HHV WORLD

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Editorial

The first quarter of the financial year is over. HHV has developed new technology in the last eight months and aims to increase market share and sales through its innovative high technology products.

We have formally demerged into two organizations: 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.

The DSS furnace is made is specifically for the PV industry and has the capability to produce high quality ingots suitable for processing high efficiency poly-crystalline solar cells.

In the thin films area new products have been developed in defence and space sectors. HHV's night vision optics are designed with dual band capabilities for the MWIR and LWIR bands. HHV also now has a state of the ar diamond turning facility to machine high precision germanium, silicon and other IR materials in the following profiles aspherics, diffractives and flats.

Our special thin film equipment uses for various coating processes developed collaborations with industrial leaders to build large area telescopes. For the microelectronics industry our latest thermal atomic layer deposition system is used to advance microelectronic coatings for a variety of applications. The launch of our range of 'Made in India' Ophthalmic coaters, under the OPTICOAT platform of coaters, for ophthalmic lenses has also taken place in March 2023.

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

HHV continues to attend and host multiple exhibitions both virtual and in person. We have webinars to enhance our technological presence in building state of art capacity in vacuum and thin film technology. We have participated in Laser World of Photonics in Munich, Photonics 2023 at the Indian Institute of Science, SPIE in San Francisco, IIM and HTS to name a few.

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. Our global footprint is expanding with new distributors in South Korea and Singapore.

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HHV Builds Directional Solidification Furnace for Solar PV Industry.

Bengaluru-based Hind High Vacuum (HHV) has designed and built a directional solidification (DSS) furnace to produce polycrystalline silicon ingots in the solar industry.

Bengaluru-based Hind High Vacuum (HHV) has introduced a directional solidification (DSS) furnace for silicon growth in the solar PV industry. It designed and built the furnace to international standards based on its expertise in industrial furnace manufacturing and long experience in manufacturing and supplying vacuum furnaces.

"The furnace is meant for the production as well as R&D on polycrystalline silicon ingots. This product is suitable for all the poly-C-Si solar cell manufacturers that want a backward integration in their PV production value chain and want to begin their own ingot/wafer production facility. Simultaneously, the existing ingot makers can make use of this latest equipment for improving the growth process and quality of ingots. The poly c-Si cell manufacturing industry and academia having R&D setup on improving production technology, not only from India but other parts of the globe also who want to stay away from Chinese products, will be able to get the benefits of having this system available from India," Nagarjun Sakhamuri, managing director of HHV, told PV magazine.

Figure 1: Directional Solidification Furnace

The company said the furnace can produce high-quality ingots suitable for processing high-efficiency polycrystalline solar cells.

"The unique production mechanism can enhance the properties of the standard and mono-like/quasi-mono cells produced out of the wafers wire-sawed from these ingots to increase the performance of the solar cells further," stated HHV.

The furnace produces polycrystalline silicon ingots, which undergo minimum loss while producing wafers. This higher yield also contributes to lowering the cost of solar wafers and cells.

HHV's DSS furnace also considers the possibility of any accidental breakage of the silica crucible, a critical component of the furnace. Breakage of this part can lead to lengthy downtimes and costs to repair. Several safety functions are incorporated to protect the furnace against overpressure and malfunctioning.

Academia and research institutions can pursue research activities on mc-Si/ mono-like Si with furnaces and technology like this.

Prof. P. Ramasamy, Dean (Research), SSN College of Engineering, Chennai, said, "The furnace will contribute to studies in improving the quality of silicon grown and the efficiency of the equipment. This will help us make these material processes more competitive and attractive to renewable energy power producers."

Sakhamuri added, "As India is rapidly increasing its footprint into PV installations, these furnaces will help India become self-reliant in making its own wafers and satisfy the 'Make in India' and 'Atmanirbhar Bharat' [self-reliant India] initiative of the Govt. of India. This also helps produce solar cells at a lower cost, and solar modules made out of these will become more economical than the prevailing mono-C-Si modules. The DSS furnace is built to international standards with state-of-the-art PLCs, automatic controls and processing, and mandatory safety features and interlocks."

HHV is a thin-film and vacuum technology company with over 55 years of expertise in designing and manufacturing high-vacuum equipment for research and industrial applications. HHV's products are integral to multiple sectors, including aerospace, automotive, and defense.

Figure 2: Multi-crystalline ingot of 800 Kg

Published in PV Magazine JUNE 9, 2023,

Induction Heated Diffusion Bonding Vacuum Hot Press

This versatile induction heated vacuum hot press is a high precision integrated equipment which is used for highly precise experiments and production of metal to metal (SS + Ti) bonding by the diffusion method.

The metal to metal diffusion takes place at very high temperatures and high applied pressures. The job is heated and pressed under vacuum to achieve bonding.

The chamber is cylindrical, D shaped, water cooled and designed as per ASME standards. A 10 ton capacity hydraulic press with active bottom ram is used to apply pressure to the job. The job will be heated to high temperature using an Induction coil and Induction power supply.

The induction power supply employs IGBT modules as switching elements for converting DC in high frequency which enables a higher heating rate of the job. A 10 KW and 125KW power supply is used to heat various sizes of the job. Accordingly two different types of Induction coils are used.

The high vacuum pumping system ensures high vacuum in the chamber to start the process. The process is completely automatic and user friendly.

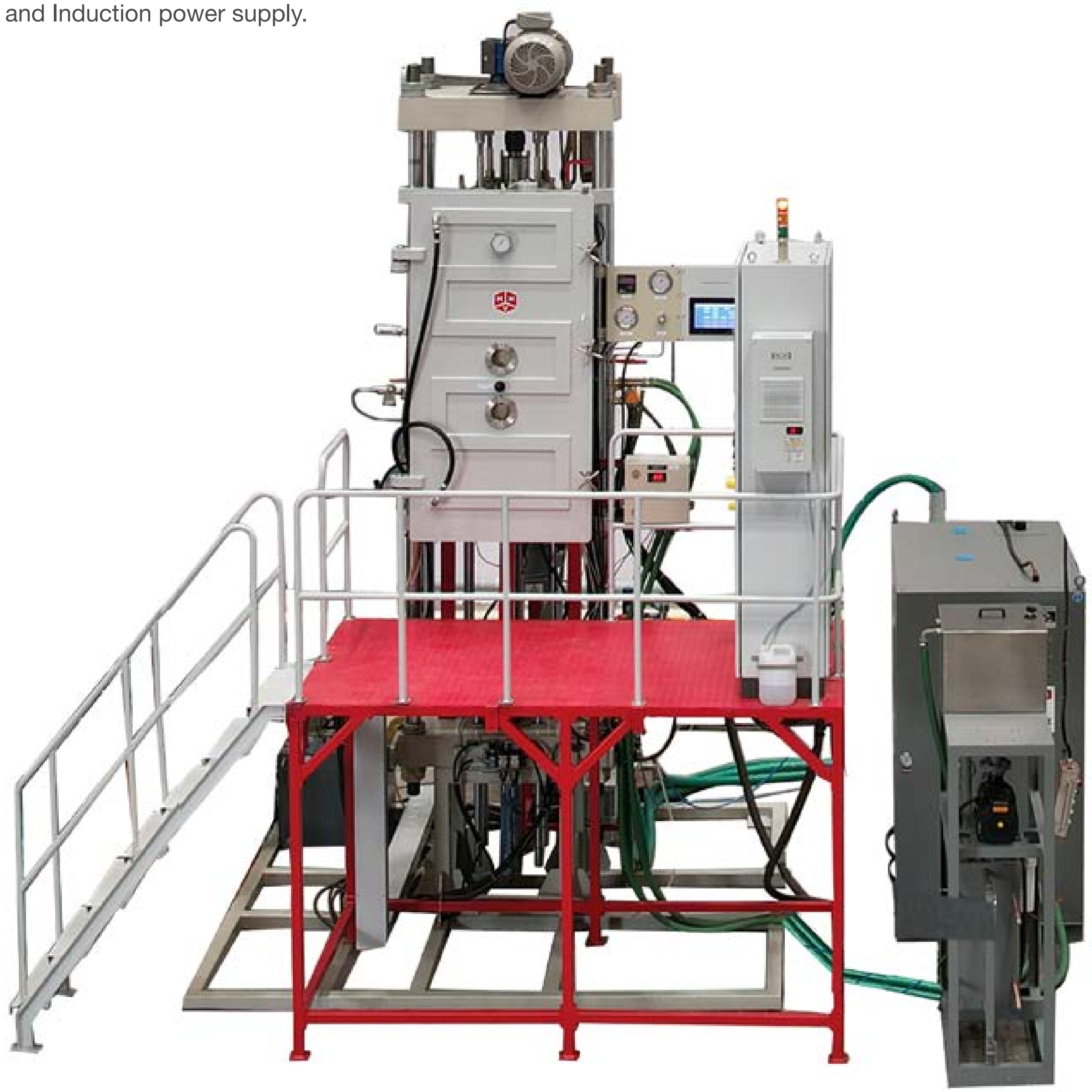


Figure 1: Induction Heated Diffusion Bonding Vacuum Hot Press

High Temperature Vacuum Hot Press with 200 Tonne Capacity

Vacuum hot pressing has a limited field of application for such materials which do not sinter to high densities due to low diffusion coefficients or for cases where a pore-free state is required

With this process only parts with simple shapes like plates, blocks, cylinders can be manufactured easily. With a highly sophisticated design of pressing dies also more complex shapes can be produced.

Designed pressing force: 200Ton at 1.0×10^{-6} mbar vacuum, at max. 1600°C, applicable for components size of 630mm(W)x 630mm(D) x 630 mm(H) in an all-metal hot zone.

Hot pressing technology is applied various in fundamental research and production fields.

The system consists of Rotary-Roots pumps with a combination of 3 high speed turbomolecular pumps to create high vacuum during process. The external Heat Exchanger at 2 bar(G) Argon/Nitrogen gas pressure gives fast cooling of the job which enables the customer to do more cycles per day.

Application of hot pressing in the field of ceramics include:

- MMC and CMC materials, composite materials
- Silicon nitride, mixed ceramics of Al2O3, TiC/TiN and sialon for cutting tools, components of heavy-duty valves, bearings, wear parts for process technology.
- Boron carbide (B4C) for extreme wear resistant parts and armors.
- Sputter targets manufacturing
- Vacuum braze light weight heat exchangers used in fighter aircrafts and Aerospace.

Figure 1: High Temperature Vacuum Hot Press

Thermal ALD: Atomic Layer Deposition for Advancing Microelectronics and Coating

Thermal ALD: Atomic layer deposition for Advancing Microelectronics and Coatings Atomic layer deposition (ALD) has emerged as an important technique for depositing thin films for a variety of applications.

Figure 1. SAARA Thermal ALD system

Semiconductor processing (high dielectric constant gate oxides and for copper diffusion barriers) for advanced microelectronic devices has been one of the main motivations for the recent development of ALD. Miniaturization in the semiconductor industry has led to the requirement for atomic level control of thin film deposition.

Miniaturization has produced very high aspect structures that need to be coated conformally. No other thin film technique can approach the conformality achieved by ALD on high aspect structures. The necessity for continuous and pinhole-free films in semiconductor devices has driven the advancement of ALD.

Other applications with similar demanding requirements outside of the semiconductor industry are low electron leakage dielectrics for magnetic read/write heads and diffusion barrier coatings with low gas permeability. ALD can meet the needs for atomic layer control and conformal deposition using sequential, self-limiting surface reactions. A schematic showing the sequential, self-limiting surface reactions during ALD is displayed in Figure 1.

Most ALD processes are based on binary reaction sequences where two surface reactions occur and deposit a binary compound film.

Because there are only a finite number of surface sites, the reactions can only deposit a finite number of surface species. If each of the two surface reactions is self-limiting, then the two reactions may proceed in a sequential fashion to deposit a thin film with atomic level control.

The advantages of ALD are precise thickness control at the angstrom or monolayer level. The selflimiting aspect of ALD leads to excellent step coverage and conformal deposition on high aspect ratio structures. Some surface areas will react before other surface areas because of different precursor gas fluxes.

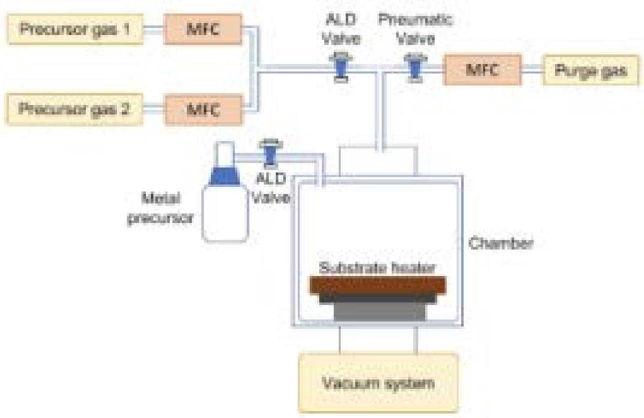


Figure 2. Schematic of Thermal ALD.

(Top from left) Temperature profile across 8" area; Al_2O_3 thickness non-uniformity across 6" with 100 cycles (± 0.73%) and 800 cycles (± 0.41%); (Bottom from left) 6" Si wafer with Al_2O_3; 3D ball bearings with 200 and 100 nm of Al_2O_3; Refractive index of Al_2O_3.

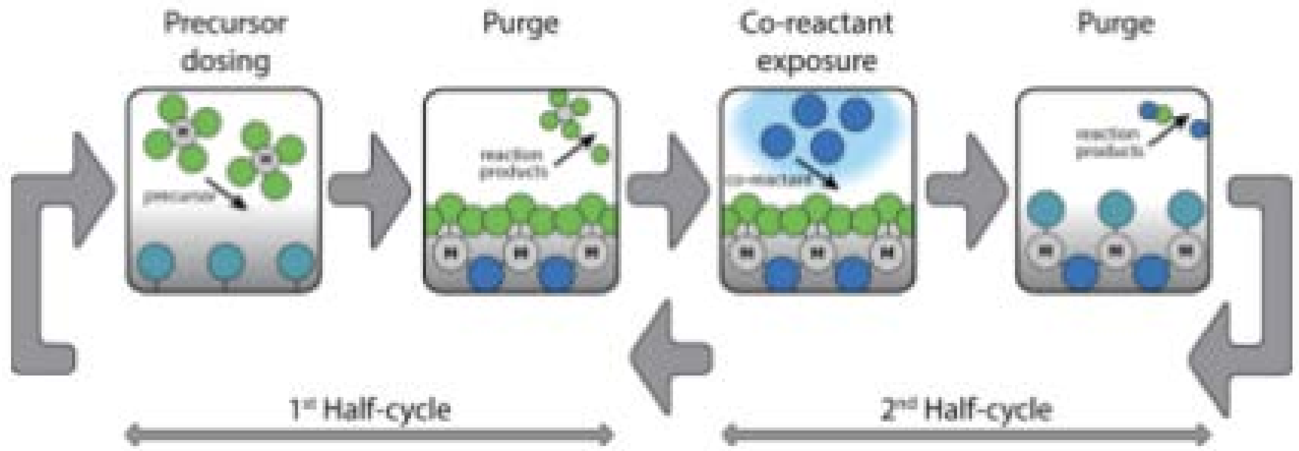


Figure 3. Schematic showing the sequential and self-limiting surface reactions in ALD.

However, the precursors will adsorb and subsequently desorb from the surface areas where the reaction has reached completion. The precursors will then proceed to react with other unreacted surface areas and produce a very conformal deposition. The self-limiting nature of the surface reactions also produces a nonstatistical deposition because the randomness of the precursor flux is removed as an important factor.

As a result, ALD films remain extremely smooth and conformal to the original substrate because the reactions are driven to completion during every reaction cycle. Because no surface sites are left behind during film growth, the films tend to be very continuous and pinhole-free.

This factor is extremely important for the deposition of excellent dielectric films. HHV has been building ALD systems since 2017 with cross flow reactor and showerhead reactor configurations capable of processing substrates with a diameter up to 6" and a substrate temperature of up to 400 °C. The reactor configurations could be equipped with both high and low vapor pressure precursors to deposit various types of oxides, metal oxides, and sulphides.

HHV has recently introduced the ALD system on its SAARA platform, that consists of a process chamber fabricated from single block Aluminum with approximate dimensions of 400 mm diameter and height of 250 mm with the baking facility up to 200 °C. A substrate size of maximum 8" diameter can be loaded directly into the process chamber or through a load-lock with telescopic transfer arm.

A gas shower head ensures uniform gas distribution of both high / low vapor precursors and reactant gases as in water, O_2, O_3, and other sulfides. The substrate holder is provided with a maximum heating temperature of 800 °C. The distance between the gas shower head to substrate is fixed at 50 mm. The geometrically circular substrate platen is made of non-corrosive material.

Thermal ALD process development at HHV: Review HHV has been forefront in developing state-of-the-art ALD systems. The scientists at HHV are actively working towards qualifying and optimizing the ALD systems for its easy and foolproof operation by developing oxides and nitride processes.

Some of the developed processes are Al_2O_3, ZnO, TiO_2, AlN, and TiN on 2D and 3D substrates. The developed oxides and nitrides are synthesized and evaluated for its structural, optical, electrical, mechanical, and chemical properties.

OPTICOAT 600: Coating System for Ophthalmic Lenses

The OPTICOAT 600 is a versatile vacuum coating system designed for high quality anti-reflection (AR) coatings on lacquered CR 39 and polycarbonate lenses by means of an evaporation process. The coating material is evaporated within the vacuum chamber with aid of a suitable evaporation source.

The evaporated material moves freely in the vacuum chamber. When the material comes in contact with the surface (substrate), it condenses and forms a coating. This system is ideal for production volumes, and exceptional reliable for daily production operations. The system is packaged to meet all the requirements of small and mid-sized Rx- Labs.

The used equipment, subsystems, and components are highly reliable and durable, and they are also manufactured by the most reputable, established, and well-known industrial leaders.

The Opticoat 600 features a box coater design with front opening door fabricated from SS 304 material. The dimension of the chamber is 600 mm diameter x 800 mm height. To ensure the proper sealing, O ring and two points articulated hinges are used. Two sets of removable side shield are provided with the chamber which can be easily removed for cleaning.

The high vacuum pumping system consists of diffusion pump (10”) and for low vacuum a dual stage rotary pump with booster pump is used.

Figure 1: Ophthalmic coating system model : Opticoat 600

Figure 2: Segmented work holder

The main pumping system is fitted with a baffle to reduce the heat load from transferring to the high vacuum valve and sealing in order to extended the lifetime of valves and seals. Another aspect of the baffle is to reduce contamination of valves and seals due to evaporated materials.

An additional pumping system for water vapour is installed in the coating system. This is so called cold trap is operated with a cryo chiller (fast cycle water vapour cryogenerator). The cold trap assists the vacuum system. It adsorbs water vapor in the process chamber and thus shorten the pumping cycle. The automatic control system including supply line, cold valve and heat up system is interred with the system control software.

A substrate holder is connected to the main rotation body through gear. The substrate holder has circular apertures for holding the individual substrates. It is spherically shaped. This enables uniform coating of all the substrates, so that the substrates are practically an equal distance from the sources. The substrate holder consists of three segments, which are inserted into the rotary work holder. In this case, when the substrates being changed, the holder stays mounted on the process chamber and only the segments are removed from it. The work holder holds 42 numbers of 70 mm diameter substrates. Additional lens supporting rings with suitable diameters are provided for the proper lens mounting on the calotte. Lens supporting spring rings also provided for uncut lenses.

The gridless ion source is used for pre-treatment of the substrate’s surface to improve adhesion capabilities prior to the coating process. The source is enabled to generate a high current low energy beam for wide area coverage. The ion source process and parameters are controlled automatically.

An electron beam source, 6KW, utilizes a 270 ° beam deflection method, with 6 pockets hearth. Automatic pocket selection is drive by crucible indexer. The electron beam source equips m with 6KW solid state power supply and interface with the deposition controller for monitoring and controlling. All the interlocks are monitored through the computer screen for safety purpose. The electron beam source is used for coating of optical layers such as Al_2O_3, SiO_2, ZrO_2, ITO, TiO_2, Ta_2O_5, etc. The electron beam is installed in the centre position of the chamber base plate. A thermal evaporation source is also installed in the system for top(hydrophobic) layer coating. An electro pneumatically operated shutter installed in the chamber for the deposition sources.

A closed loop thin film deposition controller is provided to monitor and/ or controls the rate and thickness of the deposition of the films. The sensor head locates in the centre of the fixture rotation.

The entire system operation is controlled via industrial PC with SCADA software. It provides the interface between the system control and operating personnel. The software installed under the Microsoft windows operating (XP) system that provides display of the status of the processes and the system, system control functions, recipe processing, trend functions, online process control, pass word protection and remote access.

HHV Thin Film Deposition System with Glove Box

HHV has designed, manufactured thin film deposition system with a electron beam deposition source for the deposition of elemental, alloy, composite, metallic, ceramic, cermet, refractory as well as special" materials in a variety of purity levels.

The system comprises a load lock chamber with an access door for a single sample of up to 100mm/4" diameter.

The load lock chamber is integrated with a Acrylic Glove Box System for handling the sample in inert environments and contains of pressure sensors, Solenoid valves, Butyl sleeves with reusable gloves and pressure controlling kit.

Characteristics:

- Versatile front loading coating system with box chamber fabricated out of stainless steel.
- A rugged PLC is used to control the vacuum system with HMI within easy reach of operator.
- Rack panel provides space for thin film accessories and power supplies.
- Intelligent high vacuum valves

VACUUM SYSTEM	
Chamber	400 mm Diameter x 500mm Height
Pumping System	Turbopump Scroll dry pump
SOURCE	
Organic Sources	HHV 3KW Electron Beam Source with 4 x 4cc volume crucibles. Motorized turret indexer Beam sweep controller with independent control in both X and Y direction. Telemark ST-4 solid sate power supply
Source Shutters	Electromagnetically operated source shutter
SUBSTRATE TOOLS	
Substrate holder	Static water cooled workholder. Z-lift to receive substrate carrier from load lock via transport arm.
Substrate size	For up to 4 inch diameter substrate.
Film thickness monitoring	Inficon deposition monitor Model SQM-160 for in-situ thickness measuring and monitoring.

Figure 1: Thin Film Deposition System with Glove Box

Single Point Diamond Turning (SPDT) Facility

HHV has established a diamond turning facility for high precision optics. Single-point diamond turning is an ultraprecision machining process used for the creation of surfaces and components with sub-nanometres level surface roughness, and sub-micrometre geometrical form accuracies.

Diamond machining has broad applications that include the manufacture of precision aspheric, diffractive, and freeform optics for defence and commercial applications.

HHV has the capability to machine metals, Germanium, Silicon, and Zinc Sulphide up to 350 mm in diameter. HHV has two SPDT machines, a Nanoform X and Nanoform 200 with corresponding Taylor Hobson Freeform PGI metrology in house. For the best possible quality, natural diamonds are used as single point cutting tools during the final stages of the machining process.

HHV has manufactured Germanium aspherics and diffractive component used in thermal imaging systems.

Figure 1: Germanium lens, IRG and night vision goggles

Figure 2: Nanoform machines for machining and Taylor Hobson for metrology

Table 1: Details of the germanium lenses fabricated.

Ø31.5X3.00mm	Aspheric	Spherical diffractive
Radius of curvature	0.010±mm	0.010±mm
Surface irregularity/ Form error	0.2fringe at 632nm	0.2fringe at 632nm
Surface defects	60:40 S/D	60:40 S/D
Surface roughness	10nm RMS	10nm RMS

HHV also machines IRG materials. IRG is a popular alternative to Germanium due to their light weight.

We also fabricate Silicon lenses and metal mirrors. Metal mirrors are used in laser gyros for space and defense applications.

Table 1: Details of the IRG lenses fabricated.

Ø51X5.00mm	Aspheric	Spherical
Radius of curvature	0.010±mm	0.010±mm
Surface irregularity/ Form error	1fringe at 632nm	1fringe at 632nm
Surface defects	80:50 S/D	80:50 S/D
Surface roughness	8nm Rq	8nm Rq

All machined parts then go for further coating processing. We have the capabilities to coat Germanium, Silicon, Zinc Sulfide in single, dual and triple bands depending on the final application.

ARC for Night Vision Optics

Night vision is the technology that, as the name indicates, enables one to view the surroundings and identify the target during the night or in low-light areas. Based on its purpose, this technology is being utilised in two different forms, namely, thermal imaging and image intensification.

Figure 1: Night vision optics

A thermal imaging system detects the infrared (IR) radiation emitted in the form of heat by different objects. Whereas image intensifiers take advantage of the ambient light available and convert that light energy into electrons that are amplified to give a more intense image of the object.

Originally, the intent of the night vision equipment was to locate the enemy objective in the night. It continues to play an important role in military warfare in various forms till date, where it is used in thermal imaging cameras, monocular, binoculars, and night vision goggles. Now, along with this, it is being adopted for other commercial purposes for civilian users, such as surveillance cameras, navigation, demining, aviation, etc.

Night vision equipment contains precision optics assemblies that play a crucial role. Firstly, the lens or glasses used need to be transparent in the IR region for the obvious reason of collecting the incoming IR radiation for detection, and for this, Zinc Sulphide (ZnS), Zinc Selenide (ZnSe), Germanium (Ge), Silicon (Si), chalcogenides glass are the most used IR substrates. Secondly, these substrates need to collect the maximum amount of incoming radiation to improve the overall device performance, which is made possible by coating the optics with Anti-

Reflective (AR) coatings. Based on the application, these coatings can be designed to function in the Short-Wave IR region (0.9-1.7 µm), Mid-Wave IR (3-5 µm) region and/or Long-Wave IR region (8-14 µm).

Especially from the point of view of night vision devices used for military purposes, there is a need for two kinds of AR coatings i.e., High Efficiency AR (HEAR) coatings and High-Durability AR (HDAR) coatings. In general, the HEAR coatings are mainly utilised to get better overall transmission (T) (~ Tavg ≥ 98% in the case of Ge) in the range of interest and have a lower durability specification. These coatings will essentially come on the inside surface of the optics which will not be exposed to the external environment. However, HDAR coating is done for the very purpose of obtaining high durability on the surface of the optics, which will be capable of withstanding the harsh environmental conditions specified as per military standards. But will have a slightly lower spectral performance (Tavg ≥ 97% in case of Ge) as compared to HEAR coating.

At HHV, we have been working towards establishing both HEAR and HDAR coatings, utilising our in-house developed in PVD and PECVD systems, to function in the targeted IR region. The most common challenge when it comes to designing the HEAR and HDAR IR coatings is choosing the coating materials that are suitable to work in the required region. Since there is a direct relation between the material's refractive index and density, which in turn is connected to the hardness, there is a very fine balance that needs to be found while designing the coating with the desired durability and spectral performance. HEAR coating requires a low index material (lower density) for best AR performance, which compromises its hardness, while HDAR coating requires the layer property to be hard and the performance to be scratch-resistant, which implies compromising the high efficiency performance. Striking this balance also poses the challenge of obtaining a design with optimal layer thickness for the coating to withstand the test of time and harsh environmental condition.

On the HEAR front, multi-layer coatings are designed with a combination of suitable high, medium, and low refractive index IR materials that also have minimum absorption in the desired wavelength range. Currently, at HHV, we have developed and optimised the HEAR coating on Ge, working in the LWIR region, that passes moderate abrasion, humidity, temperature cycling, salt fog, and salt solubility tests.

On the HDAR front, Diamond-like Carbon (DLC) coating is deposited on the Ge substrate using the Plasma-Enhanced Chemical Vapour Deposition (PECVD) technique. In addition to coming through all the tests mentioned above for HEAR, this coating also clears the severe abrasion test and the windshield wiper test, (10000 cycles of wipes of sand water mixture with a 40 g load).

With continued effort, we are working to improve our coating performance over time to provide our customers with the best quality AR coating that is intended to work in multiple IR regions and thereby reinforce the capabilities of the night vision devices.

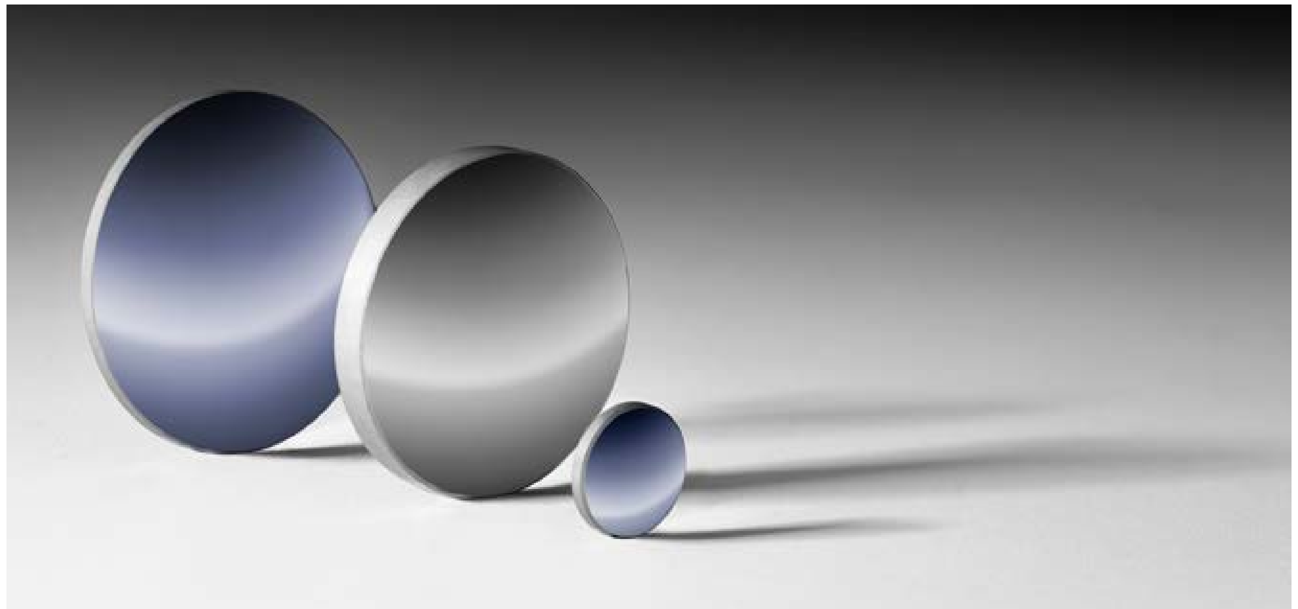


Figure 2: Night vision optics

Reliable low TCR Thin Film Resistors

HHV's photo lithography lab (PLL) has embarked on SiCr and NiCr resistor materials to produce high precision and compact arrays of thin film resistors by adapting simple manufacturing processes using vacuum technology

HHV is capable of manufacturing resistors as per the required application and with customized temperature of coefficient values (TCR) (Negative for SiCr). Good TCR value of a resistor shows its stability towards ambient temperature variations and also self-heating capability when power is applied.

HHV has proven precision thin film resistors will meet the exact requirements which is ideal for specific applications which requires low noise, high stability, and ultra low temperature coefficient of resistance.

HHV's SiCr and NiCr based thin film resistor (TFR) is in the form of individual and resistor arrays. The array of resistors developed through photolithography process which consists of 8 to 50 resistor patterns

Figure 1: SiCr Thin Film Resistor

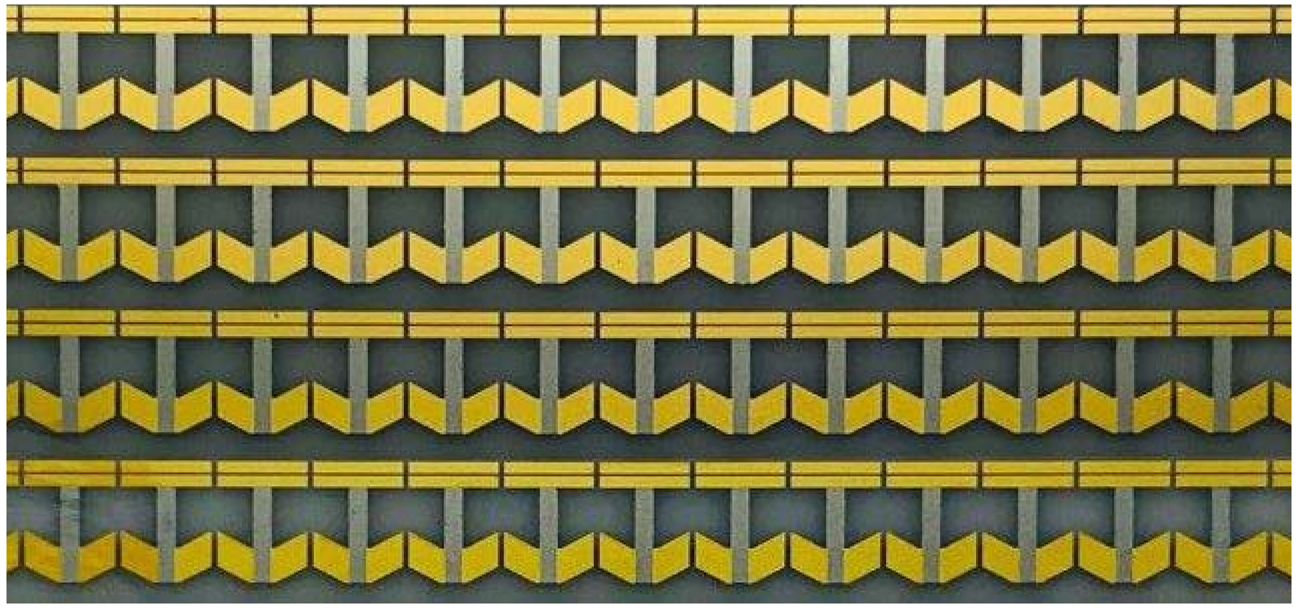


Figure 2: NiCr Thin Film Resistor

World Environment Day

The 5th of June every year is a day denoted by the United Nations as the World Environment Day. It is used to stimulate awareness of ecological issues and encourage everyone to take action to protect the environment. HHV has always been on the forefront of this drive to protect and preserve the environment. ISO 45001: 2018 certification is evidence for HHV's commitment to the environment safety. On this day employees of HHV took part in special environment preservation activities like tree plantation and the like.

International Women's Day

The International women's day is celebrated every year on 8th March. This year with the theme "DigitALL: Innovation and Technology for Gender Equality. 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 different departments. HHV believes and implements equal opportunity employment practices

International Safety Day

April 28th is marked as World Safety Day. The day is to encourage the balance of safe, healthy and appropriate working environments worldwide.

HHV organises a safety and health 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.

Annual Sports Meet

Sports and games have always been an integral part of the culture of HHV. HHV organises an annual sports meet every year. HHV finds it is a fantastic team building event. Various games have been organised for employees' children and for the women. The group company employees participated enthusiastically and made the day memorable. This year mens cricket winners were HHV Crystals and womens winners were HHV Crystals.

COSEIn, 2023 - Bangalore, India

Indian semiconductor manufacturing is brimming with activity thanks to the USD10 Billion India Semiconductor Mission (ISM) that aims to establish India as the global hub for semiconductor manufacturing and services.

To sustain the massive investments, India must build a vibrant semiconductor ecosystem for services, consumables, and workforce.

The Conference on "Semiconductor Ecosystem In India" (COSEIn), 2023, was organized by Centre for Nano Science and Engineering, Indian Institute of Science, held on 16th March 2023. Being an Industry Affiliated Program (IAP) member of CeNSE, ASMHHV had been invited to participate in the conference and Mr. Prasanth Sakhamuri, The Director of ASM-HHV was one of the panellists in the panel discussion on the topic pertaining to Supply Chain and Consumables along with other dignitaries from Semiconductor domain and academia.

The broader highlight of Supply Chain and Consumables discussion was to identify various commodities and their volumes required to run a fab, advanced equipment, maintenance and operations, quality, quantity and grade of various consumables, existing eco system and adopting to new demands etc.

COSEIn brings together all stakeholders of the India semiconductor ecosystem. The target participants of COSEIn are tech decision-makers and technical leads of industry, academia and policy makers. To those interested in semiconductor manufacturing, COSEIn is the place to network, discuss, and learn. This is a technical conference for in-depth and honest discussion with decision makers of the future fabs, existing fabs, strategic sector, academia, state and central government.

DEFEXPO 2022 - Ahmedabad, India

HHV has participated in the 12th edition of biennial DefExpo 2022 held in Ahmedabad- Gandhinagar, Gujarat from 18th to 23rd October 2022. HHV has demonstrated its strong globally accepted range of thin films and optics products in line with the India's vision of transform India into a strong and self-reliant nation. It was well appreciated by the visitors and there are several demands for HHV's future growth.

MET & HTS 2022 - Mumbai, India

HHV participated in MET & HTS 2022, an International Exhibitions & Conferences on Materials, Engineering, Technology & Heat Treat, from 2nd to 4th November 2022, at Bombay Exhibition Centre, Mumbai organized by ASM International India Chapter.

HHV showcased its capability in manufacturing a range of vacuum heat treatment and vacuum brazing and HHV's special purpose vacuum equipment for metallurgical applications.

ISAMPE INCCOM-17, 2022 - Hyderabad, India

HHV participated in the international conference of composites (INCOMM), held from 2nd to 4th November 2022 at Hyderabad with the theme of recent advances in composite engineering and research.

HHV demonstrated its capability and manufacturing facility to produce "Carbon-Carbon composites to cater to the needs of users from defense, space aerospace, and automobile industries.

The salient components of HHV's facility such as Impregnator, Carbonizer, Graphitizer and siliconization for carbon-carbon composites. The production capacity ranges from carbon filament to composite parts in the manufacturing center.

IIM-ATM 2022 - Hyderabad, India

HHV has participated in the Indian Institute of Metals IIM-ATM 2022 held at Ramoji film city, Hyderabad from 13th to 16th November 2022.

HHV showcased its range of state-of- the-art vacuum furnaces, and special purpose vacuum equipment for metallurgical applications. It was well received by the largest gathering of the Metallurgical and Material Engineering community.

LWOP 2022 - Mumbai, India

HHV's Thin Films and Optics Division showcased its latest offerings in the area of Laser Optics. Optics Fabrication, and its offering at Laser World of Photonics India, December 7–9, 2022, Bombay Exhibition Centre, Mumbai

The display of HHV's thin films and optics products generated plenty of footfall and generated large queries from interested domestic and international customers.

OPTIKA Mumbai 2023 - Mumbai, India

HHV participated in an optical fair titled Optika Mumbai at a new venue - NESCO, Goregaon East, Mumbai from 21- 23, January 2023. HHV showcased its capability in designing and developing thin film equipment to produce optical products with processes with innovative ideas and also shared its range of products offering for this optics sector.

Samaya Bharati 2023 - Bengaluru, India

HHV Crystals has showcased its range of products "watch crystals" from 19th to 22nd January 2023 in "India International Watch & Clock Fair Samaya Bharati 2023 – Bangalore", Karnataka, India.

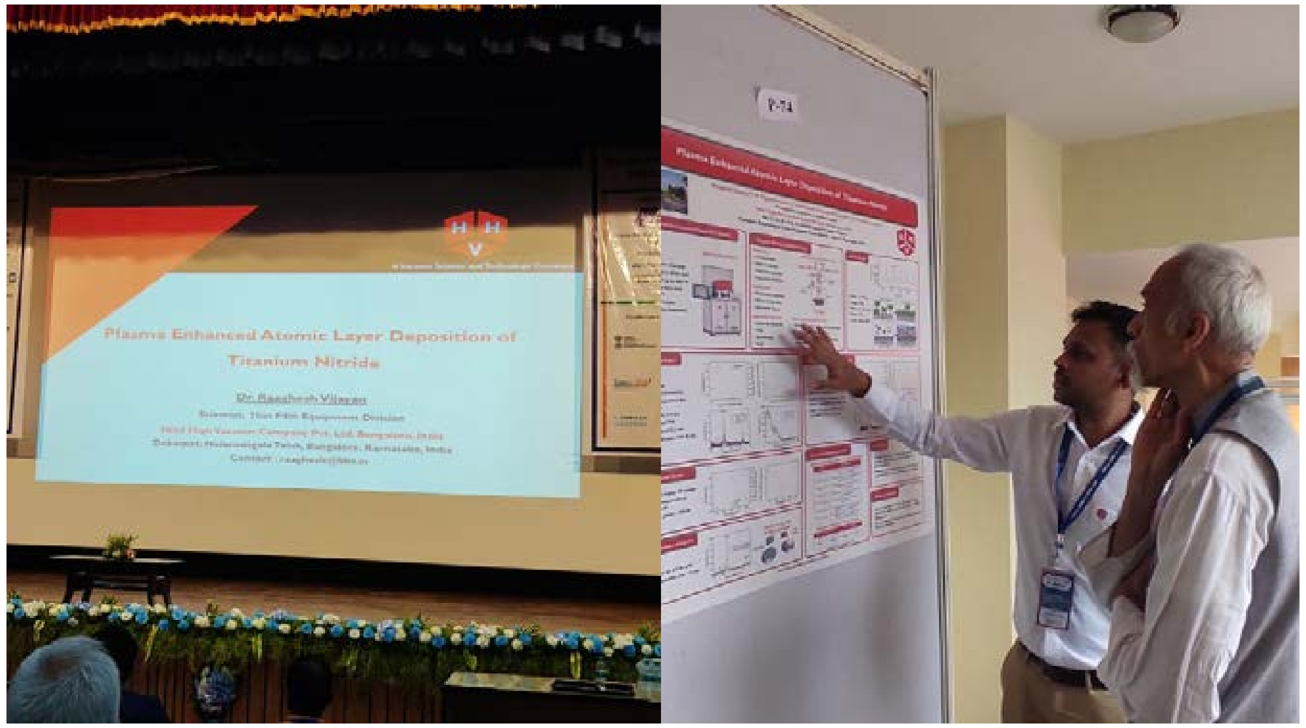
AIAA 2023 - Bengaluru, India

HHV showcased its capability in developing technology and machineries for Space applications in the 25th AIAA International Space Planes and Hypersonic Systems and Technologies Conference is jointly organized with the Society for Shock Wave Research (India) and the Center of Excellence in Hypersonics, Indian Institute of Science.

This conference has given an opportunity to meet and exchange of its strength in design and developing range of vacuum equipment for leading-edge research and development activities associated with space planes and hypersonic atmospheric flight vehicles by leveraging over 59 years its expertise with the attendees from across the globe.

SPIE Photonics West Expo 2023 - San Francisco, USA

HHV participated in SPIE Photonics West 2023 at San Francisco's Moscone Center from 28th January to 2nd February 2023, the largest annual photonics conference at USA to demonstrate globally accepted range of HHV's thin films and optics products. It was well received by the visitors and for forecasting bright chances for HHV's future business growth.

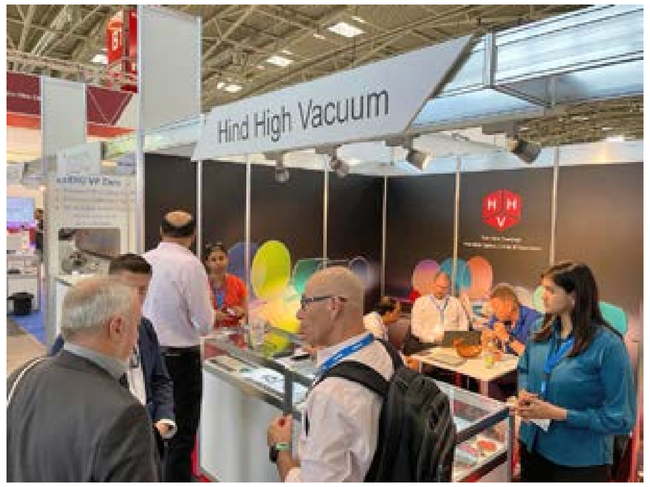


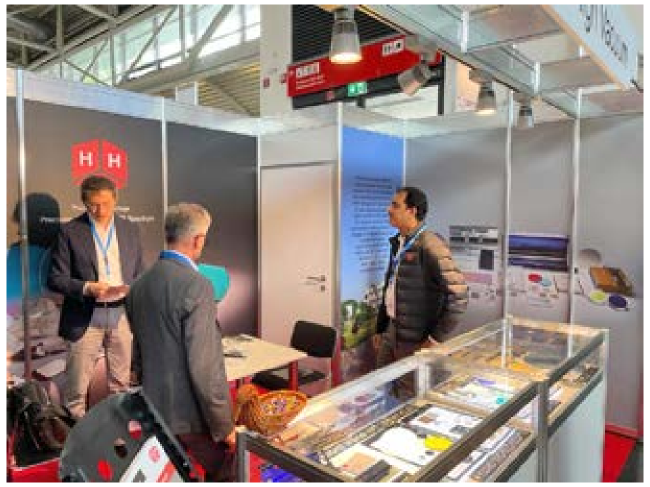
IMC 2023 - Pune, India

HHV participated in the International Materials Conclave (IMC)-2023, from 8th to 10th March 2023, organized by Centre for Materials for Electronics technology C-MET, Pune, India. HHV also made its poster presentation on Atomic Layer Deposition System and the process

LWOP 2023 - Munich, Germany

HHV participated in the Laser world of Photonics 2023 in Munich, and demonstrated its latest development s in optics. HHV's range of optical products generated many enquiries from the global optics users and researchers.





Photonics 2023 - Bangalore , India

HHV has participated at Photonics 2023 at the Indian Institute of Science from 5th to 8th of July 2023, and showcased its range optical products.

HHV moderated the panels of "Women in Optics" and the Industry Panel focusing on Emerging Photonics Technologies in India.

HHV also presented its latest developments in Atomics Layer Deposition and Hard Coatings on Zinc Sulphide substrates during the industry talk of the conference.

HHV's annual lecture was delivered by Prof. Nikolay I. Zheludev on Pico Photonics it was well received by scientists and students who participated in the conference from around the globe.

59th Foundation Day 2023 Bengaluru, India

HHV celebrated its 59th Foundation Day on 10th April 2023 at HHV Dabaspet, Bengaluru. The function started with the traditional lighting of the lamp and prayer.

Managing Director – Mr. Nagarjun Sakhamuri, and Mr. Prasanth Sakhamuri in their speeches indicated that the expansion of manufacturing facilities to meet the needs of users and your team guided by their seniors will become a leading global company in the field of vacuum science and technology.

HHV's new products developed during earlier year and the ongoing research activities were presented and were received enthusiastically by the employees.

Sakhamuri family scholarships are given to HHV employee's children to promote their education. And the event ended with the awards being presented to the best performers, long-service employees.

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