3: Top View

DLI Based PECVD Systems

HHVAT has designed and manufactured the SAARA Plasma Enhanced Chemical Vapour Deposition (PECVD) platform with a Direct Liquid Injection (DLI) setup for the deposition of multilayer interference coatings of dielectric materials at low temperatures.

Figure 1: DLI Overview

The deposition can be carried out on various substrates that can be either insulating, semiconducting, or conducting in nature, including crystals, glass, silicon, polymer, metals, etc. The system has been installed at Raja Rammana Centre for Advance Technology (RRCAT)- Indore.

The SAARA PECVD platform is equipped with a load-lock chamber, an automated substrate transfer mechanism, and a touch-screen PC for complete process automation. An optimized recipe for the deposition of silicon dioxide thin films is built into the system's process library. The small footprint, low cost, ease of use, and superior performance make the SAARA PECVD platform ideal for a wide range of applications including R&D, prototyping, pilot line, and low-volume production.

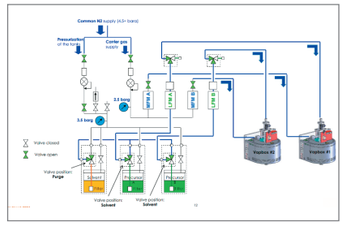
Features of the system:

- Single block Aluminum reactor and load lock chamber for processing wafers as large as 150 mm in diameter.
- Motorized automatic vertical motion of the reactor chamber top plate allows for opening and closing the chamber for maintenance.
- Dual frequency power supplies for reduction of stress developed in thin film.
- A motorized pressure controller valve to control the reaction pressure.
- Direct Liquid Injection system with two precursor chambers, for two different materials.
- Provision for in-situ cleaning of the reactor chamber with a mixture of carbon tetrafluoride and other gases.
- Complete process automation.
- Compact design ring minimized footprint.
- Built-in process library.
- Fully interlocked for operator safety

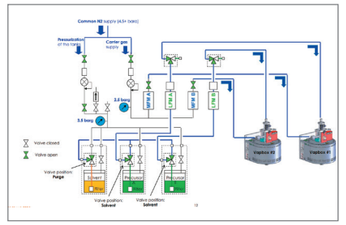
Overall view

Reactor with load lock chamber

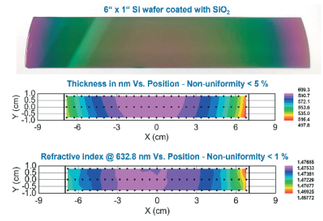
Top View



Top plate lifting

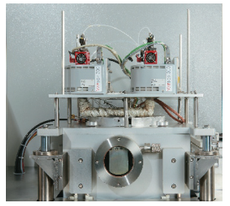


Schematic of DLI setup

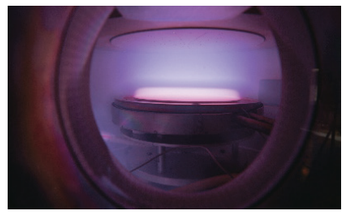


Thickness Uniformity results

DLI panel



Reactor with vaporisers



Process view

System Configuration:

Reactor chamber	Aluminum, 450 mm (L) x 450 mm (W) x 260 mm (H)
Pumping System for reactor	Combination of corrosive turbo pump, >400 liters/second and dry pump, 100 m^3/hr
Upper electrode	200 mm ϕ
Lower electrode	150 mm ϕ
Sample Temperature	Up to 350 °C
RF power supplies	600 W, 13.56 MHz RF, 600 W LF (100- 460 kHz) power supply
Gas lines	4 Mass flow controllered lines (Ar, O_2, N_2 and CF_4)
Liquid Precursors	Tetraethyl orthosilicate (for SiO_2) and Hafnium (IV) tert-butoxide (for HfO_2)
Load lock chamber	Aluminum, 425 mm (L) x 300 mm (W) x 130 mm (H)
Pumping system for Load lock	Turbomolecular pump, 80 lit/sec + Dry pump, 6 m^3/hr.
System Control	15" monitor, Windows operating system, Simplicity SCADA
Ultimate vacuum	1 x 10^{-6} mbar
Leak rate	< 1 x 10^{-9} mbar. lit/sec
Thickness Uniformity	< ± 5 % over 150 mm ϕ
Dimensions	2100 mm (L) x 1250 mm (W) x 2000 mm (H)

PVD System Substrate Holders

PVD systems are commonly used to produce multilayer precision coatings for various applications such as optical, filters, ophthalmic, etc. Many of these coatings are applied to substrates made of thin, flat disks that are then cut to size.

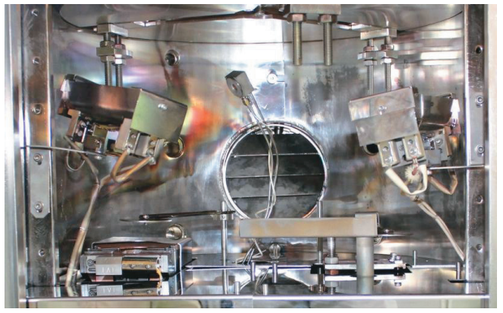
The coating flux from a source in a PVD system is relatively stable; however, its spatial distribution can result in deposited films with non-uniform thickness if the substrates remain stationary. To improve uniformity, the geometrical relationship between the source and substrate must be chosen correctly. Good results have been obtained when the substrate is rotated about an axis perpendicular to the plane of the surface to be coated, and when multiple substrates are mounted on multiple spindles in a planetary configuration.

Catering to these demanding requirements, the HHVAT design team developed a variety of substrate holders for both research and development and production applications. This article discusses some of the most recent developments in work holders.

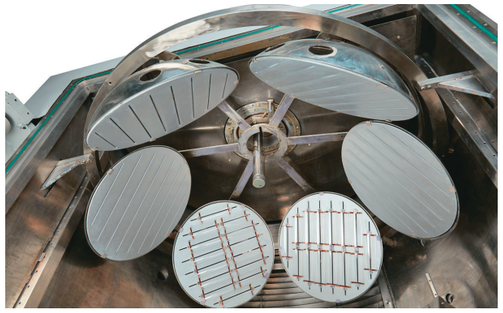
A. Substrate work holders: For Production applications:

The work holders used in thin film technology have to be able to withstand temperatures of over 350 degrees centigrade. The distance from source plane to work holder should be maintained constant to ensure consistent results across the work holder.

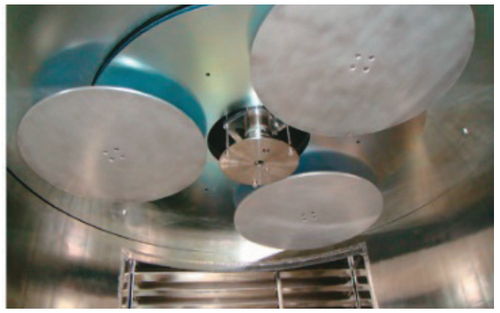
- We developed and have been using four types of component tooling, each dedicated to component shape, these are: -
- Flat plates - for large prisms and flat components.
- Calottes - for high volume lens held by circular rings.
- Segmented calottes - for holding smaller, more complex prisms and lenses.
- Planetary systems -for components with steep curvatures.



Flat work holder



Knudsen Planetary work holder

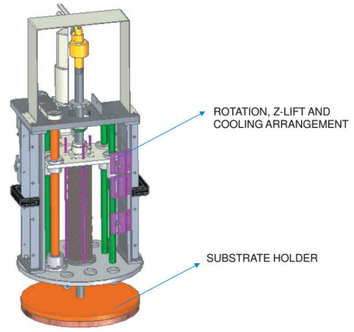


Segmented domed workholder

Flat planetary work holder

B. Substrate Holders – Cooling:

We have also developed and manufactured a wide range of cooled substrate holders for applications in which substrates must be actively cooled or kept at specific temperatures. These range from water-cooled to refrigerated/heating circulators, with working temperatures ranging from -30°C to +70°C depending on the application. We offer sizes ranging from 1” to 200mm Ø.



Cooled work holder

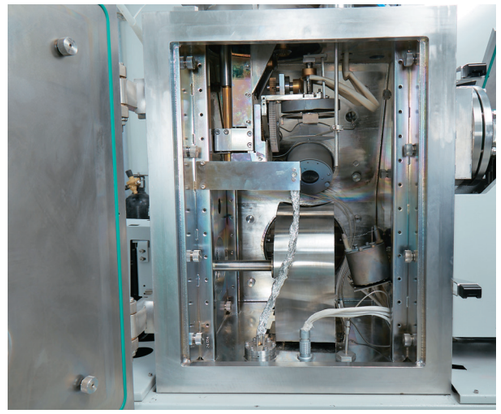
The work holder includes rotation and linear Z movement. Other options like RF/DC biasing, substrate shutter is also available.

C. GLAD Substrate Holder:

Glancing Angle Deposition (GLAD) is gaining popularity in areas where structured three-dimensional deposition is required, as it allows for different microstructural architectures and increases the surface area of thin films.

In these systems, the sample holder’s rotational speed and angle relative to the cathode/deposition source can be precisely controlled. As a result, novel structures can be formed. The GLAD stage is extremely suitable for use with all of the common directional deposition sources, including:

- Thermal Evaporation
- Electron Beam Evaporation
- Magnetron Sputtering
- Ion Beam Sputtering



GLAD substrate holder

Technical Data:

Standard flange	DN 150CF to DN 300CF (depending on the sample size, other on request)
Base pressure range	10^{-8} mbar
Sample Rotation	360° continuous, servo motor, with adjustable speed up to 20 rpm
Substrate Tilt	± 45^{0}, Motorised
Z linear movement range	50 to 100 mm (others on request)
Drive control for Z movement	Servo motor
Shutter	External, pneumatic operated
Heating methods	Resistive
Substrate temperature	up to 800 °C (resistive)
Thermocouple	1 x K type

Commander Sight High Efficiency and High Durability Germanium Windows

Germanium (Ge) windows play a crucial role in thermal imaging technology. Their infrared transparency makes them ideal for capturing thermal radiation, which is essential for night vision and thermal imaging systems.

In defense applications, like those used in tanks and other military vehicles, Ge windows help provide clear and accurate thermal images even in complete darkness or challenging conditions. The benefits of Ge in these systems are due to its ability to transmit infrared light effectively, which allows for high-resolution imaging and target detection. This capability is crucial for tactical operations, where precise identification and tracking of objects can be critical. Germanium's role in night vision goggles, thermal cameras, and other imaging devices underscores its importance in modern defense technology.

Making a significant development for our team HHVAT has produced a large octagonal-shaped Ge window of size 170x 162x 8 mm for Indian military services (Bhishma T-90 Tanker). This is made of optical grade Germanium. Processing of Germanium involves precise Single Point Diamond Turning (SPDT).

During the SPDT process, the parallelism is maintained within 3μ to get the polishing finish. Customized fixtures were designed and fabricated to hold the parts using the vacuum on the SPDT machine. The diamond-turned parts are then processed through conventional polishing for controlling surface quality and surface flatness and coated on both sides. The stringent flatness criteria of 0.5 fringes, surface quality up to 10-5, and parallelism within 10" (arc seconds) are controlled by conventional polishing techniques.

This IR material is highly prone to surface quality issues, and maintaining the surface quality is highly cumbersome. The surfaces tend to get scratched during the final cleaning of optics as well as during the cleaning process for coating. Hence a robust cleaning process is developed with imported cleaning materials, for which our technicians are highly competent at cleaning Germanium.

Figure 1: Nanoform systems for Single Point Diamond Turning

Figure 2: Talysurf PGI Freeform for freeform and aspheric optics

Germanium material is relatively hard compared to the other infrared transparent materials like ZnS and chalcogenides. It has a high refractive index of around 4.002 and is effective across a broad range of infrared wavelengths, specifically from the mid-wave infrared (MWIR) to the long-wave infrared (LWIR) region (3-14 μm). These attributes make Ge an excellent choice for IR optics, especially where high performance in the infrared spectrum is crucial. However, to take full advantage of this material as the window for the thermal imaging equipment poses two unique challenges to the optical coating designer.

Firstly, due to its high index, Ge suffers a considerable amount of reflection loss, around ~36% per surface in its transparency range. This substantial reflection loss can seriously impact the overall system throughput. The best way to tackle this challenge is to apply a high-efficiency AR multi-layer coating (HEARC) on the Ge substrates to bring the reflection losses down to 0.5% or better (per surface). The choice of non-radioactive materials in designing a HEARC is crucial for ensuring safety and environmental compliance. The multi-layer coating stack is designed with the right combination of low, medium, and high index materials, and the coating is deposited onto the Ge window using the ion-assisted electron beam evaporation. The performance of HEARC is highly dependent on the precise control of deposition conditions such as deposition temperature and process parameters that are unique for each material in the design stack. HEAR coating on both the surfaces of Ge window can yield total transmission > 98% in the LWIR region. Additionally, HEARC, which is done on the inside surface of the Ge window, is also capable of passing the environmental tests specified under MIL-675C.

Secondly, since the front surface of the Ge window is constantly in harsh environments such as those experienced by tankers, requires special consideration compared to the inside surface. For this reason, it is coated with a less efficient but highly durable anti-reflection coating called diamond-like carbon (DLC) coating using the Plasma-Enhanced Chemical Vapour Deposition (PECVD) technique. DLC coating is highly robust and enhances the durability of Ge window to also withstand the windscreen wiper test (10000 cycles of wipes of sand water mixture with a 40 g load) as per RSRE TS-1888, along with other accelerated tests like severe abrasion, salt fog, and salt solubility under MIL-C-675C military standard.

At HHVAT, we have been successfully producing Ge windows in full force with the combination of HEARC and DLC coating. With that, we have achieved transmission better than 90% in the LWIR (8-12 μm) region. Along with single-band coatings, we have expanded our capabilities by also producing coating solutions to meet the customer requirements that target both MWIR (3-5 μm) as well as LWIR region. With the continued effort and improvements, we aim to address emerging needs in fields like defense, industrial imaging, and scientific research.

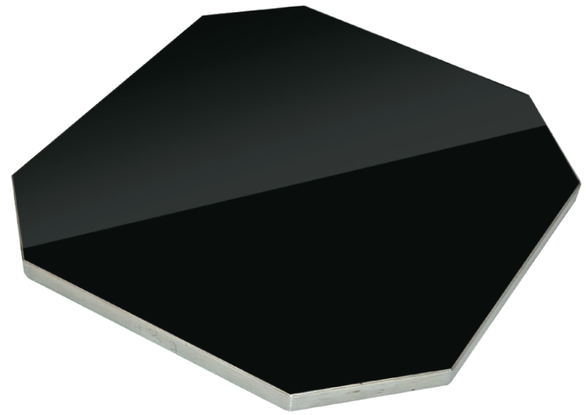


Figure 3 : Ge Windows

HHV Periscopes for the Zorawar tank

HHV Advanced Technologies is proud to be a part of the Zorawar light weight tank development. The periscopes on the tank are designed, fabricated and assembled at HHV Advanced Technologies.

Photo: Credit First post

HHV Advanced Technologies Periscope Prisms consist of ITO coated heater plates that are laminated with a prism through an autoclave process for high durability, sealing and encapsulation. Our reflective coatings are finished with protective paint to prevent it from atmospheric degradation. The entire assembly is bullet-proof and chemically inert. We also offer customizable laser safety coatings on the prisms as well.

Features:

- Total field of view, Horizontal up to 110°and Vertical up to 30°
- Laser Safety protection is available.
- Custom periscope can be designed and produced upon request.

The ‘Zorawar’ light battle tank weighs 25-tonnes and will be able to navigate steep mountains and cross water bodies like rivers. Developed by the Defence Research and Development Organisation (DRDO) and Larsen and Toubro (L&T), it has been designed for rapid deployment largely along India’s border with China.

The Indian Army is looking at deploying over 350 light tanks mostly in the mountainous border areas. The army wants these tanks equipped with AI, as well as integrated tactical surveillance and loitering munition drones.

Figure 1: Periscope

Blood Cell Counting Slides

HHV Crystals manufactures Blood Cell Counting Slides used in the Hemocytometer to count the numbers of cells in a specific volume of solutions.

A Hemocytometer consists of a thick glass microscope slide with a grid of perpendicular lines etched in the middle. The grid has specified dimensions so that the area covered by the lines is known, which makes it possible to count the numbers of cells in a specific volume of solutions.

The unique cells are cut, machined, coated and printed.

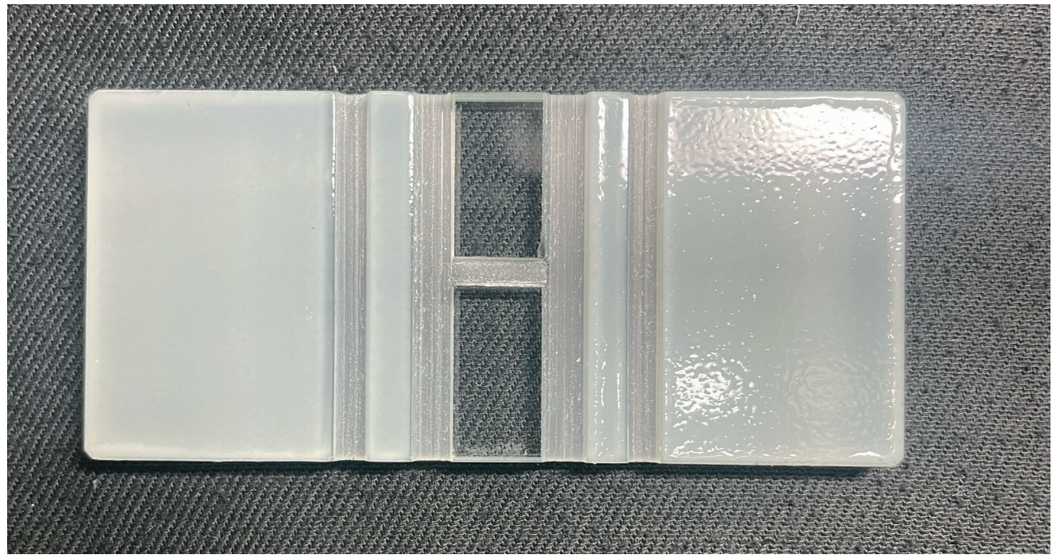


Figure 1: Cell Counting Slide

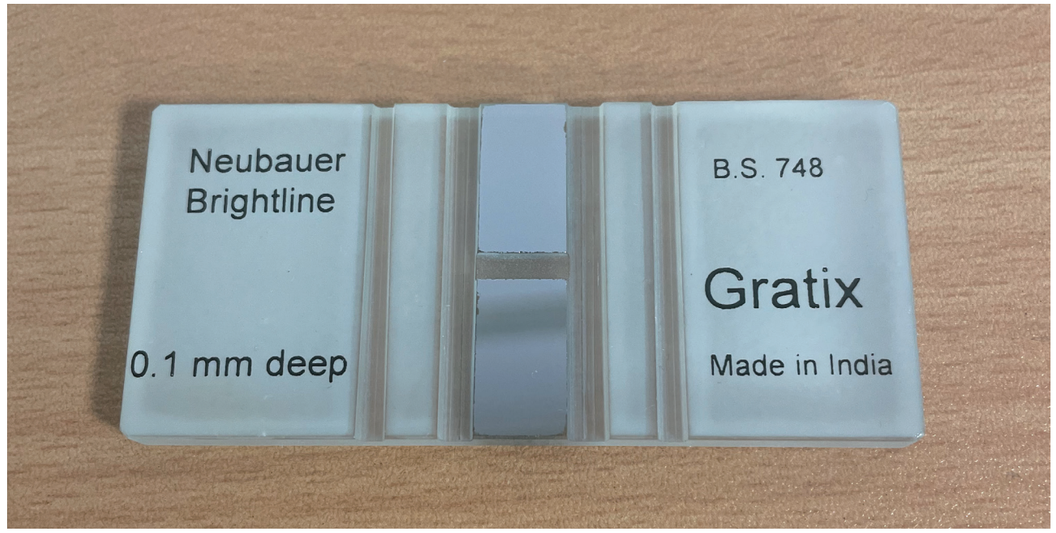


Figure 2: Cell Counting Slide

HMC Qualification

We are happy to announce that our Hybrid Micro Circuit lab has once again received the prestigious Qualification Validity Certification from the Space Applications Centre (SAC) of the Indian Space Research Organisation (ISRO) for our metallization and lithography processes on alumina substrates for space flight applications.

Figure 1: HMC Lab

The HHV Group has proudly been associated with ISRO for the past six decades, including the construction and supply of India's first space simulation chamber. We are honored to continue supporting ISRO's groundbreaking missions and advancements in space technology.

Hind High Vacuum Advanced Technologies (HHVAT), a subsidiary of the Bengaluru-based HHV group, announced that its Hybrid Micro Circuit (HMC) Lab has once again bagged the prestigious Qualification Validity Certification from the Space Applications Centre (SAC), Indian Space Research Organisation (ISRO) for its metallization and lithography processes on alumina substrates for space flight applications.

SAC, one of the major centers of ISRO, focuses on the design of space-borne instruments for ISRO missions and the development and operationalization of applications of space technology for societal benefits. The applications cover communication, broadcasting, navigation, disaster monitoring, meteorology, oceanography, environment monitoring, and natural resources survey.

The HHV Group has been associated with ISRO for the last 6 decades and has built and supplied India's first space simulation chamber. From providing machines and components for various applications, HHVAT has a long history with various ISRO units.

HHVAT's HMC lab is capable of 2-layer and 3-layer Thin Film Metallized Circuits (TFMC) with a line accuracy of 40 micron using photolithography process. The lab is equipped with three production sputter coating systems, a stylus profiler for measuring the thickness of the coatings, a four-probe sheet resistance meter to qualify the sheet resistance of the coatings, a laser writer for mask fabrication, UV exposure and aligner system for carrying out the photolithography process, an etching room with a chemical wet bench, dicing machines to cut metallized substrates to required sizes, and high-performance microscopes and profile projectors for inspection and measurement of the plain and patterned substrates.

The HMC Lab is housed in an ISO 7 clean room and has ISO 5 laminar flow stations for substrate handling. With these facilities, the HMC lab can produce annually 25,000 numbers of 1 inch sq metallized substrates for space and defence applications.

"HHV works closely with scientists of ISRO on these Hybrid Micro Circuits in realizing various Flight Mode projects. The Chandrayaan-3's landing on the moon has made India proud and put a feather on the cap of HHVAT for its contribution towards Make in India. We are proud to be a part of this successful journey of ISRO and India," said Prasanth Sakhamuri, Managing Director, HHVAT.

Courtesy: https://www.mmindia.co.in/article/2393/hhv-group-s-hybrid-micro-circuit-lab-bags-top-certification-from-isro

Figure 2: Thin Film Metallized Circuits

International Safety Day and Health at Work, April 2024

April 28th is marked as world safety day. The day to encourage the balance of safe, health and appropriate working environments worldwide. HHV organizes a safety and health at work at work program every year. We ensure each and every employee's safety and health at work by training and continuous discussions, the same employees take a safety oath annually. This day is dedicated to ensuring people's safety from a variety of issues.

HHV AT creates awareness health at work

HHV AT employees takes oath on the international safety day

HHV TT employees takes oath on the international safety day

HHV Crystals employees takes oath on the international safety day

Internation Women's Day 2024

The International Women's Day is celebrated every year on 8th March. HHV celebrates International Women's Day to celebrate the contribution of women in the organization. HHV is proud to have many women at different level in the company across the group. HHV believes and implements equal opportunity employment practices.

HHV TT celebrates International Women's Day, 2024

HHV AT celebrates International Women's Day, 2024

HHV Crystals celebrates International Women's Day, 2024

HHV Advanced Technologies Annual Internship - 2024

HHV conducts every year industrial internship program intended for students who pursuing master's in science, Engineering and applied sciences etc. This is year HHV organized the internship program for a period of 8 weeks from 24th June to 17th August 2024. Five students were selected from over 300 applicants for a six week internship at our thin films and optics plant. Students get a chance to experience working at an industry at industry scale and pace. The students were given extensive classroom and practical training in the area of thin film Technology and will be subsequently working on a mini-project.

NSRS-2024, IIT Kanpur, India

HHV AT participated in theNational Symposium of Research Scholars on Metallurgy and Materials at IIT Kanpur on 9th and 10th March 2024

Forensic Europe Expo 2024

HHV Ltd. participated in the Forensic Europe Expo on 19-20 June, 2024, it showcased our latest metal deposition systems used in the forensic industry

Reva University Talk

Our General Manager Ms. Smriti Sakhamuri shared her valuable insights on experience as an entrepreneur in the technology space at the Reva University as a part of their women's day celebration hosted by their Physics Department.

The talk shed light on her personal journey moving from the World Bank to the world of thin film, vacuum and high technology manufacturing.

Surveillance and Electro& Electro Optics Seminar and Expo, 2024, Delhi, India

HHV AT showcased its latest innovations and flagship products at the Surveillance and Electro& Electro Optics Seminar and Expo by IMR media on March 22, 2024 at the Manekshaw Centre in New Delhi.

Industry-Institute Conclave 2024, IISc

Our General Manager, Smriti Sakhamuri, recently took part in an insightful panel discussion on “Technology Transfer from Lab to Market: Success Stories & Unsuccessful Endeavours” at the industry-Institute Conclave conducted by Indian Institute of Science (IISc) on May 4th.

The discussion shed light on

- The importance of successful adoption of pilot technologies
- Identifying industry partners to scale technology
- Selecting the right projects
- Challenges related to indemnity and liability

MET & HTS , 2024, Mumbai, India

HHV TT participated in the 5th edition of MET & HTS , 2024, Mumbai, India, India’s Largest Exhibition on advanced Heat Treatment & Advances in Materials Engineering Technology . Showcased its latest innovative ranges of Vacuum Heat Treatment, Vacuum Brazing, Diffusion bonding furnaces for advanced metallurgical engineering, high vacuum heat treatment , brazing applications .

Photon-Quest, 2024, Bangalore, India

Dr. Raaghesh Vijayan, Senior Scientist at HHV Advanced Technologies Pvt. Ltd., gave an invited talk titled ‘Indigenous Equipment Manufacturing Towards Thin Film Materials’ focussing on the process and product development activities carried out at HHV. The talk was given at ‘Photon-Quest: Exploring Photovoltaic Materials, Devices, and Bioelectronics Horizons’, a symposium organized in honour of Dr. Raaghesh’s PhD mentor, Prof. K. S. Narayan at Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India.

DST Inauguration for CeNS Research Centre

Hind High Vacuum Company Pvt. Ltd is proud to have supplied India’s first indigenously built Ion-Beam Sputtering System to the newly inaugurated Innovation Center at Centre for Nano and Soft Matter Sciences - Official and Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR). The centre was inaugurated by Prof. Abhay Karandikar, Secretary to Govt. of India, Department of Science & Technology.

CSIR-NIIST Panel Discussion

General Manager of the Thin Film and Equipment Division - Subramanya Sastry represented HHV Advanced Technologies in a panel discussion on “Building Integrated Energy Technologies: Opportunities and Challenges” conducted by CSIR – NIIST on June 26th at Thiruvananthapuram.

The discussion shed light on the importance of laboratory level equipment in the pipeline to scale up for mass manufacturing and how to improve and sustain sustainable and environmentally friendly manufacturing processes while still being competitive.

HHV Advanced Technologies is a global leader in thin film technology. For over five decades, we have been designing, developing thin-film coatings and fabricating optics for the space, defence and industrial sectors.

CII Innoverge 2024

The annual CII Innoverge covered a whole host of discussions. In the session on “Space Sector Innovations: Opportunities & Challenges,” Dr.Unnikrishnan Nair, Director of the Vikram Sarabhai Space Centre (VSSC), described how the Bangalore Astronaut Training Centre combines hardware and software to maintain system health, conducting rigorous tests with unmanned systems before moving to manned evaluations. He also highlighted the Sustain Program’s role in addressing ongoing challenges and emphasized that the Bharatiya Antariksha Station (BAS) features advanced space suits with multi-layered technology for various functions, all crucial for the success of human space flight.

Our MD, Mr. Prasanth Sakhamuri who was a panelist and speaker highlighted the importance of advanced materials like thin films, optics, and carbon composites in space exploration, emphasizing their role in protecting against harsh environments, improving imaging, and supporting high-temperature applications in rockets and habitats. He stressed that these materials are essential for future innovations and mission success in space exploration.

Hind High Vacuum Company Pvt. Ltd.

HHV Thermal Technologies
Site No. 17, Phase 1, Peenya Industrial Area,
Bengaluru 560058, Karnataka, India.
Phone: +91-80-41931000
Email: info@hhvthermaltech.com

HHV Advanced Technologies
Site No. 31-34 & 37, Phase1, KIADB Industrial Area,
Dabaspet, Bengaluru Rural District 562 111, Karnataka, India.
Phone: +91-80-66703700
Email: infotfd@hhvadvancedtech.com

HHV Crystals
Survey No.: 13/2 & 13/3, NH-4, Tumkur Road, Malonagathihalli,
T Begur, Nelamangala Taluk, Bengaluru Rural 562123,
Karnataka, India.
Phone: +91 95353 86262
Email: sales@hhvcrystals.com

International
HHV Ltd.
Unit 14, Lloyds Court, Manor Royal, Crawley,
West Sussex, RH10 9QX, United Kingdom.
Phone: +44 (0) 1293 611898
E- mail: info@hhvltd.com
Website: www.hhvltd.com

Hind High Vacuum Company
HindHighVacuum
HindHighVacuum
Hind High Vacuum Company Private Limited