

EQUIPMENT FOR HIGH-EFFICIENCY SOLAR CONCEPTS

HISS | XEA|nova 5.5 | XEA|nova L

OUR STORY. OUR EXPERIENCE.

VON ARDENNE was founded in 1991 as a spin-off of the former Manfred von Ardenne Research Institute. The company is based in Dresden, with subsidiaries in China, Japan, Malaysia, the USA and Vietnam. Manfred von Ardenne's inventions formed the basis for our work today in the fields of vacuum, plasma and electron beam technology.

The German family-owned company develops and manufactures advanced coating equipment for the deposition of ultra-thin functional layers on materials such as glass, metal strip, wafers and polymer films. Two key technologies are applied by our equipment: magnetron sputtering, a process during which materials such as metals or oxides are atomized in plasma and then condense as a layer, and electron beam evaporation, a method of vaporizing metals and alloys by bombarding them with electron beams.

Equipment, components and technologies made by VON ARDENNE make an important contribution to the protection of the environment. Our customers use them to produce sustainable products for the generation of renewable energy and the sustainable use of resources.

The major international manufacturers of crystalline and thin-film solar modules use our highly productive equipment for their production. We are also cooperating closely with them to develop the next generation of modules that will be even more efficient.

We have acquired an excellent process know-how based on the more than 150 coating systems we have installed for crystalline solar cells and thin-film solar module providers. This expertise has been incorporated into the development of coating systems for the next generations of high-efficiency solar cells.

VON ARDENNE is a major player in the heterojunction technology (HJT) market with the modular **XEAInova** wafer coating system, which can be configured according to the needs of our customers. Such coating systems for an overall capacity of more than 3 GW are shipped to production lines all over the world. The double-sided coating of wafers in just one coating cycle is just one of the features of this highly productive and flexible tool, which is suited for both standard and special wafer formats.

The two driving factors in the industry are increasing the productivity and lowering the manufacturing costs for the cells. Our latest coating system, the **XEAInova L**, is designed to accommodate these factors. Depending on the cycle time, this coating system is able to process between 8000 and 10000 M6 wafers per hour.

This trend will continue to shape the development of the industry, which has the aim to consolidate the status of photovoltaics as a reliable and economic source of renewable energy. Therefore, VON ARDENNE will keep working on new high-efficiency cell concepts that will only be possible thanks to our highly productive and precise thin-film deposition technology.

With the flexible, modular **HISS**, we offer the ideal coating system for research and development tasks as well as for pilot production.

MARKET
LEADERSHIP

**HETEROJUNCTION
TECHNOLOGY**

> 3 GW*

**THIN-FILM
PHOTOVOLTAICS**

> 8 GW*

*MANUFACTURING CAPACITY

HIGH-EFFICIENCY SOLAR CELL CONCEPTS

Investing in photovoltaics means investing in sustainable economic development while minimizing the dependency on fossil or nuclear energy sources. It also means securing ecologically benign growth. However, for PV to become a competitive source of electricity production, the levelized cost of electricity (LCOE) from PV would have to decrease below residential and wholesale electricity prices.

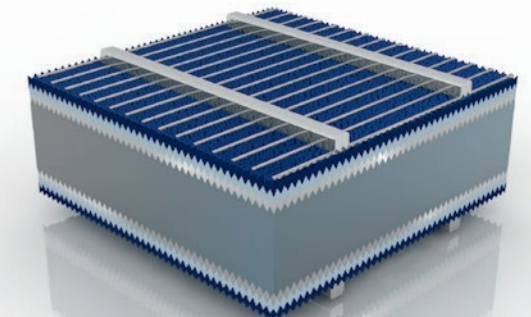
In order to meet this market demand, manufacturers of PV components need to offer more efficient and more reliable products at lower prices. High conversion efficiency and high lifetime are key. For that reason, high-efficiency crystalline silicon solar cell technology will be introduced in production. All of the concepts require new high-quality thin films in order to build up appropriate cell structures applied by means of highly productive deposition methods. VON ARDENNE provides the necessary technology and equipment.

HETEROJUNCTION TECHNOLOGY - HJT

With this cell concept, highest conversion efficiencies can be reached by means of almost perfectly passivating amorphous silicon layers applied to both sides of the silicon wafer. This is one of the most elegant and simple cell structures to aim for maximum single junction cell power.

VON ARDENNE SCOPE OF SUPPLY

High-performance TCO contact layers and metalization

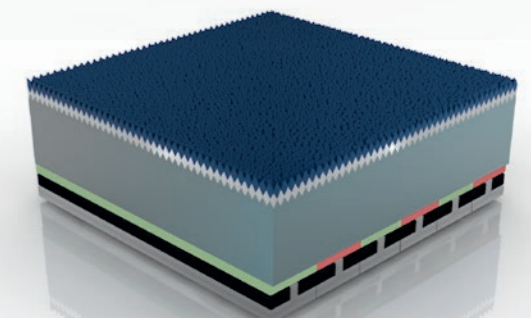


INTERDIGITATED BACK CONTACTS - IBC

This exclusive, highly efficient cell structure offers optimized light absorption by means of an unshaded cell front and electrically functional layers applied structurally to the cell rear.

VON ARDENNE SCOPE OF SUPPLY

High-performance metalization layers and back side mirror combined with lowest cost of ownership

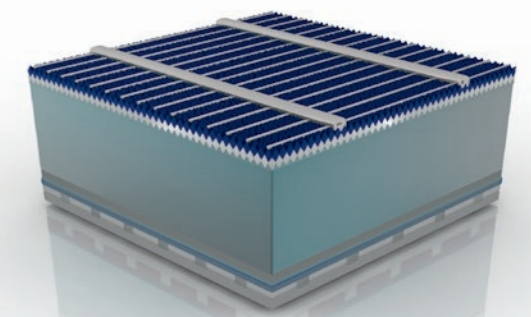


PASSIVATED CONTACTS DEVELOPMENT

Next-generation PERC technology – this is what you could call such a structure which further minimizes local recombination centers. A smart scheme of functional passivating and contacting layers is applied at the rear side of the cell by means of highly scalable thin-film deposition techniques.

VON ARDENNE SCOPE OF SUPPLY

Single-sided deposition of in-situ doped amorphous silicon as well as SiN layer for hydrogenation



CORE TECHNOLOGY BASED ON A LONG TRADITION

INDUSTRY-PROVEN, RELIABLE AND ADVANCED SPUTTERING TECHNOLOGY

1 PROVEN MAGNETRON TECHNOLOGY

The main technology used for coating on VON ARDENNE equipment is magnetron sputtering. We develop and manufacture the necessary components such as magnetron sputtering sources in-house and have more than 40 years of experience with magnetron sputtering.

VON ARDENNE MAGNETRONS

VON ARDENNE magnetrons are available for a wide range of applications. Thanks to many years of experience gained from designing and installing advanced sputtering equipment, we can offer a complete portfolio of solutions from RF and AC to DC processes, planar to rotatable applications and even magnetrons with integrated turbopumps.



SSM/SSM-SSM Magnetrons

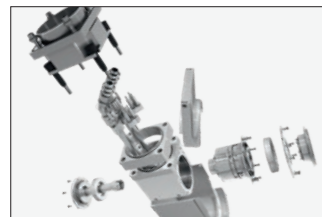


RSM/RSM-RSMT/RSMT Magnetrons



MAGNET BARS

All magnet bars and magnet systems are similar in mechanical design and therefore interchangeable.



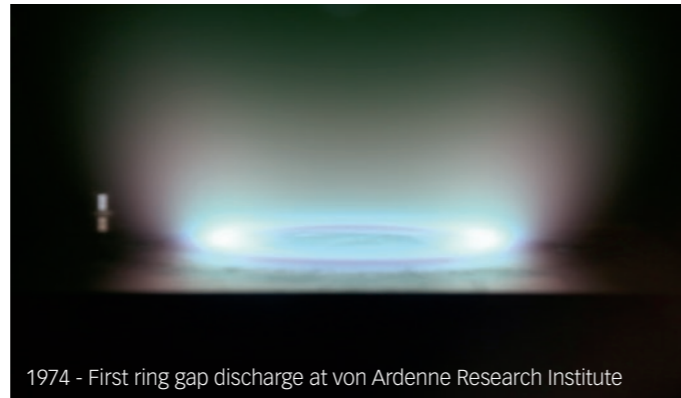
X-SERIES END BLOCKS

With our state-of-the-art X-Series end blocks, we offer both drop-in and cantilever solutions for our coating systems.



PROCESS CONTROL

The VON ARDENNE process control system VApocos2 controls the reactive magnetron sputtering of compound layers.



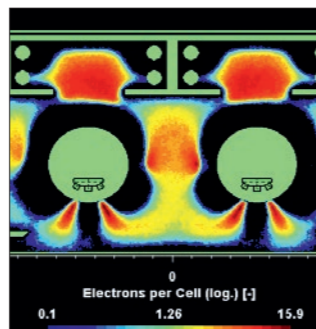
1974 - First ring gap discharge at von Ardenne Research Institute



WSM/WSMT Magnetrons

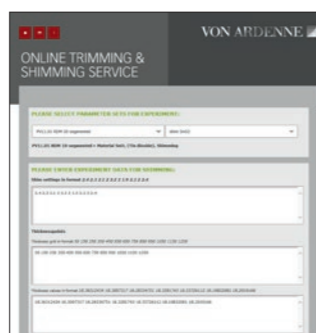


RDM/RDMT Magnetrons



DUAL ANODE SPUTTERING

Dual Anode Sputtering (DAS) is an industrially proven coating technology. It can be applied for highly-resistive target materials such as intrinsic tin oxide (i-ZnO). The DAS method guarantees a good availability of the anode as it is cleaned periodically, even when dielectrics are sputtered.



TRIMMING & SHIMMING

A web-based trimming and shimming software is available. It enables the quick optimization of the thickness uniformity of single layers. Upon request, an online adjustable magnet bar can be offered.

FEATURES AND BENEFITS OF VON ARDENNE EQUIPMENT

MODULAR, SCALABLE AND FLEXIBLE DESIGN BASED ON GERMAN ENGINEERING

2 INDIVIDUAL PROCESS CHAMBERS

The process chambers can be configured individually based on the flexible VON ARDENNE compartment system. They have a scalable design and can be configured according to the requirements of our customers. The components our systems are fitted with have proven in the industry for many years.

3 TRANSPORT SYSTEM

The substrate transport system used in our equipment can be either carrier-less or carrier-based depending on the process and the requirements of the customer. The customer can also choose between systems with a horizontal or a vertical substrate transport.

Furthermore, there are two drive modes, one for use in vacuum and one for operation under atmospheric pressure. The substrates can be transported either as a single item or as multiple items in a batch.

4 HEATING AND COOLING

HEATING CONTROL SYSTEM: The VON ARDENNE advanced heating control system is the first solution worldwide for the reliable and even heating of substrates before and during the coating process. The system is characterized by easy operation and helps increase the efficiency of the production process and lower operating costs. The reliable and quick setting of the substrate temperature within narrow tolerances and the high temperature uniformity shorten the ramp up time and minimize breakage and scrap.

The VON ARDENNE advanced heating control system is a standard component for heating treatment.

COOLING SYSTEM: The VON ARDENNE solution for the critical phase of the temperature treatment is our uniquely designed substrate cooling station that is positioned downstream the vacuum chambers. It cools by means of the air convection principle.

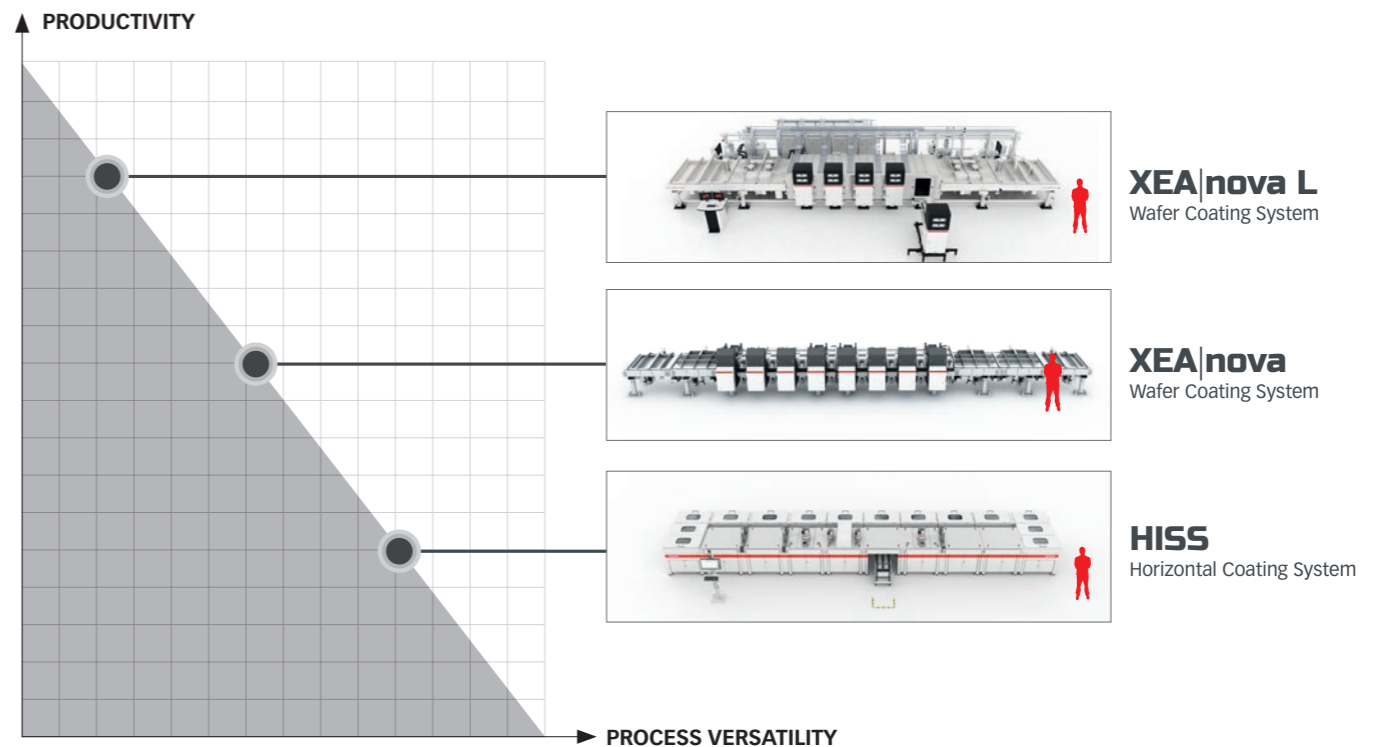
BENEFITS

- Quick setting of substrate temperature shortens ramp up time
- High temperature uniformity
- Reliable temperature control even during standby and transport system failures (gap handling, jam)
- Minimized glass consumption during conditioning
- Fast cool down of system in case of failures or maintenance
- Good fault tolerance in case of failure of heaters or other components

5 SCALABILITY

VON ARDENNE provides advanced PVD coating equipment, key components and technology expertise for all scales of production, from laboratory tasks to high-volume manufacturing.

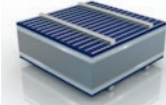
Our laboratory-scale coating systems and pilot production tools use the same key components as our systems for industrial production, however at a smaller scale. Thus, our customers can test their applications under laboratory conditions and save time when they scale their products up to a larger productivity or for mass production.



APPLICATION

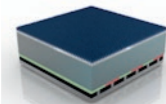
HJT

High-performance TCO contact layers and metalization



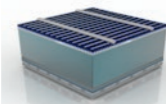
IBC

High-performance metalization layers and back side mirror combined with lowest cost of ownership



Passivated Contacts

Single-sided deposition of in-situ doped amorphous silicon as well as SiN layer for hydrogenation



The **HISS** is a modular vacuum coating system with a carrier-based substrate transport.

In the configuration specified here, it is primarily designed for crystalline photovoltaics applications on silicon wafers. However, it can also be adjusted for thin-film photovoltaics applications on glass or other applications on various flat substrates.

With the **HISS**, you can benefit from our experience gained from more than 150 coating systems that we have delivered to the PV industry. It is the perfect choice if you are looking for highly flexible production equipment with a small or medium throughput equipped with proven technology.

Thanks to its modular design, the **HISS** can be configured according to your needs. We offer two basic configurations of the system.

The **HISS LabX** is a single-ended tool for horizontal batch processing. It is ideally suited for process and application development at laboratory scale.

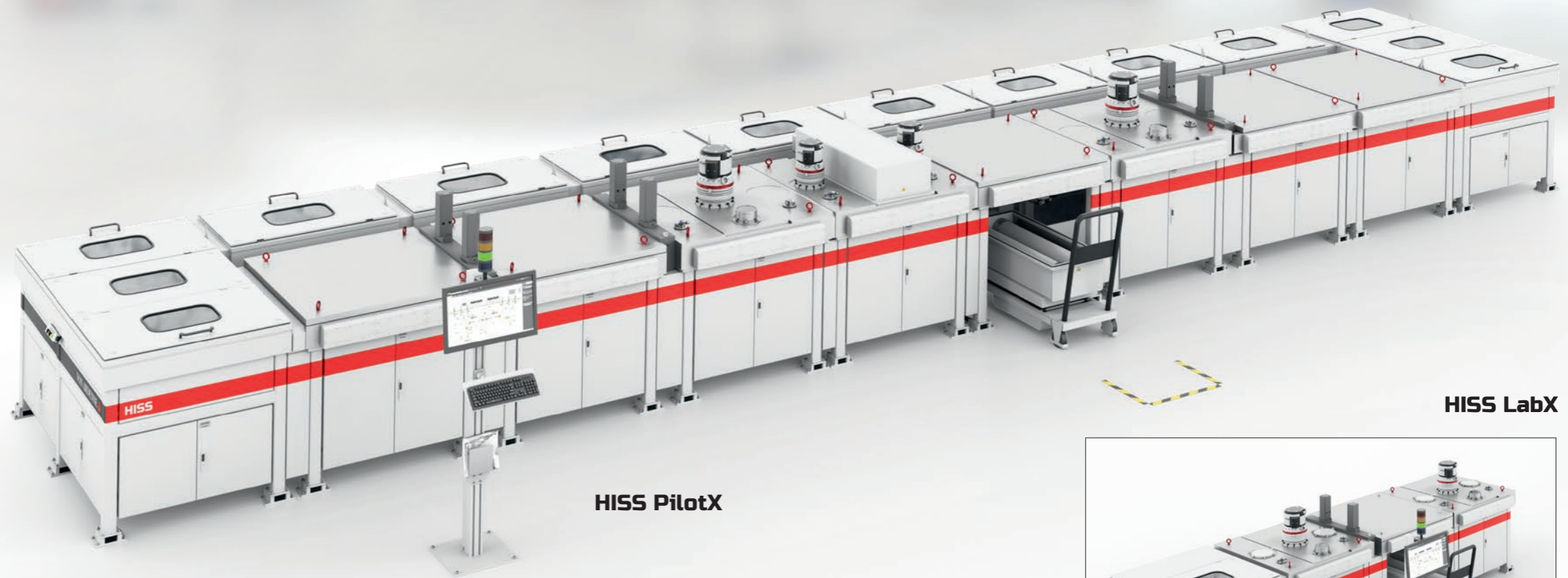
The **HISS PilotX**, on the other hand, is designed for horizontal inline operation with an automated carrier return system, which makes it suitable for pilot production.

HIGH PROCESS FLEXIBILITY

The process chamber can be configured with planar or rotatable magnetrons or with process components for thermal evaporation. Pre-treatment or heating and cooling units are available upon request. All auxiliary chambers, like entry/exit, buffer and transport chamber, can be upgraded in a similar manner.

PROVEN PROCESS COMPONENTS

Our proven process technology guarantees excellent layer properties and coating uniformity.



HISS PilotX

HISS LabX



HEATING

For transparent conductive oxides like ITO or other special applications, the substrate temperature can be precisely controlled in order to achieve reproducible and ideal layer characteristics by optional active heating or cooling.

PROCESS CHAMBER

A process chamber can be equipped with process stations either in a sputter down or a sputter up arrangement or with process components for thermal evaporation. It enables simultaneous or sequential processing of different material compositions, which is particularly suited for R&D purposes.

FLEXIBLE AND DYNAMIC DESIGN

The standardized subcomponents enable custom-made configurations with a high degree of flexibility. That means that the system can be adapted to changing processes or requirements by adding e.g. additional sputter stations or even compartments. Therefore, our customers are able to act very dynamically and to adapt to the evolution of their products.

TECHNICAL DATA

Subject to change without notice due to technical improvement.

GENERAL FEATURES

Wafer compatibility	all common formats: M2, M4, M6, M10 and M12
Throughput	
HISS LabX:	≈ 60 wafers/hour
HISS PilotX:	≈ 1200 M2 wafers/hour; ≈ 1400 M4 – M6 wafers/hour
Substrates	silicon wafers, metal plates, polymer films, glass, plastics ...
Substrate size	6" (standard), other substrate sizes possible
Substrate thickness	≤ 20 mm
Coating area on carrier	
LabX	≈ (520 x max. 900) mm ² , e.g. (3 x 5) M2 – M4 wafers
PilotX	≈ (500 x 1,000) mm ² , e.g. (3 x 6) M2 wafers ≈ (520 x 900) mm ² , e.g. (3 x 5) M4 – M6 wafers

SPUTTERING SYSTEM

Magnetron type	single or dual rotatable, planar
Sputter arrangement	sputter up and sputter down
Deposition type	DC, pulsed DC, AC, RF
Thermal evaporation source	linear
Number of independent processes	on request
Gases and media	e.g. Ar, Ar/O ₂ (max. 20 % O ₂) Ar/H ₂ (max. 2.8 % H ₂)

OPTIONAL FEATURES

- Substrate heating
- Pre-treatment (e.g. Ion etching,...)
- Automated substrate loading & unloading
- Automated carrier return system
- Controlled heating and cooling unit (CHU)
- Dry air supply (CDA)
- Carrier storage racks
- Movable carrier stacker
- Others on request

XEA|nova 5.5 WAFER COATING SYSTEM

MASS PRODUCTION
FOR HJT, IBC AND PASSIVATED CONTACTS

APPLICATION

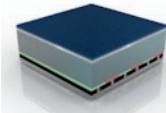
HJT

High-performance TCO contact layers and metalization



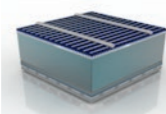
IBC

High-performance metalization layers and back side mirror combined with lowest cost of ownership



Passivated Contacts

Single-sided deposition of in-situ doped amorphous silicon as well as SiN layer for hydrogenation



The **XEA|nova** is a horizontal wafer coating system with a carrier return transport. It is also suited for other small substrates. With this tool, even very thin substrates can be treated on both sides without breaking the vacuum or flipping the substrates. These outstanding features of the **XEA|nova** enable sequenced but also simultaneous treatments of both substrate surfaces.

The coater can be equipped with rotatable magnetrons for sputtering and with evaporation sources. Special pretreatment of the substrates like cleaning or etching can either take place under vacuum or before the substrate enters the vacuum.

The **XEA|nova** benefits from our experience gained from more than 150 industry-proven coating systems that we have delivered to the photovoltaics industry.

The **XEA|nova** is the perfect choice for customers looking for highly productive and flexible production equipment combined with proven technology and design.

VON ARDENNE benefits:

- Expertise in PVD processing, especially TCO such as ITO
- Expertise in large-area deposition
- Expertise in process upscaling
- Global network and worldwide service

PROVEN MAGNETRON TECHNOLOGY

Proven rotatable magnetron technology guarantees excellent target utilization. For more than 40 years, VON ARDENNE has been developing and manufacturing proprietary magnetrons for all kinds of applications.

PRECISE TEMPERATURE CONTROL OF SUBSTRATES

For transparent conductive oxides like ITO or other special applications, the substrate temperature can be precisely controlled in order to achieve reproducible and ideal layer characteristics.



PROCESS UNITS WITH UP AND/OR DOWN ARRANGEMENT

For the substrate treatment, the retractable process units (PUs) in the process chamber can be equipped with various process tools in up and down arrangement.

SIMULTANEOUS OR SEQUENCED PROCESSING

The combination of up and down arrangements facilitates simultaneous or sequenced processing of both substrate sides without additional handling or breaking the vacuum.

CONVENIENT AND QUICK MAINTENANCE

The optimized machine design enables easy access to the process environment and the auxiliary chambers. Due to the plug-and-play design of the process units, they can be maintained during production, a fact that shortens the green to green times even more.

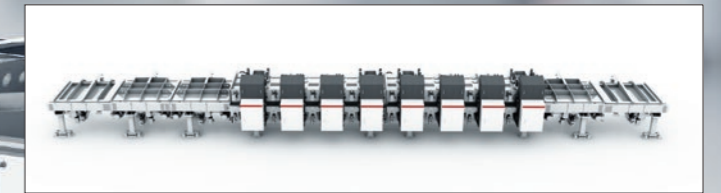
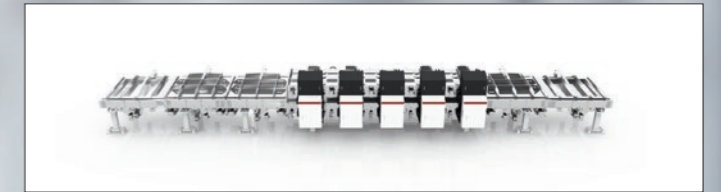
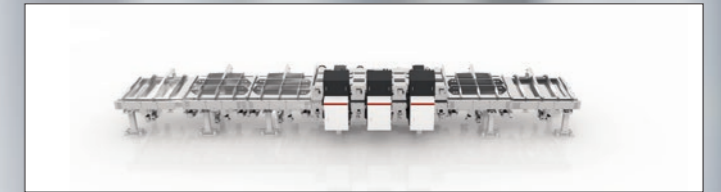
BROAD THROUGHPUT RANGE AND HIGH PROCESS FLEXIBILITY

Depending on the market and process demands of the customer, the maximum substrate throughput can be exceptionally high.

The process chamber can be configured with rotatable magnetrons, thermal evaporators as well as ion pretreatment or heating and cooling units. All auxiliary chambers, like entry/exit, buffer and transport chamber, can be upgraded in a similar manner.

FLEXIBLE AND DYNAMIC IN PRODUCTION

The standardized subcomponents enable custom-made configurations with a high degree of flexibility. That means that the system can be adapted to changing processes or requirements. Therefore, our customers are able to act very dynamically and to keep their production in accordance with the evolution of their product.



TECHNICAL DATA

Subject to change without notice due to technical improvement.

GENERAL FEATURES

Throughput	≤ 5500 substrates/hour for M6 wafers
Substrates	silicon wafers, metal plates, polymer films, others
Substrate size	all common formats: M2, M4, M6, M10 and M12
Substrate thickness	≤ 3 mm
Coating area on carrier	≈ (1 x 1.7) m ² , e.g. (6 x 9) for M6 wafers

SPUTTERING SYSTEM

Magnetron type	single or dual rotatable
Sputter arrangement	sputter up and sputter down
Deposition type	DC, pulsed DC, AC
Number of independent process	unlimited
Gases and media	e.g. Ar, O ₂ , N ₂ , H ₂ O, X
Target utilization	> 80 %, depending on process & material

OPTIONAL PROCESS FEATURES

Substrate heating	
Pre-treatment (e.g. Ion etching ...)	
Alternative deposition technologies upon request	

OPTIONAL FEATURES

Automated substrate loading & unloading	
Automated carrier return system	
Controlled heating and cooling unit (CHU)	
Dry air supply (CDA)	
Carrier storage racks	
Others on request	

AUTOMATION OPTIONS

Configuration	single- or double-end
Automation system	fully automatic
Substrate feeding	cassette, box, other

XEA|nova L WAFER COATING SYSTEM

HIGH-VOLUME MASS PRODUCTION
FOR HJT, IBC AND PASSIVATED CONTACTS

APPLICATION

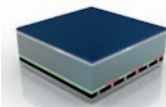
HJT

High-performance TCO contact layers and metalization



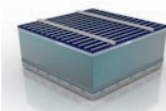
IBC

High-performance metalization layers and back side mirror combined with lowest cost of ownership



Passivated Contacts

Single-sided deposition of in-situ doped amorphous silicon as well as SiN layer for hydrogenation



The **XEA|nova L** is an inline coating system based on our proprietary large-area coating technology. The system is wider than the **XEA|nova** and can process more substrates at the same time. Therefore it is especially suited for high productivity applications at very low costs. It is suited for silicon wafers or other small and even very thin substrates.

Thanks to its modular design, the **XEA|nova L** can be equipped with rotatable magnetrons for the sputter deposition of high-performance TCO layers or several other materials, such as metals and metal oxides. It can also be adapted for other deposition technologies. The substrates can also be pre-treated by cleaning or etching, either under vacuum or before it enters the vacuum.

VON ARDENNE is also working on introducing single-sided passivated contacts processed by means of high-rate soft sputtering into mass production. The necessary sputtering process technology will be designed to fit into the **XEA|nova L** platform.

HIGHEST ECONOMY OF SCALE

Due to its large width, the productivity of the tool is exceptionally high while the process utilization is brought to a maximum. Thus, the **XEA|nova L** offers best cost of ownership by providing applicable economy of scale.

PROVEN MAGNETRON TECHNOLOGY

Proven rotatable magnetron technology guarantees excellent target utilization. For more than 40 years, VON ARDENNE has been developing and manufacturing proprietary magnetrons for all kinds of applications.

PROCESS CHAMBER

The process chamber enables simultaneous processing of different material compositions, such as TCO's, TCO stack layers and/or combinations of TCO, metal oxides and metal stacks.

PRECISE TEMPERATURE CONTROL OF SUBSTRATES

For transparent conductive oxides like ITO or other special applications, the substrate temperature can be precisely controlled in order to achieve reproducible and ideal layer characteristics by optional active heating or cooling.



EDGE EXCLUSION, FULL AREA, ALL AROUND & BEVEL

The innovative VON ARDENNE carrier concept is very flexible and enables the deposition on substrates with full or partial edge exclusion. Furthermore, the substrate can be coated on the full area and all around, including the bevel.

CONVENIENT AND QUICK MAINTENANCE

The optimized machine design enables easy access to the process environment and the auxiliary chambers.

FLEXIBLE AND DYNAMIC IN PRODUCTION

The standardized subcomponents enable custom-made configurations with a high degree of flexibility. That means that the system can be adapted to changing processes or requirements. Therefore, our customers are able to act very dynamically and to keep their production in accordance with the evolution of their product.

TECHNICAL DATA

Subject to change without notice due to technical improvement.

GENERAL FEATURES

Throughput	
XEA nova L8:	8000 wph (M2, M4, M6), 6600 wph (M10), 4700 wph (M12)
XEA nova L10:	10000 wph (M2, M4, M6), 8300 wph (M10), 6600 wph (M12)
Substrates	silicon wafers, metal plates, polymer films, others
Substrate size	all common formats: M2, M4, M6, M10 and M12
Substrate thickness	≤ 3 mm
Coating area on carrier	≈ (1.5 x 2.3) m ² , e.g. (9 x 12) for M6 wafers

SPUTTERING SYSTEM

Magnetron type	single or dual rotatable, planar
Sputter arrangement	sputter down and sputter up
Deposition type	DC, pulsed DC, AC
Number of independent processes	unlimited
Gases and media	e.g. Ar, H ₂ , O ₂ , N ₂ , H ₂ O, X
Target utilization	> 80 %, depending on process & material

OPTIONAL PROCESS FEATURES

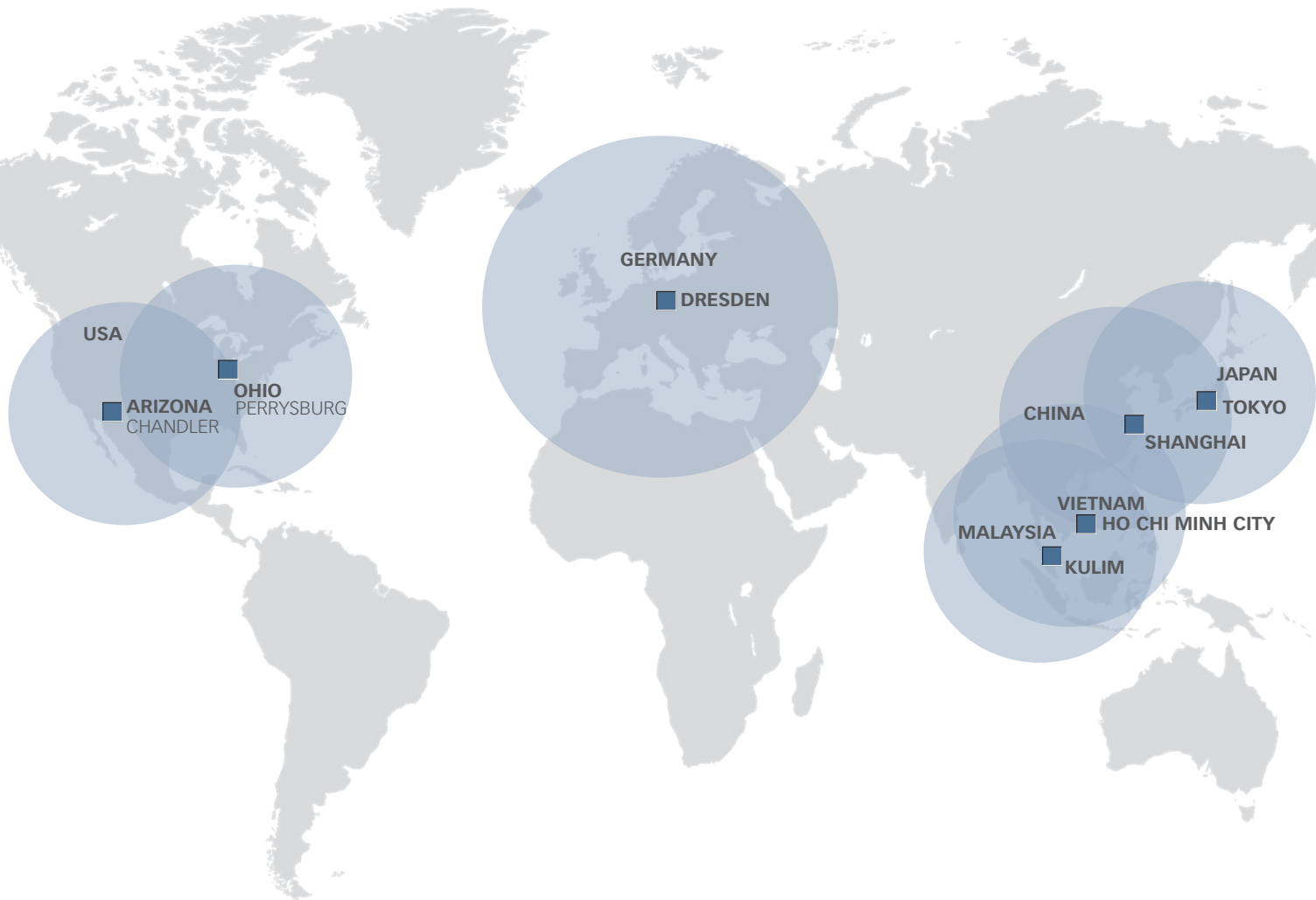
Substrate heating	
Pre-treatment (e.g. Ion etching ...)	
Alternative deposition technologies upon request	

OPTIONAL FEATURES

Automated substrate loading & unloading	
Automated carrier return system	
Controlled heating and cooling unit (CHU)	
Dry air supply (CDA)	
Carrier storage racks	
Others on request	

AUTOMATION OPTIONS

Configuration	single- or double-end
Automation system	fully automatic
Substrate feeding	cassette, box, other



**PRODUCT
TOPICS**



**PRODUCT
INDEX**



COMPONENTS



www.vonardenne.biz

WHO WE ARE & WHAT WE DO

VON ARDENNE develops and manufactures industrial equipment for vacuum coatings on materials such as glass, wafers, metal strip and polymer films. These coatings give the surfaces new functional properties and can be between one nanometer and a few micrometers thin, depending on the application.

Our customers use these materials to make high-quality products such as architectural glass, displays for smartphones and touchscreens, solar modules and heat protection window film for automotive glass.

We supply our customers with technologically sophisticated vacuum coating systems, extensive expertise and global service. The key components are developed and manufactured by VON ARDENNE itself.

Systems and components made by VON ARDENNE make a valuable contribution to protecting the environment. They are vital for manufacturing products which help to use less energy or to generate energy from renewable resources.



**SALES
CONTACTS**



**SERVICE
CONTACTS**

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