HHV WORLD

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Editorial

The new year has showed us that the country is on path to a slow recovery. Multiple vaccinations with an effective roll out are bringing back people to the workforce in a steady pace.

The impact of COVID on the manufacturing industry will take time to heal. With renewed hope HHV has developed new technology in the last six months and aims to increase market share and sales through its innovative high technology products.

Vacuum brazing furnaces serve a variety of industries. Vacuum aluminium brazed parts include thermal radiators, condensers and heat exchangers. As the brazing requires precise timing HHV systems are built with sophisticated controls.

HHV continues to build thin film systems for a range of applications. HHV is able to meet the needs of industry and research with the various range of products it provides ranging from twin door metallizers used in the automotive industry to complex atomic layer deposition systems which are now being used to deposit nano layers for various applications in photovoltaic, fuel cells, MEMS and sensors. HHV's robust ATS 500 can be used for research and production purposes. The ATS500 has been increasingly popular in the international and domestic markets.

Thin film coating applications continue to become popular. Thin film coatings on Zinc Sulphide and Selenide materials has always been a challenge to achieve precision due to the nature of the material. HHV has developed new dual band anti reflection coatings on Zinc Selenide substrates for infra-red sensor systems.

HHV Crystals is a newly established watch crystal manufacturing plant. Initially part of HHV it is now under the HHV group as an independent establishment. The plant produces over 3 million watch crystals a year for domestic and international customers.

HHV had a host of online events in the last quarter. We held a webinar on laser safety glasses which was well participated with international and domestic customers and research members. We also had a technical lecture for our employees on new nano technology.

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

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Twin Door Sputtering System for the Automobile Industry

The automotive industry as a whole is being driven to be cost effective, environmentally friendly, light weight and more sophisticated. To this effort, there is a move to replace metallic parts, such as lamp reflectors, with less expensive, light weight plastics that are coated with a thin film of a desired reflective metal.

HHV is a leading supplier of state-of-the-art, high production, twin door vacuum metallizing systema for the automotive industry across the globe. These systems have been designed to deposit material, utilizing sputtering, which enhances the quality, reliability and durability and offers dense and thick coatings. These coatings have high durability and withstand automotive standard environmental tests.

The metalizing system is suitable for coating parts made of:

1. Thermoplastics
   (PC, ABS, ABS+PC, PC-HT, PBT.),
2. Thermosets (UP-BMC),
3. Varnished base - coated metals
   (Al, Mg, and SST).

High Production Rate

HHV's Twin Door vacuum metalizing system with sputtering technique is suitable for metalizing automobile parts made of plastics. The twin door mechanism reduces the cycle time and hence increases productivity. The system achieves an ultimate vacuum of 10^{-6} m.bar through a dual pumping system.

HHV's lean Twin Door Sputtering system can accommodate a 710 mm diameter satellite and two planar magnetrons that use a 30KW DC power supply. The two magnetron sources are water cooled and can hold metal targets of size 173 mm (Width) x 1392 mm (height). The system can accommodate up to 60KW power supplies. The system has been designed with a vertically configured chamber and doors.

The drive mechanism located on the bottom plate of the chamber consists of a Ferro fluidic vacuum shaft which is attached to a servo motor with an encoder. The number of rotations of the satellite can be controlled precisely between 3 secs per rotation to 20 secs per rotation with accuracy of 0.5 deg.

A cryo-refrigerator extracts moisture condensed on the substrate which enhances the reflectivity of the reflector. The dual pumping system helps to enhance the productivity of the equipment without any down time.

Flexible Process Cycle

The system has unique features of inbuilt process cycle parameters which can be selected as required. They include:

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

These processes can be done in any order and guarantee protection of the substrate and prevents deterioration and corrosion.

User friendly operations and safety

There are three independent gas inlet systems, one for Argon gas to carry out the glow discharge cleaning process, one for the monomer to carry out the plasma polymerization process for the base and top coats and the one gas inlet for reactive gas. A HMI enables complete automation of vacuum and sputtering cycles with necessary safety, alarm and control systems.

On the whole, the twin door metallization system with sputtering technique enhances the life of coated product, increases productivity by reducing cycle time, and ensures a user friendly and safe operation process.

Vacuum Aluminium Brazing Furnace

Aluminium Brazing

Vacuum aluminium brazing requires a precise balance of time, temperature, and vacuum levels. These are controlled to maintain the fundamental brazing process parameters –cleaning and loading parts, heating parts in high vacuum, melting the brazing filler material, and unloading parts. This is done in a controlled work environment utilizing sophisticated controls.

Advantages

Vacuum aluminium brazing minimizes distortion of the part through 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.

Applications

Vacuum aluminium brazed parts often include heat exchangers, thermal radiators, condensers, and evaporators used in automotive, aerospace, nuclear, and energy industries.

Vacuum Aluminium Brazing Furnace

HHV has recently developed a front loading high vacuum aluminium brazing furnace with a job loading and unloading trolley for a charge weight of 600kgs. It has an effective hot zone size of 600 mm (Width) x 600 mm (Height) x 900 mm (Depth). It has been designed as per the latest ASME pressure vessel design code. The furnace is designed for exceptional temperature uniformity at very high vacuum.

Vacuum Pumping

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 conditions.

Heating and Cooling

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 6 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 chamber with water guiding channels in annular space for effective water cooling and heat dissipation.

Automation

The totally automated HHV vacuum aluminium brazing furnace has been provided with auto-mode facility for operation with temperature controller, programmable logic controller (PLC), Desktop PC, HMI with SCADA software, and measuring instrumentations. A multi-channel paperless recorder is provided to record the temperature and vacuum levels.

The furnace is provided with number of safety devices to protect the system and the operator from mal-function and possible operator's errors.

ATS 500 Research and Production Coater

HHV's ATS500 is a highly versatile coating system, designed for advanced research and production. It features touch-panel control and a wide range of process techniques, including thermal evaporation, electron beam evaporation, magnetron sputtering, and ion beam sputtering. The ATS500 is clean room compatible and offers high throughput and efficiency for applications such as lift-off coatings, OLED and organic electronics, photovoltaics and semiconductors, and for coating lenses and filters in optical applications.

The product build quality, features and the customization options that are part of the ATS500 has attracted customers from various parts of the world including China. This product in a short period of time since development has been sold to various locations in China, Australia, Singapore, UK, US and to the Indian market. We have orders from other parts of globe and also from leading institutes in India.

The ability of HHV to offer a wide range of customized solutions for various processes, and also build in it's own recipes into the systems sets it apart from other manufacturers in the country. The value proposition and a global sales and service network sets it apart from the global competition.

Full range of deposition techniques:

- Resistance evaporation, single or multi-sources
- Temperature controlled sources for OLEDs
- Electron beam sources from 6kW upwards
- RF, DC, Pulsed DC sputtering
- Single or co-sputtering options
- Sputter up or sputter down (dedicated sputter systems)
- Standard Diffusion, Turbo, Cryo pumping options
- Rack panel provides space for thin accessories and power supplies
- Advanced process options:
- Ion source options provide substrate cleaning or IBAD

Film thickness monitoring and control:

The standard touch screen is available with an optional built-in film thickness monitor, while conventional thickness monitor and control options are available for the advanced user.

Mass flow and chamber pressure control:

ATS systems feature mass flow control for single, dual or multi-gas channels plus chamber pressure control systems.

Range of sample stages:

Includes rotation, heating and cooling, while further options for indexing, substrate bias, and z-axis lift for sample transfer.

Sample transfer:

Available on the ATS500 with HHV's telescopic sample transfer system.

Chamber options:

Standard chamber is 500mm x 500mm and height and width options are available for specialist applications such as lift-off. The generous size allows multiple sources or deposition techniques to be accommodated.

High vacuum pumping:

- Vacuum system options include turbo pumps from 400l/s to 1000l/s and a 1500l/s cryo pump is also available.
- Foreline pumps can be rotary or scroll.

High vacuum valve:

ATS 500 turbo systems can be supplied with or without a high vacuum gate valve between chamber and high vacuum pump as process and preferences allow.

Ease of operation

- Colour touch screen control systems provide a clear, modern user interface
- Process recipe control with password protection
- Auto/manual process accessory operation

HHV's ATS 500 is highly versatile and provides the user access to a full range of deposition techniques from single or multi-source resistance evaporation to co-sputtering options. A rack panel provides space for thin accessories and power supplies to ensure that the system footprint is minimized. The system comes equipped with modern interfaces through colour touch screens and password protected recipe control to ensure that processes can be repeated and unchanged. HHV's ATS500 is the latest addition to its large array of thin film coating platforms and has been designed and manufactured to serve both the research and production markets.

Dual Band AR Coatings on ZnSe for IR Systems

The development of dual-band IR sensors with optics that share a common viewing window has created a need for optical dual-band AR coatings.

These systems allow the Mid-IR (3.5 to 5 µm) and Far-IR (7.8 to 10.5 µm) spectral regions to be viewed simultaneously. This enables the enhancement of visibility and lowers the optical systems weight and cost.

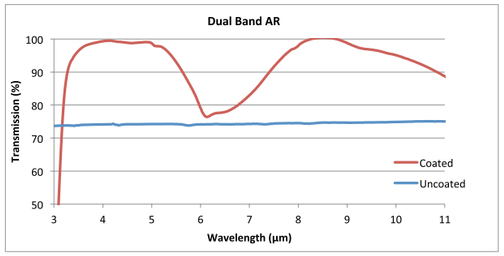
Commercially available Antireflection (AR) coatings have optimized performance for either the Far or Mid-IR spectral band but not both on the same material. At HHV, we have demonstrated a method of designing and fabricating high performance dual-band AR coating on ZnSe. A needle synthesis optimization technique has been used for the coating design. These coatings are typically thicker and more complicated to design and execute than single band AR coatings.

Ion Assisted Electron-beam Evaporation is used to fabricate these thin films. Infrared materials with low absorption and good transmission in both the Mid-IR and Far-IR regions have been chosen as coating materials. Uncoated ZnSe transmits approximately 74% in both these spectral regions.

The measured performance of dual-band AR coating is given in the below table.

Wavelength region (µm)	Achieved transmission (%)
3.5-5	98.81%
7.8-10.5	97.32%

The enhancement in the transmission for both the spectral regions is significant. A Shimadzu FTIR spectrophotometer has been used to measure the spectral transmission.



These coatings have passed through MIL-48497 standard tests which include adhesion, abrasion, humidity and salt corrosion.

High Precision Reticles for Defense and Medical Applications

HHV's photo lithography lab (PLL) has developed reticles using lithography. HHV's photo lithography lab is equipped with class 10000 clean rooms and vacuum coating systems.

The required glass substrates are manufactured in HHV's own high precision optics fabrication unit.

The glasses are first cleaned in an ultrasonic bath to remove organic and inorganic particles from the substrate. The substrates are then loaded under a class 100 laminar flow station where they are chromium coated via sputtering.

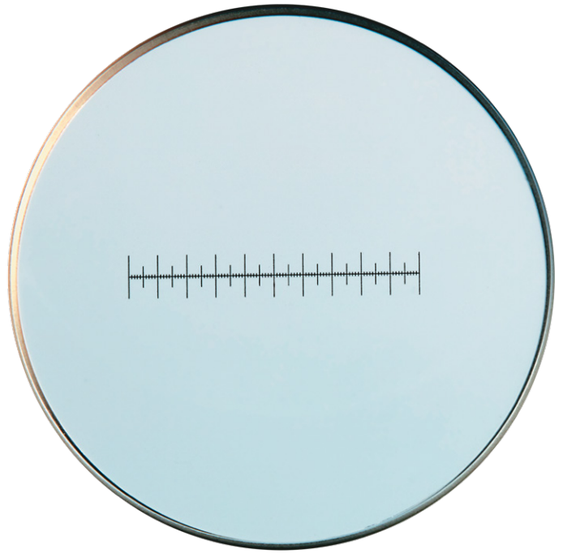
HHV's complete lithography facility includes a laser writer to make the standard chromium masks, etching stations which includes a Laurell Spin Coater and SUSS MJB3 UV exposure systems. HHV has the capability to achieve line resolutions of 10±2µm on reticles and has the ability to produce different types of reticles such as cross hairs, concentric circles, linear and cross hair scales.

Features

- Positive and Negative Crosshair and Concentric Circle Patterns
- Sizes: Ø19.0 mm, Ø21.0 mm, or Ø25.4mm (customizable)
- Borofloat, BK7 and UVFS glass substrates
- AR coating on both sides of the reticle if required
- Line resolutions of 10±2µm

Applications:

- Rifle scopes
- Range finders
- Sights and night sights
- Periscopes
- Surveillance instruments
- Eye piece reticles
- Stage micrometres
- Optical encoders



HHV Crystals New State of the Art Manufacturing Facility

HHV Crystals is India's premier watch crystal manufacturing company with over 25 years of expertise in manufacturing intricate and complex watch crystals at global quality standards. HHV Crystals is a subsidiary of Hind High Vacuum Company Pvt. Ltd (HHV).

By leveraging over five decades of HHV's expertise in vacuum science and technology development and manufacturing, HHV Crystals manufactures plain, metalized, and printed watch crystals of any size and profile that can be customized to the customer's requirements. HHV Crystals provides end to end manufacturing as well as in-process services.

HHV Crystals uses the best raw material to ensure its watch crystals have the highest optical clarity. HHV Crystals produces Plain, Metallized and Printed watch crystals, with single or double bevel (N3) polishing in a variety of profiles and colours.

HHV Crystals specialized watch crystal line includes Cylindrical and Spherical Plano Convex Crystals; Concavo Convex Crystals; Single and Multi Facet Crystals; Circular and Shaped Flat Crystals; Direct and Optical Bent Crystals and Inner Radii Crystals.

Our new facility includes over 50 manufacturing and quality specialists with over 25 plus years of experience. HHV Crystals has state of the art machinery and precise manufacturing standards that meet the exacting requirements of the horology industry. HHV Crystals' new facility manufactures customized products at scale.

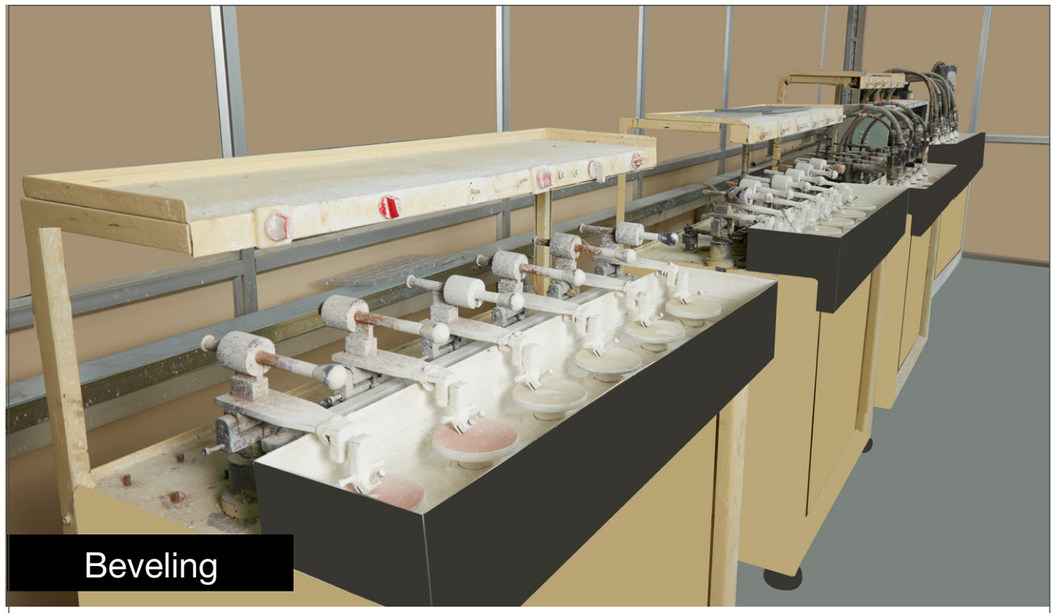
**Chairman Emeritus,
Shri S V Narasaiah at HHV Crystals**

HHV Crystals is another milestone for HHV. Shri S V Narasaiah, Chairman felt proud, when he visited HHV Crystals, a company that has been running under the HHV group from 25 years to produce high quality plain and metallized watch crystals for HMT and Titan.

New Facility Manufacturing Equipment

The new facility includes the following equipment and process capabilities:

There are 45 contouring machines which have got the capability to contour variety of configurations such as circular, squares, rectangular, oval, and all odd shapes. Machines can give any configuration within 20 microns accuracy and shape crystals of 4 mm to 70 mm in diameter. These machines also create negative radius. They can handle glass of thickness ranging from 0.8 mm to 5.00 mm.



Four spindles and six spindle bevel creation and polishing machines that create a single or double side, 45 degree polished bevel that is free of edge chipping. These machines can polish crystals to N3 standards.

Lapping

Five double side lapping machines are used to bring crystals to desired thickness and the parallelism. The accuracy achievable in thickness is 10 microns and the parallelism better than 3 arc minutes. Working range is from 4 mm to 70 mm in diameter.

Polishing

Sixteen double side surface polishing machines with variable speed and pneumatic pressure are used to work on flat crystals. These machines can create polished surfaces without any scratches and sleeks meeting Horological standards. To work on curved crystals several cylindrical polishing machines are available.

Coating

Four customs designed coating units metallize custom colours and standard colours such as gold, silver, rose gold and dark grey. The entire coating process is automated. Our coatings ensure crystal clarity and deposit defect free coatings for maximum uniformity and lustre. All our coatings withstand all durability tests.

Bending

Six optical and vacuum bending machines bend plain glasses to different radius of domes. These machines are essential to produce curved crystals.

Screen Printing and Etching

Several screen printing machines with highly skilled technicians are capable of printing 20 micron line widths. Our facility has etching capability to achieve a variety of patterns as per customer requirements.

Ultrasonic Cleaning

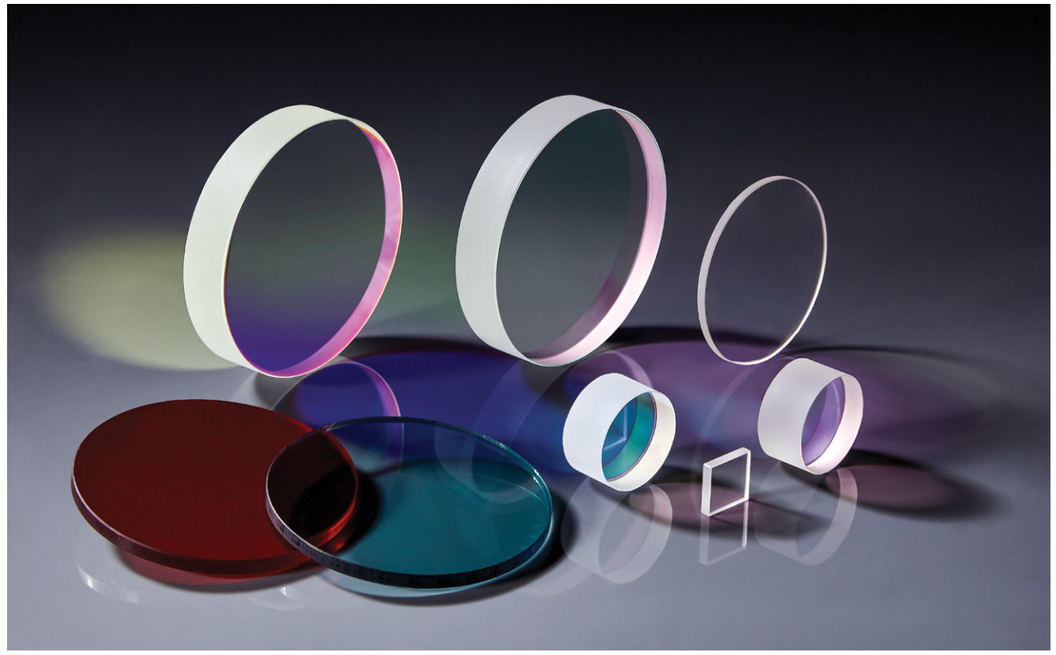
To manufacture the highest quality crystals four automated ultrasonic cleaning machines are established to ensure crystals are free from oil, cerium oxide and other contaminants. These machines are used at several stages of crystal manufacturing.

QUALITY

To ensure world class quality our facilities are equipped with Profile Projectors to ensure dimensional accuracy, Toughness Testing Equipment to test the crystals mechanical strength, Spectrophotometers to measure optical parameters, and a complete environmental testing laboratory with Humidity Chambers, Thermal Chambers, Salt Soak Testing Equipment and Corrosion Testing Equipment. To test coating durability coated crystals are kept in the Humidity Chamber for 24 hours at 150°C, put through a Salt Solubility Test (3.7% of NaCl2)y, placed in a corrosion chamber to test the corrosion effect and then finally tested for Adhesion and Abrasion. Our highly experienced, 14-member quality team check visual defects such as sleeks, scratches, smudges etc.

Durable Optical Coatings for Advance Laser Safety Applications

HHV has recently published an article in the December 2020 Issue of Photonics Spectra. The article focused on ***Durable Optical Coatings for Advanced Laser Safety Applications.***



Laser systems are deployed in a range of applications in academia, medicine, military and manufacturing. As applications get more precise and intricate, the systems become more refined and higher powered, creating a need for laser eye safety glasses that can achieve high ODs and withstand a high laser-induced damage threshold (LIDT). Commercial laser safety glasses are traditionally polycarbonate based, low cost, suffer from low visible light transmission (VLT) and can therefore only be used for low powered laser applications. Thin-film based glasses, made by alternating high and low index layers, meet the requirements for mid to high power laser applications at multiple laser wavelengths simultaneously. Producing such coatings requires advanced design optimization, superior layer control during fabrication and precise OD measurements. E-Beam IAD methods provide the best compromise between durability and cost of operation over other techniques resulting in a versatile solution for laser safety goggles.

To read the article please visit:
https://www.photonicsspectra-digital.com/photonicsspectra/december_2020/MobilePagedReplica.action?pm=2&folio=54#pg54

HHV Webinar Series

It is an ongoing program from HHV to cover the various aspects of vacuum based thin film coating tools, and the products manufactured using these tools. Please check out our website and social media pages on LinkedIn and Facebook for future programs.

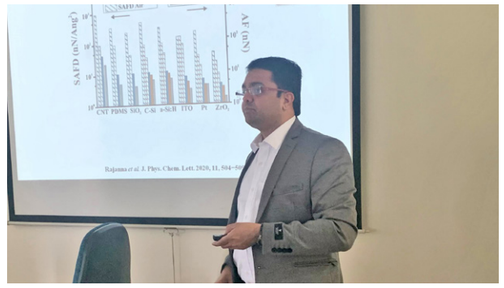
ALD Fundamentals & Applications
27th August 2020

HHV started off its online webinar series with ALD Fundamentals and Applications on the 27th of August 2020. The webinar had speakers joining in from Indian Institute of Space Technology, Cochin University of Science and Technology, and from our in-house R&D team. The session covered fundamentals of the ALD process, different equipment configurations and applications. The program was well-received with over 100 participants taking part during the webinar, and also posing a number of questions which were answered by the speakers.

Optical Coatings for Laser Safety Applications
27th October 2020

HHV's second webinar was on Optical Coatings for Laser Safety Applications held on 7th October 2020. The webinar had speakers joining in from Protect-Laserschutz GmbH, Germany, and HHV's in-house R&D team. The session covered lasers and its multitude of applications, laser safety, and current challenges. The program was well-received with participation of over 160 attendees.

For those who missed out, the recording of the webinar can be accessed through HHV's YouTube channel: https://www.youtube.com/channel/UCbvclcoTUnhkEWzxqksWX2w".



Dr. Pramod M Rajanna from MICRONOVA
22nd December 2020

Dr. Pramod M Rajanna from MICRONOVA – Center for Micro and Nanotechnology, Finland delivered a talk at HHV, Dabaspet on the 22nd of Dec 2020. Dr. Pramod holds two doctorates from the Aalto University, Finland, and Skolkovo Institute of Science and Technology, Russia.

He presented his work on the development of transparent conductive films (TCF) based on single walled carbon nanotubes (SWNT)-organic conductive polymer nanocomposites for opto-electronic applications. The various tools and the processes developed for fabricating these coatings when he was a part of various groups in Finland, Germany and Moscow were explained. The SWNT based TCF have a p-type conductivity. This makes it unique as most of the TCFs in the market have a n-type conductivity, thus opening up applications in a wide range of device architectures. The talk was attended by the scientists and the engineers of the R&D, Design and Production groups, and there was a healthy discussion on the processes and the machinery aspects of the work following the talk.

Energy (Conventional and Non-Conventional) and Energy Devices Theme
5th February 2021

Mr. Prasanth Sakhamuri, MD delivered a talk as part of an online brainstorming session organized by CSIR-NIIST under the theme of *Energy (Conventional and Non-Conventional) and Energy Devices* on the 5th February 2021. Such sessions are being conducted by various sub-verticals of CSIR to identify areas of common interest with industries, and frame up the further course of action based on the inputs received from the industrial participants. The talk by Mr. Prasanth emphasized on the need to build holistic solutions including the related process equipments in order to for the development to succeed, and went on to demonstrate HHV's capability and experience in scaling up technologies. This point was well-received by the organizers, and further interactions have been planned to take this forward.

Shri S.V Narasaiah, Chairman Emeritus of HHV, has been a member of the ASM International, formally known as the American Society for Metals, since 1986. The Bangalore Chapter of ASM International recently bestowed a Life Time Membership Award in December of 2020.

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