THIN FILM EQUIPMENT
CATALOG

DRIVING INNOVATION SINCE 1922

Rev. 1.1

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ABOUT US

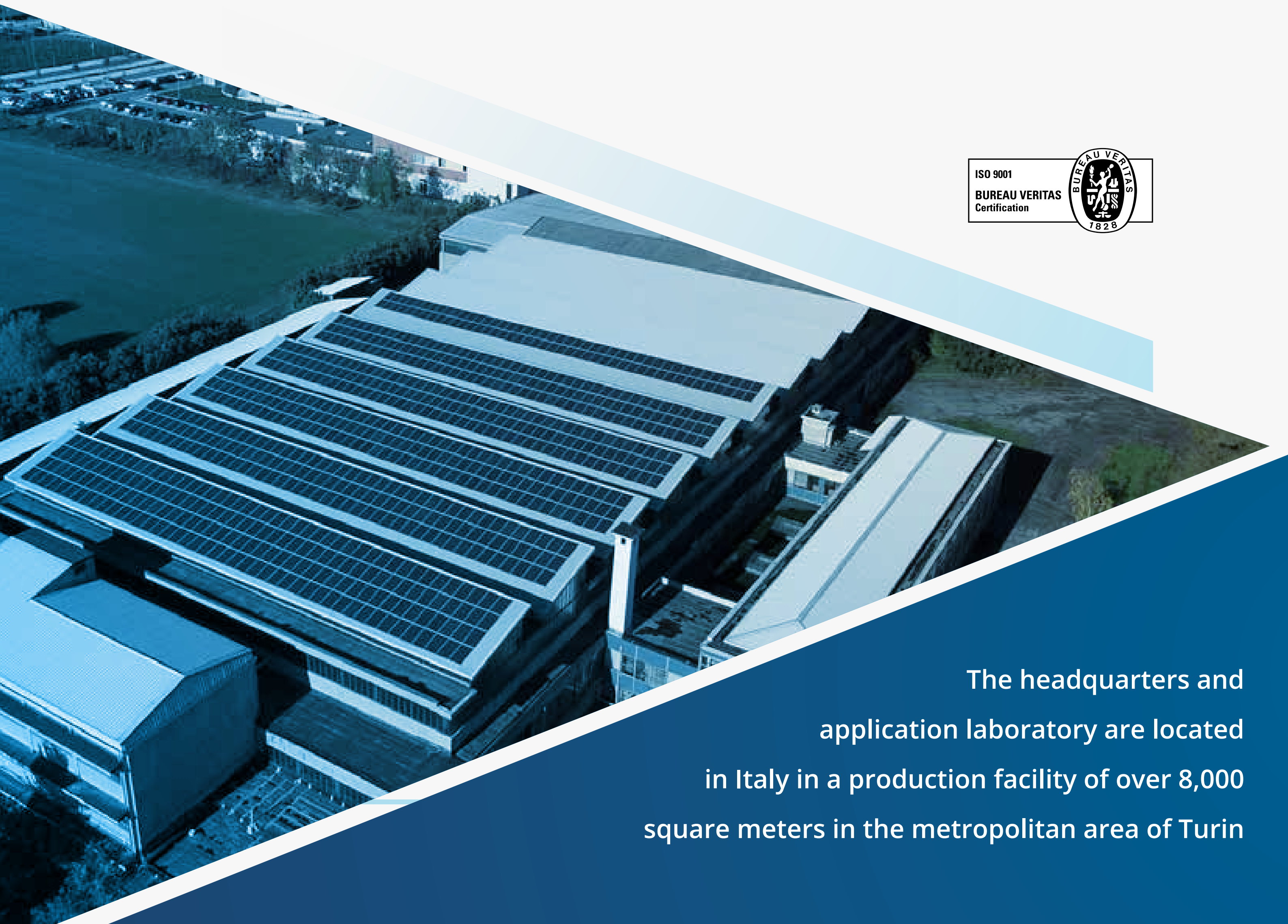
All details are essential to guarantee the performance required by customers.

WHO WE ARE

Elettrorava was founded by eng. Antonio Rava in 1922 as an electromechanical workshop.
Since 1975 we were involved in the vacuum equipment market. Our extensive R&D efforts in the 1950's resulted in turbomolecular pumps whose construction technology has been licensed to Varian, a leading international vacuum company.
In 1987 the first thin film depostion system was engineered and since then we acquired an important and consolidated know-how in the design and manufacture of deposition systems based on both PVD and CVD technologies.
Today we design, develop and manufacture customized solutions for research and development, pilot and small production applications. All our products are supported by a Scientific Committee that has to his credit more than 300 publications in the field of thin film coatings and nanotechnologies.
For over 30 years we have been a strategic partner alongside our customers with a passionate team of engineers and technicians providing end-to-end support from design through installation and ongoing maintenance.

To date, more than 100 universities and high-profile laboratories around the world adopt our deposition systems.

ISO 9001
BUREAU VERITAS
Certification



The headquarters and application laboratory are located in Italy in a production facility of over 8,000 square meters in the metropolitan area of Turin

THE VALUE

PRODUCTS AND SERVICES

Through constant investment in R&D we have expanded our portfolio of deposition techniques which allows us to satisfy our customers in applications ranging from pure research to small pilot productions.

PVD SERIES

SPT SERIES

CVD SERIES

E SERIES

With internal design we can respond to any need for customization

The machines are equipped with all accessories (targets and consumables)

We provide full life-time service and refurbishment or upgrade of older systems

We can provide a guarantee of performance achievement for each system built

MADE IN ITALY

PVD SERIES

THERMAL EVAPORATION (PVD)

Thermal evaporation is a physical deposition technique used to create thin films on a substrate surface by evaporating a solid material. This versatile method allows for the deposition of a wide range of materials, like aluminium, gold, silver, nickel, chrome, etc. The material is located in a crucible, in a chamber kept in a high vacuum environment, and is subject to heating, until the temperature reaches the material evaporation point, when it starts to evaporate. The resulting vaporized molecules travel to the substrate surface, where they nucleate and form the thin film. It is possible to deposit organic materials too using this technique, but it requires precise temperature control, often achieved through the use of a source similar to an effusion cell.

KEY FEATURES

- HV or UHV configuration
- Single or multiple coils, boats, crucibles, or Knudsen effusion Cells
- Reactive gases (O_2, N_2, etc) can be added for direct reaction during deposition process
- Fully integrated quartz crystal controller for the automatic control of the thickness as well as for programming multilayers and deposition rate in each layer, directly from main software
- Optional automatic or manual load lock with optional pre-heating and / or plasma treatments
- Optional wide range optical thickness monitor for the control of layer thickness.

APPLICATIONS

Thermal evaporation is a popular technique for producing electric contacts and metal layers in the semiconductor industry, as well as for R&D purposes in microelectronics. Moreover, organic thermal evaporation can be used for manufacturing optical antireflective coatings for glasses and lenses, as well as for organic electronics, OLEDs, and other applications.

- Microelectronics
- Automotive Industry
- Aerospace and defence
- Healthcare and medical devices
- Optics and photonics
- Energy storage
- Wearable technology

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PVD SERIES

TECHNICAL DATA

THERMAL EVAPORATION (PVD)	
Base pressure HV	< $1x10^{-6}$ mbar
Base pressure UHV	< $1x10^{-9}$ mbar
Pumping system	Turbomolecular, Cryo, TSP
Sources	Single or multiple coils, boats or crucibles
Additional sources	Electron Beam, Ion Beam for Etching/Deposition, Magnetron sputtering cathodes
Deposition area	up to 20”
Substrate handling	Rotation: up to 50 rpm, optional planetary configuration Tilt: ±45° Offset (Z or X): up to 100 mm
Process temperature	Up to 800 °C
Reactive process	One or more reactive gases (0_2 , H_2 , N_2 , etc.)
Thickness uniformity	Up to 3%
Process control	Programmable quartz crystal thickness controller and/or in situ optical monitor
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, can be motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer charge system up to 25 wafers
Deposited materials	Metals, Oxides, Semiconductors, Organics

Thermal Evaporation:

a reliable and affordable technology for a wide range

of deposited materials

PVD SERIES

ELECTRON BEAM EVAPORATION (EBPVD)

Electron beam evaporation is a physical deposition technique used to create thin films on a substrate surface by evaporating a solid material placed in a crucible. The e-beam is generated through the thermionic emission process, where an electric current passes through a tungsten filament, causing the filament to heat up and emit electrons. High voltage is then applied between the filament and the hearth, allowing the liberated electrons to accelerate towards the crucible, while a magnetic field focuses them into a beam. The collimated electron beam hits the material in the crucible, allowing the evaporation process and the aggregation on the substrate surface. Compared to thermal PVD, EBPVD allows high evaporation temperature materials deposition as thin films. Deposition rates using electron beam processes can vary from 1 nm per minute to several µm per minute, depending on the required structural and morphological film control.

KEY FEATURES

- OHFC copper hearth crucible with up to 8 pockets of various sizes
- HV or UHV configuration
- Fully integrated quartz crystal controller for the automatic control of the thickness
- Optional reactive gases, such as oxygen or nitrogen useful to reactively deposit non-metallic films.
- Optional automatic or manual load lock with optional pre-heating and/or plasma treatments
- Optional ion beam source for bombarding the substrates during deposition (Ion Beam Assisted Deposition - IBAD)
- Evaporation sources come in various sizes and configurations, single or multiple pockets

APPLICATIONS

E-beam evaporation finds widespread use in various industries, like semiconductor, thin-film solar, aerospace, and cutting and tool industries, for producing wear-resistant and thermal barrier coatings. This technique is used also to produce dielectric, optical coatings, and Josephson junctions and in micro and nano-fabrication for lift-off processes.

- Automotive industry
- Consumer Electronics
- Aerospace and Defense
- Healthcare and medical devices
- Optics and Photonics
- Energy storage
- Cutting tool industry

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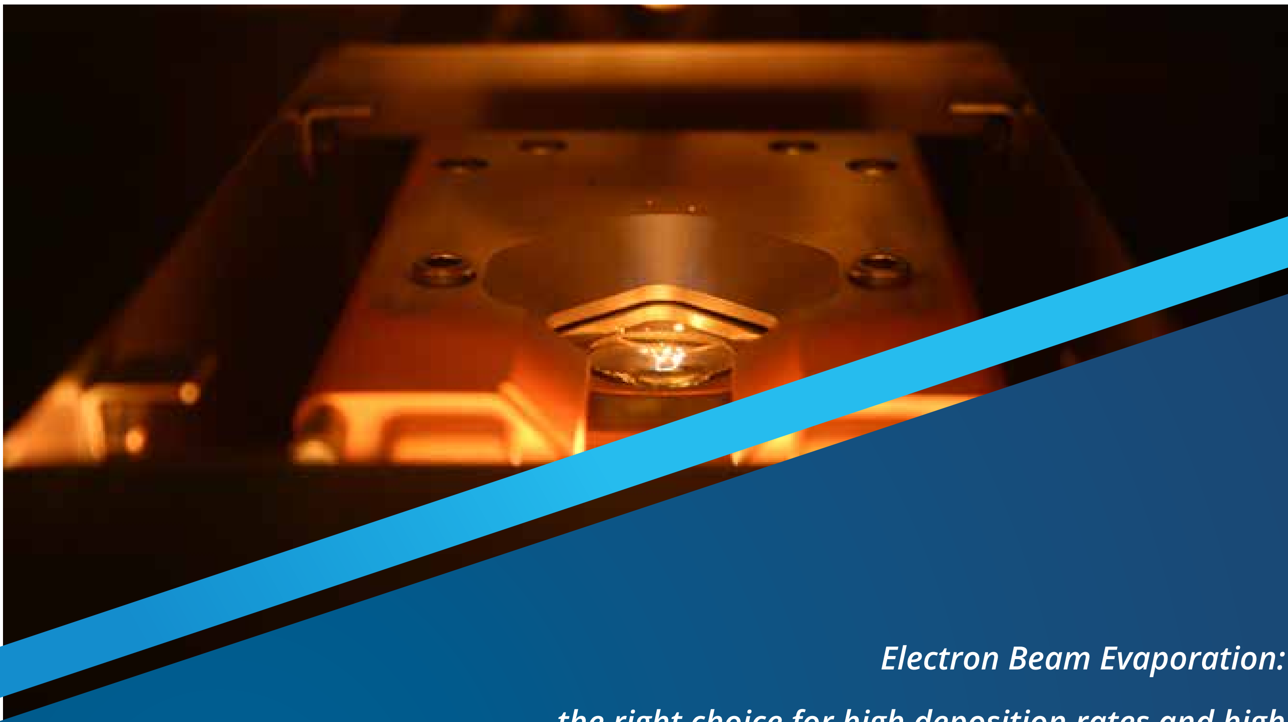
TECHNICAL DATA

ELECTRON BEAM EVAPORATION (EBPVD)	
Base pressure HV	< 1×10^{-6} mbar
Base pressure UHV	< 1×10^{-9} mbar
Pumping system	Turbomolecular, Cryo, TSP
Sources	Single or multiple Electron Beam with up to 8 crucibles, power up to 15 kW
Additional sources	Evaporation, Ion Beam for Etching/Deposition, Magnetron Sputtering cathodes
Deposition area	Up to 20”
Substrate handling	Rotation: up to 50 rpm, optional planetary configuration Tilt: ±45° Offset (Z or X): up to 100 mm
Process temperature	Up to 800 °C
Reactive process	One or more reactive gases (O_2 , H_2 , N_2 , etc.)
Thickness uniformity	Up to 3%
Process control	Programmable quartz crystal thickness controller and/or in situ optical monitor
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, can be motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer charge system up to 25 wafers
Deposited materials	Metals, Oxides, Nitrides, Carbides, Semiconductors



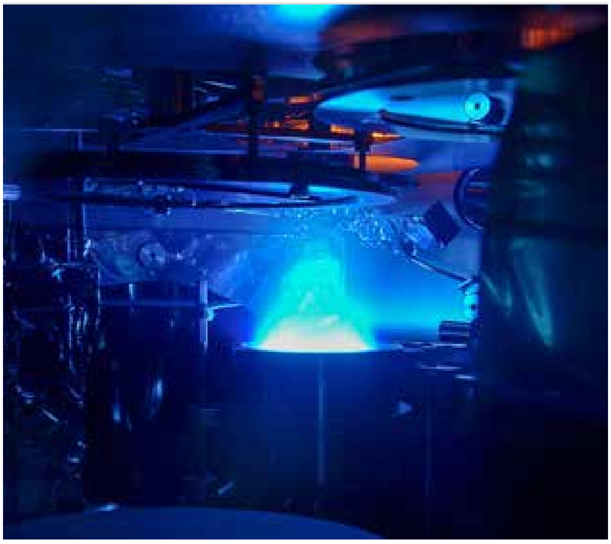
Electron Beam Evaporation:

the right choice for high deposition rates and high quality metal and dielectric films

SPT SERIES

MAGNETRON SPUTTERING (MS)

Magnetron sputtering is a versatile deposition technique used to create thin films on a substrate surface by sputtering atoms or molecules from a target material.
It offers a good deposition rate and the ability to deposit a wide range of materials including metals, dielectrics, and semiconductors.
In this process, an Argon plasma is ignited above a negatively biased and magnetized target material, drawing ions from the plasma towards the target material. As a result, Argon ions impact the target, causing atoms or molecules to be ejected from the surface through a process known as sputtering.
The sputtered material forms a vapour that condenses on the substrate surface, resulting in the formation of a thin film.



KEY FEATURES

- Single, vertical coplanar, confocal or linear configuration sources can be combined for DC, DC pulsed, RF, HIPIMS
- Co-sputtering configuration
- Reactive gases (0_2 , N_2 , etc) can be added for direct reaction during deposition process
- Integrated quartz crystal controller for thickness monitoring
- Optional automatic or manual load lock (optional pre-heating and/or plasma treatments)
- Optional wide range optical thickness monitor for the control of layer thickness for a large number of layers by T% or R% monitoring on the coated substrates
- Software interface for real time deposition monitoring

APPLICATIONS

Magnetron sputtering can be used to deposit to create optical antireflective coatings, anti-corrosive coatings, IR optics, dental protheses, and super-insulation. This deposition method is also employed in microelectronics for producing metal film capacitors, optical data storage, and microprocessors, as well as in the consumer industry for manufacturing anti-reflective coatings.

- Consumer Electronics
- Automotive Industry
- Solar Energy
- Aerospace and Defence
- Healthcare and Medical devices
- Optics and Photonics
- Surface engineering

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SPT SERIES

TECHNICAL DATA

MAGNETRON SPUTTERING (MS)	
Base pressure HV	< 1x10^{-6} mbar
Base pressure UHV	< 1x10^{-9} mbar
Pumping system	Turbomolecular, Cryo, TSP
Sources	Mounted in Single, coplanar, confocal or vertical configuration (single or multiple) DC, DC pulsed, RF, HIPIMS
Additional sources	Evaporation, Electron Beam, Ion Beam for Etching and Deposition
Deposition area	Up to 20"
Substrate handling	Rotation: up to 50 rpm, optional planetary configuration Tilt: ±45° Offset (Z or X): up to 100 mm
Process temperature	Up to 800 °C
Reactive process	One or more reactive gases (O_2, H_2, N_2, etc.)
Thickness uniformity	Up to 2%
Process control	Programmable quartz crystal thickness controller and/or in situ optical monitor
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, can be motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer charge system up to 25 wafers
Deposited materials	Metals, Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials

Magnetron Sputtering:

a robust solution enabling the widest range of deposited materials

SPT SERIES

ION BEAM SPUTTERING (IBS)

Ion Beam Sputtering is a deposition technique that uses an ion source to sputter a target material onto a substrate. The system includes a rotary multitarget assembly, a substrate, and an ion source used to sputter the target and deposit it onto the substrate surface. Using gas (Ar) injection into the ion gun, a high electric field causes gas ionization, creating a plasma inside the source region. The ions generated in the plasma are accelerated from the source to the target, creating a collimated ion beam with a well-defined ionic energy and density. This beam impacts the target material, causing it to sputter towards the substrate. Plasma in IBS is confined within the ion source, allowing the chamber pressure to be maintained low. An additional ion beam source can be used to bombard the substrate with Ar ions to improve the density or reactive gas ions to maintain stoichiometry. Substrate heating during deposition can improve overall sputtering performance.

KEY FEATURES

- Low pressure processing (10^{-5} to 10^{-4} Torr range)
- Reduced porosity (higher density) in deposited films (low pressure means reduced included gas)
- High quality optical films with smooth surfaces
- Single Ion Beam or Dual Ion Beam configuration sources can be combined for DC, DC pulsed, RF depending on target material and layers that will be deposited
- Substrate conditioning from –35 °C up to 800 °C
- Reactive gases (0_2, N_2, H_2, etc.) can be added for direct reaction during deposition process
- Optional automatic or manual load lock with optional pre-heating and/or plasma treatments
- Optional full optical thickness monitor for an unlimited number of layers by T% or R% wavelength scans on the coated substrates

APPLICATIONS

Ion beam applications encompass a wide range of processes that range over deposition, etching, or their combination.

These applications include laser facet coating, mirrors for ring laser gyroscopes, X-ray optics, infrared sensors, telecom optic filters, Magnetic Random Access Memory (MRAM), dielectrics, spintronics, and superconductors.

- Consumer Electronics
- Automotive Industry
- Aerospace and Defence
- Healthcare and medical devices
- Optics and Photonics
- Energy storage

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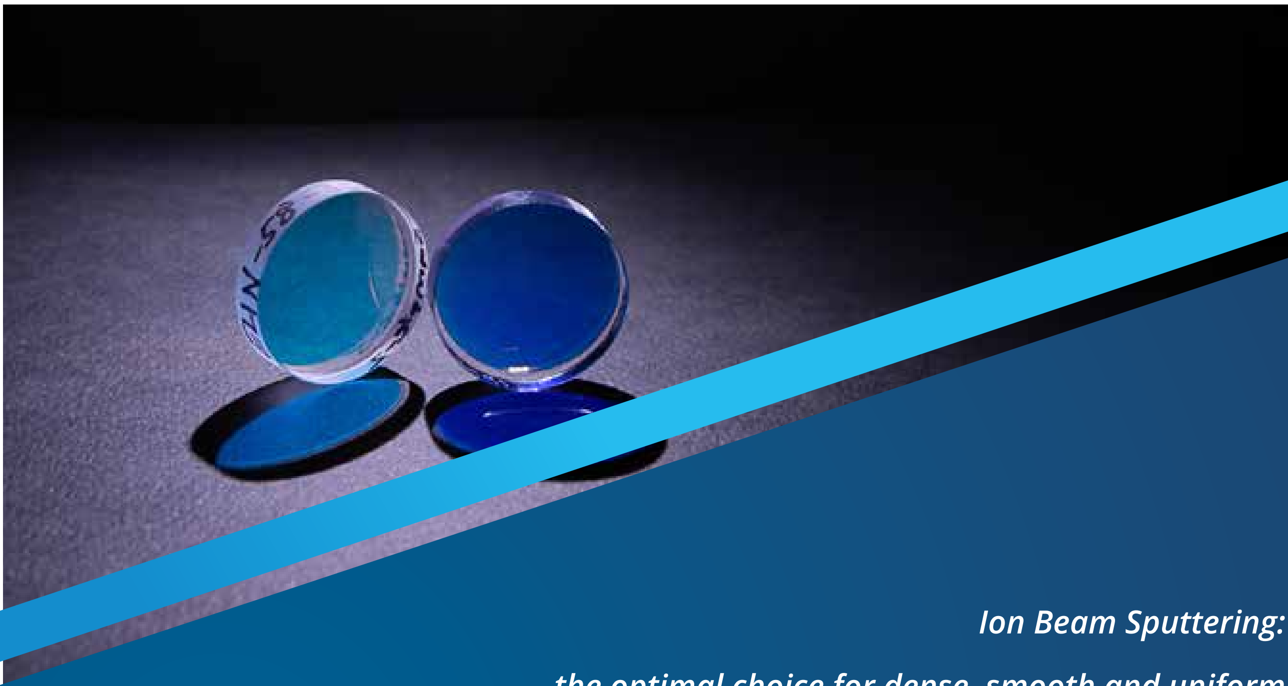
SPT SERIES

TECHNICAL DATA

ION BEAM SPUTTERING (IBS)	
Base pressure HV	< 1x10^{-6} mbar
Base pressure UHV	< 1x10^{-9} mbar
Pumping System	Turbomolecular, Cryo, TSP or combined Cryo / Turbo for ultimate vacuum and processes
Ion Sources	Single or Dual (gridded or not gridded) DC, DC pulsed, RF
Source Power	Evaporation, Electron Beam, Magnetron sputtering
Chamber Size	Up to 12”
Deposition area	Rotation: up to 50 rpm, optional planetary configuration Tilt: ±45° Offset (Z or X): up to 100 mm
Substrate rotation	Up to 800 °C
Substrate tilt	One or more reactive gases (O_2 , H_2 , N_2 , etc.)
Reactive process	Up to 1%
Source combination	Programmable quartz crystal thickness controller and/or in situ optical monitor
Process control	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Substrate load	Single or Multiple Load Locks, can be motorized with multiple substrate holder
Load lock	Optional multi wafer charge system up to 25 wafers
Deposited materials	Metals, Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials



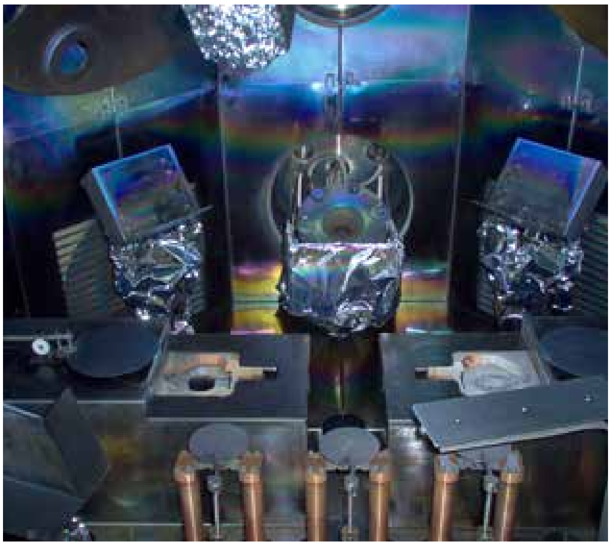
Ion Beam Sputtering:

the optimal choice for dense, smooth and uniform coatings

SPT SERIES

ION BEAM ASSISTED DEPOSITION (IBAD)

Ion Beam Assisted Deposition is a deposition technique that uses any deposition source to deposit the material onto a substrate which is bombarded by ions coming from an ion beam source. This process enables the deposition of metals, semiconductors, dielectrics, and ceramics. During IBAD process the material to be deposited vaporizes and then condenses onto the substrate surface. At the same time the thin film and the surface of the substrate are exposed to energetic ions emitted by the ion beam, causing the surface to undergo changes like densification, surface diffusion, and thin film nucleation. This technique can be used on more temperature-sensitive materials, such as plastics or polycarbonate lenses, since it can be performed at relatively low temperatures. The angle of the ion beam with the substrate is used to influence the roughness and texture of the film surface.



KEY FEATURES

- Low pressure processing (10^{-5} to 10^{-4} Torr range)
- Reduced porosity (higher density) in deposited films (low pressure means reduced included gas)
- High quality optical films with good stoichiometry, low optical absorption and smooth surfaces
- An Assist Ion Beam is combined with a deposition source (Ion Beam, E–Beam, Sputtering depending on target material and layers)
- Substrate conditioning from –35 °C up to 800 °C
- Reactive gases (0_2, N_2, H_2, etc.) can be added for direct reaction during deposition process
- Optional automatic or manual load lock with optional pre-heating and/or plasma treatments
- Optional full optical thickness monitor for an unlimited number of layers by T% or R% wavelength scans on the coated substrates

APPLICATIONS

Ion Beam Assisted Deposition is a versatile thin-film deposition technique widely utilized in the semiconductor, sensor industries to fabricate high-performance films with controlled properties and top-quality optical coatings and in the medical industry for fabrication of metallic coatings that are compatible with medical implants for biocompatibility or to create antimicrobial surfaces.

- Consumer Electronics
- Solar energy
- Healthcare and medical devices
- Optics and Photonics
- Energy storage
- Wear resistant coatings
- Nanotechnology

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SPT SERIES

TECHNICAL DATA

ION BEAM ASSISTED DEPOSITION (IBAD)	
Base pressure HV	< $1x10^{-6}$ mbar
Base pressure UHV	< $1x10^{-9}$ mbar
Pumping system	Turbomolecular, Cryo, TSP or combined Cryo / Turbo for ultimate vacuum and processes
Sources	Gridded or not gridded, DC, DC pulsed, RF
Additional sources	Evaporation, Electron Beam, Magnetron sputtering, Ion Beam
Deposition area	Up to 12”
Substrate handling	Rotation: up to 50 rpm, optional planetary configuration Tilt: ±45° Offset (Z or X): up to 100 mm
Process temperature	Up to 800 °C
Reactive process	One or more reactive gases (O_2 , H_2 , N_2 , etc.)
Thickness uniformity	Up to 1%
Process control	Programmable quartz crystal thickness controller and/or in situ optical monitor
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, can be motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer charge system up to 25 wafers
Deposited materials	Metals, Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials

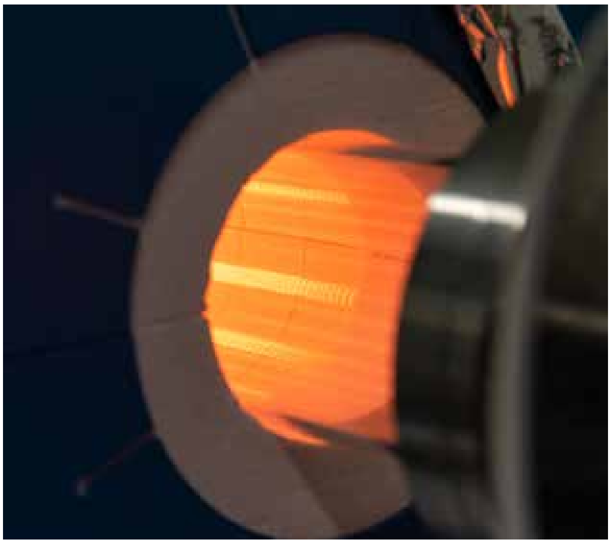
Ion Beam Assisted Deposition:

the best choice for high end optical coatings

CVD SERIES

THERMAL LOW PRESSURE CVD (LPCVD)

Thermal Chemical Vapor Deposition is a method of depositing thin films on a substrate surface through a thermally activated chemical reaction between one or more reactive gases and the substrate. This deposition technique is used for the deposition of silicon, silicon dioxide, silicon nitride and for the production of carbon nanotubes and graphene. In thermal CVD process, the precursor gas molecules are introduced into a heated chamber in vacuum atmosphere, reacting with the substrate surface at high temperatures, depositing a thin film of the desired material onto the substrate. The substrate is heated to provide the energy needed for precursor reaction and/or decomposition, because the high temperature enables the gas to react with the substrate, improving crystallinity and density of the thin film.



KEY FEATURES

- Hot Wall CVD or LPCVD configuration, up to 1200 °C. Precise and auto tuneable temperature control with completely settable ramp parameters
- Single or multiple furnaces in Hot Wall or Quartz Tube configuration.
- Reactive gases (SiH_4, NH_3, H_2, CH_4, N_2, etc.) and/or liquid precursors controlled directly from the software
- Optional vapor source controller for liquid Precursor with tank/cylinder in a closed cabinet for safe refill
- Optional single or multiple automatic or manual load lock with optional pre-heating and/or plasma treatments

APPLICATIONS

Thermal CVD is a common method for depositing various materials including Silicon Oxide (SiO_2), Silicon Nitride (Si_3N_4), Silicon Carbide (SiC), transition metal oxides (Ta_2O_5, TiO_2, and ZrO_2), transition metal silicates (SiO_2)–(ZrO_2) alloys, and carbon-based materials like graphene and carbon nanotubes.

- Consumer electronics
- Aerospace and Defense
- Healthcare and medical devices
- Optics and Photonics
- Energy storage
- Catalysis

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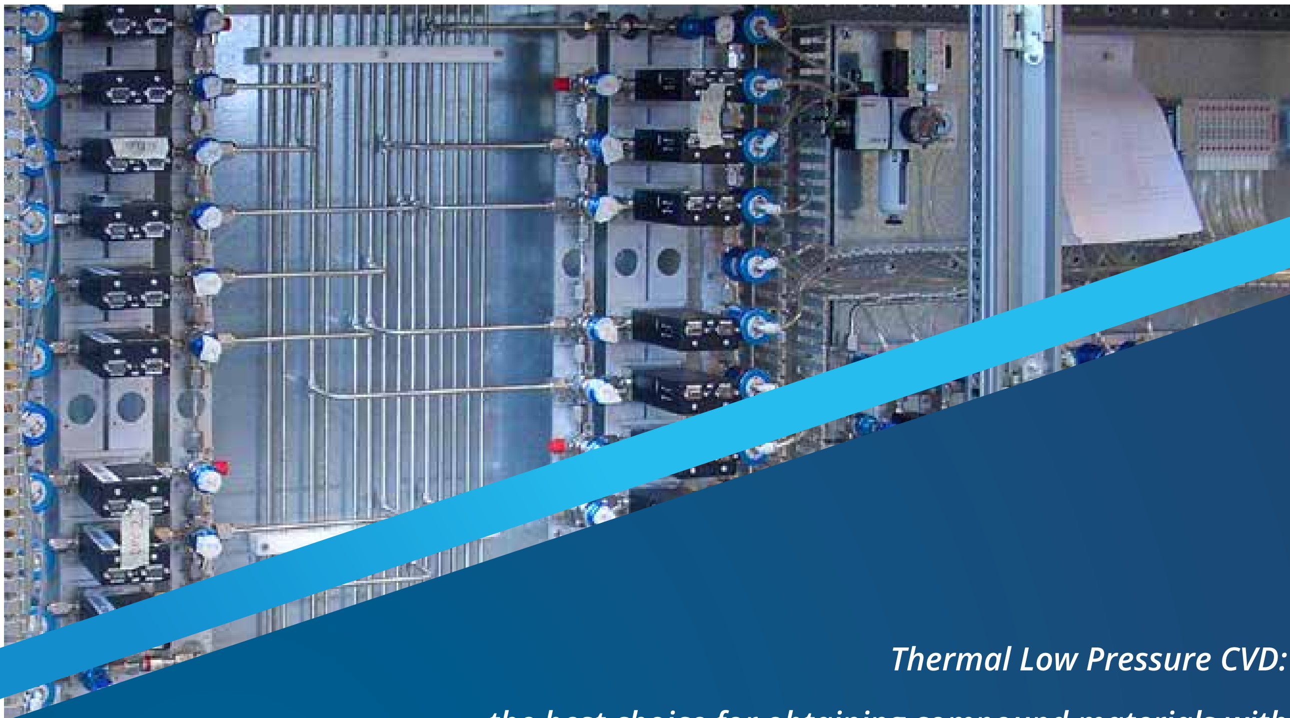
CVD SERIES

TECHNICAL DATA

THERMAL LOW PRESSURE CVD (LPCVD)	
Base pressure HV	< $1x10^{-6}$ mbar
Base pressure UHV	< $1x10^{-8}$ mbar
Pumping system	Dry primary pump, Turbomolecular high vacuum pump
Sources	Resistive or infrared
Additional sources	Optional plasma generator
Deposition area	Up to 12”
Substrate handling	Multi wafer holder
Process temperature	Up to 1000°C
Reactive process	One or more reactive gases (O_2 , H_2 , CH_4 , SiH_4 , etc.)
Thickness uniformity	Up to 3%
Process control	Pyrometer or thermocouple for temperature control
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, manual or motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer cassette system up to 25 wafers
Deposited materials	Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials, Organics



Thermal Low Pressure CVD:

the best choice for obtaining compound materials with

finely tailored composition starting from gaseous precursors

CVD SERIES

METAL ORGANIC CHEMICAL VAPOR DEPOSITION (MOCVD)

Metalorganic Chemical Vapor Deposition is a method of depositing thin films on a substrate surface through a chemical reaction between one or more reactive gases and the substrate.
Using this method is it possible to create high purity dielectric, metallic or semiconducting thin films. In the MOCVD process, ultrapure metalorganic precursor gases are introduced into a reactor, where they undergo pyrolysis on the semiconductor wafer. As a result, the subspecies are absorbed onto the wafer surface.
The metalorganic precursor is introduced into the process chamber via a system known as "bubbler", which uses an inert carrier gas (such as He or Ar) to transport the precursor liquid into the chamber. MOCVD operates at moderate pressures (1 to 760 Torr) in the gas phase.

KEY FEATURES

- Metal organic liquid precursors
- HV or UHV configuration
- Reactive gases (SiH_4, NH_3, H_2, CH_4, N_2, etc.) and/or liquid or solid precursors controlled directly from the software
- Optional vapor source controller for liquid Precursor with tank/cylinder in a closed cabinet for safe refill
- Optional single or multiple automatic or manual load lock with optional pre-heating and/or plasma treatments
- Optional wide range optical thickness monitor for the control of layer thickness

APPLICATIONS

MOCVD is commonly used in the production of laser diodes, LEDs, and semiconductors for advanced optoelectronics, high power and high-speed electronics, enabling mass production of semiconductor heterostructures via bandgap engineering.
Furthermore, MOCVD can be utilized to precisely fabricate 0D, 1D, and 2D nanomaterials.

- Consumer Electronics
- Solar energy
- Aerospace and Defense
- Healthcare and medical devices
- Optics and Photonics
- Power electronics
- Research

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TECHNICAL DATA

METAL ORGANIC CHEMICAL VAPOR DEPOSITION (MOCVD)	
Base pressure HV	< $1x10^{-6}$ mbar
Base pressure UHV	< $1x10^{-8}$ mbar
Pumping system	Dry, Turbomolecular pumps
Sources	Heating power supply
Additional sources	Plasma generator
Deposition area	Up to 12”
Substrate handling	Rotation: up to 50 rpm
Process temperature	Up to 800 °C
Reactive process	One or more reactive gases (O_2 , H_2 , N_2 , etc.) and liquid precursors
Thickness uniformity	Up to 3%
Process control	Optional optical monitor according to deposited material type
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, manual or motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer cassette system up to 25 wafers
Deposited materials	Metals, Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials, Organics

Metal Organic Chemical Vapor Deposition:

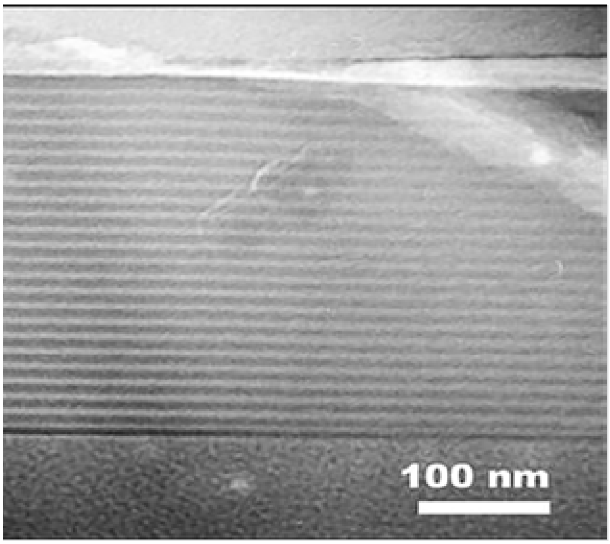
the best choice for obtaining compound materials with

finely tailored composition starting from liquid precursors

CVD SERIES

ATOMIC LAYER DEPOSITION (ALD)

Atomic Layer Deposition is a method of depositing thin films on a substrate surface through a chemical reaction between one or more reactive gases and the substrate. It is an advanced deposition technique that enables the deposition of ultra-thin films with exceptional precision. During ALD process, one or more reactive gases are introduced into a vacuum chamber, where they react with the substrate surface to deposit a thin film via a chemical reaction. This deposition method involves introducing gas phase precursors into the process chamber one by one, in a series of sequential, non-overlapping pulses. By reacting sequentially with the surface of the substrate, each precursor forms a self-limiting layer, and the reaction stops when all the reactive sites are consumed. Through repeated exposure to separate precursors, a thin film is slowly deposited.



KEY FEATURES

- Vapor source controllers for liquid Precursors with tank/cylinder in a closed cabinet for safe refill
- High speed pulsed valves for alternating precursor delivery
- Single or multiple furnaces in Hot Wall or Quartz Tube configuration.
- Reactive gases (SiH_4, NH_3, H_2, CH_4, N_2, etc) and/or liquid precursors controlled directly from the software
- Optional load lock with pre-heating and/or plasma treatments
- Optional Plasma Enhanced configuration
- Optional Emission Spectrometer for in-situ plasma diagnostics and End Point Detection

APPLICATIONS

ALD technology enables the production of a broad range of functional films with different electrical, optical and mechanical properties, including high-k dielectric, protective, anti-reflective, and gas diffusion barrier layers.
The low deposition temperature also allows for the creation of inorganic/organic polymer composites.

- Consumer Electronics
- Aerospace and Defense
- Healthcare and medical devices
- Optics and Photonics
- Energy storage
- Catalysis

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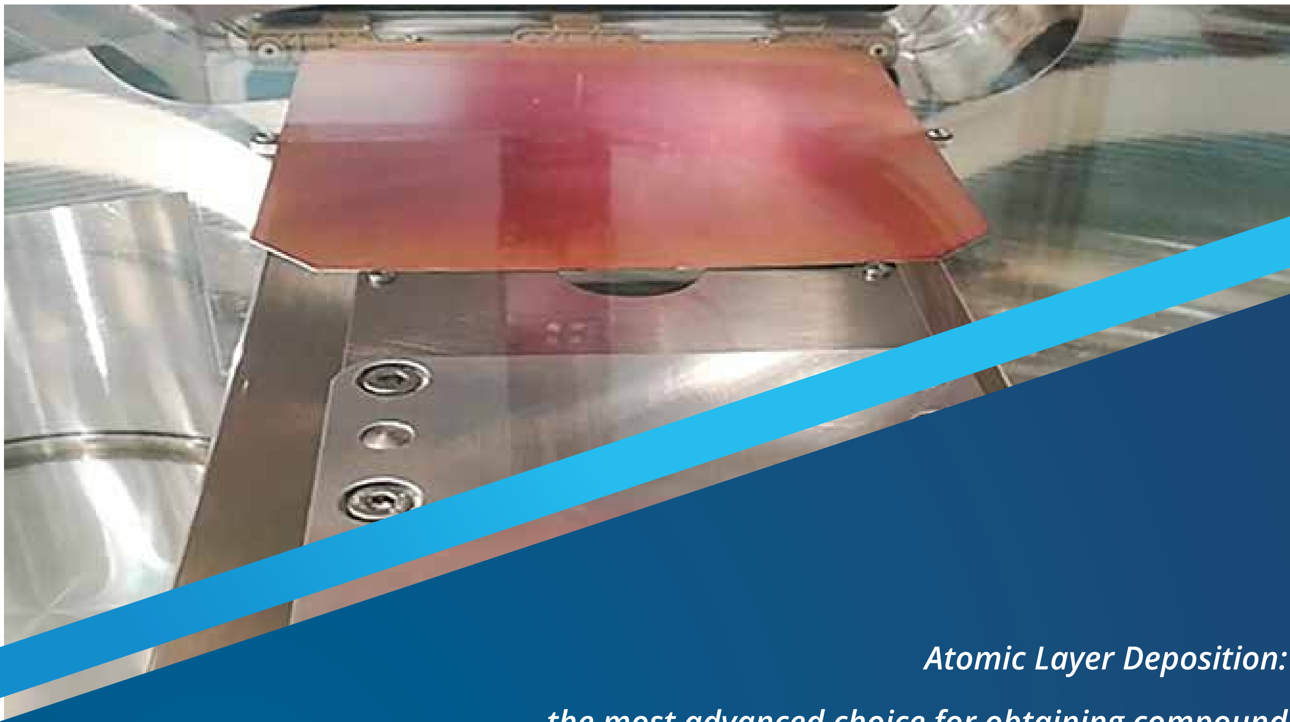
TECHNICAL DATA

ATOMIC LAYER DEPOSITION (ALD)	
Base pressure HV	< 1x10^{-6} mbar
Base pressure UHV	< 1x10^{-8} mbar
Pumping system	Dry primary pump, Turbomolecular high vacuum pump
Sources	Thermal
Additional sources	Plasma DC, DC pulsed or RF for PEALD configuration
Deposition area	Up to 12”
Substrate handling	n.a.
Process temperature	Up to 800 °C
Reactive process	One or more reactive gases (O_2 , H_2 , CH_4 , etc.) and liquid precursors
Thickness uniformity	Up to 3%
Process control	Optical monitor or optical emission spectroscopy
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, can be motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer charge system up to 25 wafers
Deposited materials	Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials, Organics



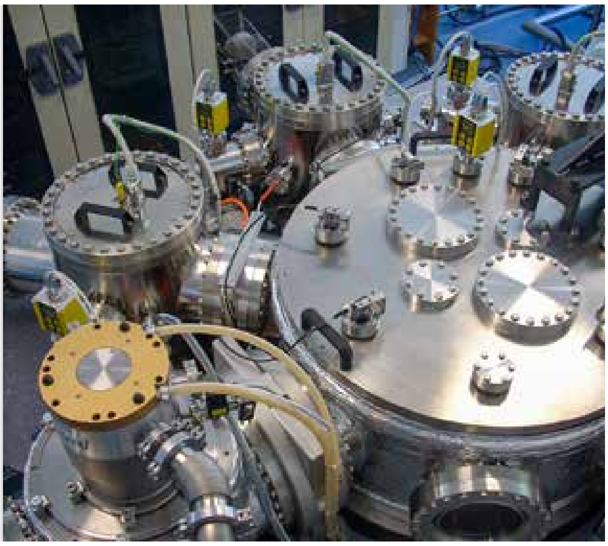
Atomic Layer Deposition:

the most advanced choice for obtaining compound materials mixing gaseous and liquid precursors

CVD SERIES

PLASMA ENHANCED CVD (PECVD)

Plasma-enhanced chemical vapor deposition is a plasma-based deposition method used to deposit material on a substrate surface. PECVD is commonly used for depositing silicon oxide/nitride, hydrogenated amorphous and microcrystalline silicon and carbon, Diamond-like carbon (DLC), semiconductors and oxides. The process involves introducing a gas mixture into the vacuum chamber, where a plasma is generated. The process gases are ionized and decomposed into ions and radicals, which react with the substrate via chemical reactions, leading to the deposition of a thin film on the substrate. The plasma can be generated using different methods such as radio frequency (RF), alternating current (AC), or direct current (DC) discharge between two electrodes. PECVD offers a higher deposition rate while maintaining a lower temperature compared to thermal CVD.



KEY FEATURES

- RF showerhead electrode for uniform electric field and gas distribution
- Modular process gas manifold with mass flow controllers for up to 12 gases
- Optional vapor source controller for liquid Precursor (i.e. TEOS) with tank/cylinder in a closed cabinet for safe refill
- Automatic process pressure control
- Alternatively Hot Wire CVD
- In situ spectroscopic plasma monitoring
- Optional automatic or manual load lock (optional pre-heating and/ or plasma treatments)
- Optional wide range optical thickness monitor for the control of layer thickness
- Optional in situ spectroscopic ellipsometry for thickness measurement

APPLICATIONS

PECVD is used to produce high-quality semiconductor and dielectric films required for various applications, like low and high-power semiconductor devices, photovoltaic solar cells' active layers, metal-insulator-metal (MIM) capacitors, laser diodes, sensors, detectors, LEDs, thin film transistors, and more.

- Consumer Electronics
- Automotive Industry
- Solar Energy
- Aerospace and Defense
- Healthcare and medical devices
- Optics and Photonics
- Wear resistant coatings

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CVD SERIES

TECHNICAL DATA

PLASMA ENHANCED CVD (PECVD)	
Base pressure HV	< $1x10^{-6}$ mbar
Base pressure UHV	< $1x10^{-8}$ mbar
Pumping system	Dry primary pump, Turbomolecular high vacuum pump
Sources	DC, DC pulsed, RF, Microwave
Additional sources	n.a.
Deposition area	Up to 20”
Substrate handling	n.a.
Process temperature	Up to 1000 °C
Reactive process	n.a.
Thickness uniformity	Up to 3%
Process control	Multilayer recipe control, optionally plasma monitoring or ellipsometry
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, manual or motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer cassette system up to 25 wafers
Deposited materials	Metals, Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials, Organics

Plasma Enhanced CVD:

the right choice for obtaining large area compound materials mixing gaseous and/or liquid precursors at any temperature

CVD SERIES

INDUCTIVELY COUPLED PLASMA CVD (ICPCVD)

Inductively Coupled Plasma Chemical Vapour Deposition is a plasma-based deposition method used to deposit material on a substrate surface. This plasma is generated by an RF generator in an inductively coupled plasma (ICP) source, resulting in higher plasma densities compared to the capacitive coupled plasma (CCP) used in standard PECVD techniques.

The process gases are decomposed into ions and radicals, which are then deposited as thin films on the substrate surface. Due to the higher plasma density, the deposition process can be carried out at lower temperatures (as low as 100 °C), making it suitable for deposition on temperature-sensitive substrates such as polymers.

KEY FEATURES

- High power ICP RF source
- Modular process gas manifold with mass flow controllers for up to 12 gases
- Optional vapor source controller for liquid Precursor (i.e. TEOS) with tank/cylinder in a closed cabinet for automatic and safe refill
- Automatic process pressure control by throttle valve and capacitance manometer
- In situ spectroscopic plasma monitoring
- Optional automatic or manual load lock (optional pre-heating and/ or plasma treatments)
- Optional wide range optical thickness monitor for the control of layer thickness
- Optional in situ spectroscopic ellipsometry for thickness measurement

APPLICATIONS

ICPCVD is a common method for depositing High-quality semiconductors and dielectrics for applications like low and high-power semiconductor devices, photovoltaic solar cells' active layers, metal-insulator-metal (MIM) capacitors, laser diodes, sensors, detectors, LEDs, thin film transistors, and so on.

- Consumer electronics
- Automotive Industry
- Aerospace and Defence
- Healthcare and medical devices
- Optics and Photonics
- Energy storage
- Wear resistant coatings

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CVD SERIES

TECHNICAL DATA

INDUCTIVELY COUPLED PLASMA CVD (ICPCVD)	
Base pressure HV	< 1x10^{-6} mbar
Base pressure UHV	< 1x10^{-8} mbar
Pumping system	Dry primary pump, Turbomolecular high vacuum pump
Sources	RF, Microwave
Additional sources	n.a.
Deposition area	Up to 12"
Substrate handling	n.a.
Process temperature	Up to 1000 °C
Reactive process	n.a.
Thickness uniformity	Up to 3%
Process control	Multilayer recipe control, optionally plasma monitoring and ellipsometry
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, manual or motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer cassette system up to 25 wafers
Deposited materials	Metals, Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials, Organics

Inductively Coupled Plasma CVD:

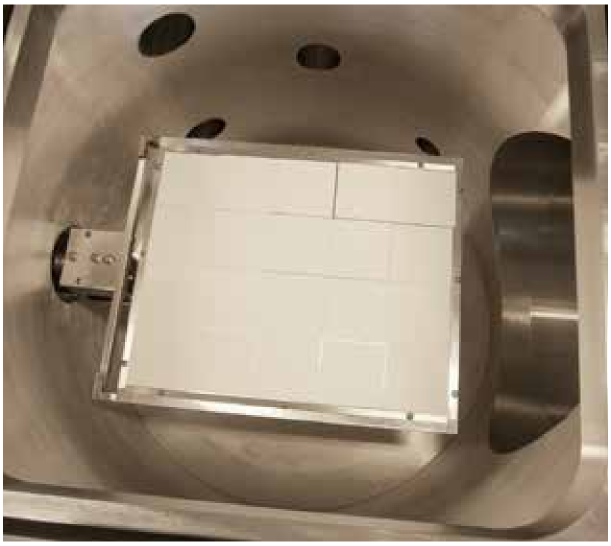
the right choice for obtaining high density compound materials mixing gaseous and/or liquid precursors at any temperature

E SERIES

REACTIVE ION ETCHING (RIE)

Reactive Ion Etching is a plasma-based etching method used to remove material from a substrate surface. During RIE, gas species are activated within the plasma discharge area and transported to the substrate surface through diffusion. A negative electric bias then accelerates these species to the substrate surface to perform etching.

When the substrate surface is exposed to the reactant, three processes take place: absorption of the precursors onto the surface, reaction with the substrates surface, and then desorption as volatile reaction products. These reaction products diffuse back to the plasma and are exhausted by a vacuum pump. Typically, a mask is used to pattern the substrates surface, allowing for selective etching in certain areas.



KEY FEATURES

- Substrate cooling down to -35 °C
- Single or multiple automatic or manual load lock and manipulators
- Optional optical emission spectrometer for in-situ plasma diagnostics and End Point Detection
- Optional real-time, in-situ, plasma etch depth monitoring and end point detection plus co-linear wafer vision system.
- Different plasma sources can be selected from DC, DC pulsed, RF
- Different reactive gases (O_2, H_2, N_2, C_2H_4, CF_4, SF_6, etc.) can be used during etching process

APPLICATIONS

RIE applications range from low and high-power semiconductors for trenches and vias realization, MEMS for elimination of sacrificial material and general feature definition, de-processing and failure analysis, which makes RIE a key technique to be available in most semiconductor R&D and production facilities.

- Consumer Electronics
- Solar Energy
- Aerospace and Defence
- Biomedical and Healthcare
- Optics and Photonics

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TECHNICAL DATA

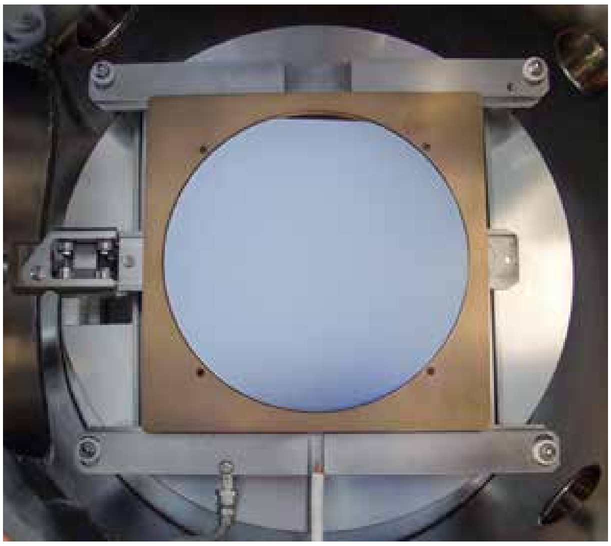
REACTIVE ION ETCHING (RIE)	
Base pressure HV	< 1x10^{-6} mbar
Base pressure UHV	< 1x10^{-8} mbar
Pumping system	Dry primary pump, Turbomolecular high vacuum pump
Sources	DC, DC pulsed, RF
Additional sources	n.a.
Deposition area	Up to 12”
Substrate handling	n.a.
Process temperature	Cooling up to -40 °C, Heating up to 400 °C
Reactive process	One or more reactive gases (O_2, H_2, N_2, C_2H_4, CF_4, SF_6, etc.)
Etching uniformity	Up to 10%
Process control	In situ optical monitor or optical emission spectroscopy
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, manual or motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer cassette system up to 25 wafers
Etched materials	Metals, Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials, Organics

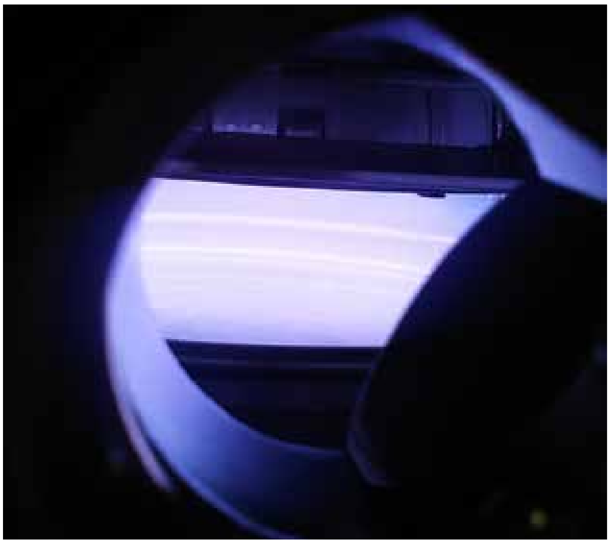
Reactive Ion Etching:
the most common and affordable choice for high quality anisotropic etching

E SERIES

INDUCTIVE COUPLED PLASMA RIE (ICPRIE)

Inductive Coupled Plasma Reactive Ion Etching is a plasma-based etching method used to remove material from a substrate surface. ICPRIE is especially useful for deep reactive ion etching (DRIE) of silicon, which is critical in advanced MEMS applications for creating high aspect ratio microstructures. During ICPRIE, gas species are activated within the plasma discharge area of the inductively coupled plasma (ICP) source and transported to the substrate surface through diffusion. A negative electric bias applied to the substrate then accelerates these species to the material surface to perform etching. A mask is can be used to pattern the substrate surface, allowing for selective etching in certain areas. It is equipped with an inductively coupled plasma (ICP) source alongside a plasma a source applied directly on the substrate, enabling better etching selectivity and higher aspect ratios of the structures produced.





KEY FEATURES

- Substrate cooling
- Single or multiple automatic or manual load lock and manipulators
- Optional optical emission spectrometer for in-situ plasma diagnostics and End Point Detection
- Optional real-time, in-situ, plasma etch depth monitoring and end point detection plus co-linear wafer vision system.
- HV or UHV configuration
- Different reactive gases (0_2, H_2, N_2, C_2H_4, CF_4, SF_6, etc) can be used during etching process

APPLICATIONS

ICP-RIE has a wide range of applications, from structuring sensors (GMR, TMR) in MEMS production to realizing trenches and vias in low and high power semiconductors.
The Bosch Process is used to fabricate trenches, holes, and pillars for various device applications, and the materials that can be etched are the same as in conventional RIE.

- Consumer Electronics
- Solar Energy
- Aerospace and Defence
- Biomedical and Healthcare
- Optics and Photonics

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E SERIES

TECHNICAL DATA

INDUCTIVE COUPLED PLASMA RIE (ICPRIE)	
Base pressure HV	< $1x10^{-6}$ mbar
Base pressure UHV	< $1x10^{-8}$ mbar
Pumping system	Dry primary pump, Turbomolecular high vacuum pump
Sources	Inductively Coupled Plasma Source
Additional sources	Plasma source on substrate
Deposition area	Up to 12”
Substrate handling	n.a.
Process temperature	-40 °C / 400°C
Reactive process	One or more reactive gases (0_2, H_2, N_2, C_2H_4, CF_4, SF_6, etc.)
Etching uniformity	Up to 10%
Process control	In situ optical monitor or optical emission spectroscopy
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, manual or motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer cassette system up to 25 wafers
Etched materials	Metals, Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials, Organics

Inductive Coupled Plasma RIE:

the best choice for high speed etching

E SERIES

ION BEAM ETCHING (IBE)

Ion Beam Etching is an etching technique that utilizes an ion source to etch material from a substrate surface with excellent uniformity and precision. IBE can be used on a variety of materials, including metals, oxides, semiconductors, and organics. This etching method involves the use of a beam of high-energy charged particles, usually Argon, to physically remove material from the surface of a sample. These ions are created within an ion source, from where they are accelerated to high energies through an electric field and then focused into a beam with the help of magnetic or electrostatic lenses. When the ion beam is directed at the sample surface, it collides with the atoms in the material, causing them to be ejected from the surface. The process can be precisely controlled by adjusting the energy of the ion beam and the angle at which it is directed.

KEY FEATURES

- Etching angle adjustment with tiltable and rotatable substrate holder
- Enhanced selectivity and rate with reactive gases
- Optional SIMS based or optical in-situ diagnostics and End Point Detection for process control
- Substrate cooling down to -35 °C
- Optional optical emission spectrometer for in-situ plasma diagnostics and End Point Detection
- Optional real-time, in-situ, plasma etch depth monitoring and end point detection plus co-linear wafer vision system
- Different reactive gases (O_2, H_2, N_2, etc) can be used during etching process
- Single or multiple automatic or manual load lock and manipulators

APPLICATIONS

Applications for ion beam technology span a wide range of uses, from milling metals in MEMS production to creating structured magnetic memory (MRAM) and sensors (GMR, TMR), reducing microroughness, and transferring patterns for optical gratings.

- Consumer Electronics
- Aerospace and Defence
- Healthcare and medical devices
- Optics and Photonics
- Research

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E SERIES

TECHNICAL DATA

ION BEAM ETCHING (IBE)	
Base pressure HV	< 1×10^{-6} mbar
Base pressure UHV	< 1×10^{-9} mbar
Pumping system	Turbomolecular, Cryo, TSP
Sources	Ion Beam source (Gridded or not gridded)
Additional sources	n.a.
Etching area	Up to 12”
Substrate handling	Rotation: up to 50 rpm, optional planetary configuration Tilt: ±45° Offset (Z or X): up to 100 mm
Process temperature	-35 °C to 300 °C
Reactive process	One or more reactive gases (O_2 , H_2 , N_2 , etc.)
Etching uniformity	Up to 5%
Process control	In situ optical monitor or optical emission spectroscopy
Substrate load	Manual in main Chamber or by Load Lock with manual or automatic manipulator
Load lock	Single or Multiple Load Locks, can be motorized with multiple substrate holder
Multi wafer loading	Optional multi wafer charge system up to 25 wafers
Etched materials	Metals, Oxides, Nitrides, Carbides, Semiconductors, Carbon Based Materials

Ion Beam Etching:

the most advanced choice for high quality directional etching

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