

VON ARDENNE 

METAL STRIP COATING SYSTEMS

ADVANCED COATING EQUIPMENT

METAL STRIP COATING SYSTEMS

Applications

VON ARDENNE is a leading manufacturer of metal strip coating systems. These systems are modularly designed, flexible production tools for thin-film coatings.

With the unique combination of our different technologies, highly reflective, highly absorbing and decorative coatings can be created. Furthermore, contact layers or layers to improve corrosion protection can be deposited for a wide range of applications.



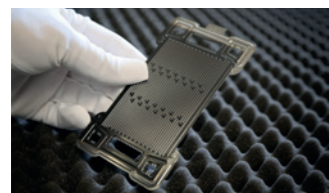
Anti-Corrosion Coatings

Zinc and/or magnesium can be efficiently evaporated on both sides of steel strips using PVD technology. This technology can be used in addition to existing hot dip galvanizing (HDG) or electroplating processes or even replace them altogether. By using ZnMg PVD coating, the corrosion protection can be improved or the thickness of the coating layer thickness can be reduced.



Decorative Coatings

Decorative coatings on metal strip create surfaces that look and feel like high-quality metal at minimum process costs. A wide range of colors can be created, either as surface-colored layers or interference-colored layers. Functional properties can be achieved as well such as protection against corrosion, abrasion and scratches.



Functional coatings for fuel cells

Multiple deposition technologies can be applied on stainless steel substrates to improve the corrosion resistance, minimize the interfacial contact resistance, and to increase the electrochemical stability and the mechanical adhesion of bipolar plates. They are a key component of fuel cells.



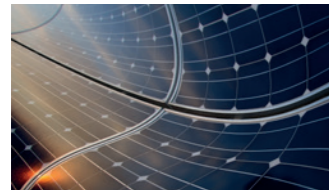
Highly Reflective Mirrors - Lighting Industries

Reflector systems based on highly reflective aluminum or silver allow for maximum light distribution and reduced energy consumption (~20 %) using the same light output.



Highly Reflective Mirrors - Concentrated Solar Power (CSP)

CSP systems generate solar power by using highly reflective mirrors (HRM) to concentrate a large area of sunlight, or solar thermal energy, onto a small area. Electricity is generated when the concentrated light is converted to heat, which drives a heat engine (usually a steam turbine) connected to an electrical power generator.



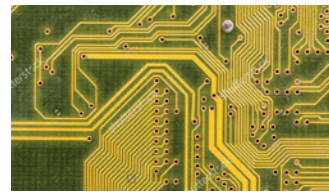
Flexible Photovoltaics

The deposition of functional layer stacks for thin-film photovoltaics on metal strip allows for manufacturing flexible building-integrated photovoltaics (BIPV) modules. The integration of flexible PV sheets into roof elements for buildings improves their environmental impact and has a positive aesthetic effect too.



Solar Absorbers

Metal strip with an absorber coating is used in flat and pressurized tube collectors. They are a centerpiece of solar thermal collectors and absorb sunlight at high efficiency and heats a fluid, which is usually water. Main applications are the heating of buildings and domestic water heating or cooling if used in connection with an adsorption chiller.



Printed Circuit Boards

The surface of copper strip is coated and then further processed to create special printed circuit boards (PCB).

Our strengths in metal strip coating

With more than 55 years of experience in electron beam processes and over 40 years of know-how in vacuum coating, VON ARDENNE is one of the leading providers of equipment and technologies in PVD thin-film technology and vacuum process technology.

We are able to turn product property requirements into efficient and competitive coating solutions, which is an essential precondition for individual machine concepts.

In-house technology & application center

- ... Product & process verification and optimization
- ... Sample coatings of customer applications
- ... Development of customized layer stacks

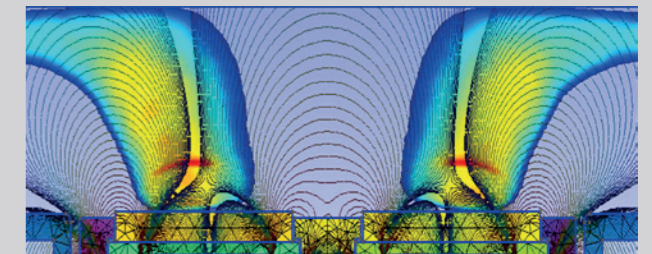
Close partnership

We cooperate with the Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology (FEP).



Professional simulation support

We offer state-of-the-art software tools for the simulation of processes and performance.



Global project experience

We have delivered and assembled our equipment in more than 50 countries.



Comprehensive service portfolio

- ... training tailored to customer requirements
- ... Supporting customer operation processes
- ... Equipment optimization
- ... Preventive maintenance of the equipment
- ... Troubleshooting
- ... Technical audits



Upgrade of existing equipment

We can upgrade your existing systems with new components and application technology.



Key Features and Parameters

Coater type

AIR-TO-AIR

- Entry and exit sections are equipped with dynamic lock roller systems to enable uninterrupted strip movement
- Strip buffer, joining and separation units as well as coilers and uncoilers are placed before and after the coater on atmosphere for continuous production
- Production campaign time is only limited by target / evaporant storage volume inside the vacuum section

BATCH

- Coil load lock chambers at entry and exit of vacuum process section, to be separated with strip valve
- Coils can be loaded and unloaded without interrupting the process vacuum
- Production campaign time is 1 coil, then stop for coil exchange; strip waste approx. 2x length of process section
- EB process is equipped with additional shutter to compensate for the coil exchange

Coating mode

SINGLE-SIDED COATING

- All coating tools are arranged on one side of the strip
- When using electron beam (EB) process, the bottom side of the strip is coated (usually)



TOUCH-FREE COATING OPTION

For sensitive optical coatings, a touch-free machine concept is available.

DOUBLE-SIDED COATING

- No major concept change necessary when using sputtering process only
- When using EB process, a two-level machine is necessary

STRIP MATERIAL

ALUMINIUM

COPPER

STAINLESS STEEL

CARBON STEEL

! Remark: other metals on request

STRIP WIDTH

100 mm ... 2000 mm

STRIP THICKNESS

0.1 mm ... 2.0 mm

STRIP SPEED

0.1 m/min ... 100 m/min

ANNUAL PRODUCTIVITY

up to **10 million m²** coated surface (one side)
up to **1 million t** steel strip

! Please note:
In order to engineer an ideal tool configuration, all dependencies between metal strip dimensions (width, thickness, coil length), layer stack properties (coating materials, layer thickness), strip transport speed (during coating process), and annual productivity need to be considered.

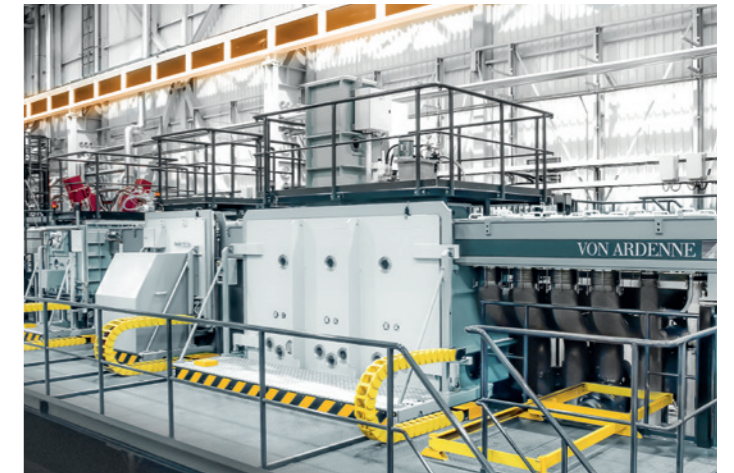
Configuration Examples

We have gained a considerable process expertise from developing and delivering numerous industry-proven metal strip coaters during the last 25 years. Thanks to this know-how, we are able to offer custom-made solutions based on standardized components.

Air-to-air system for narrow substrates

air-to-air metal strip coater consisting of lock systems, plasma pre-treatment and coating chambers, installed in a multifunctional coating line.

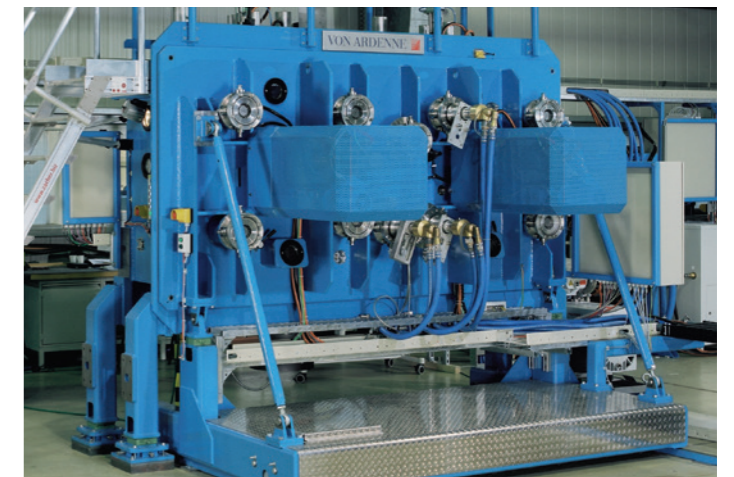
Coater type	air-to-air
Coating mode	single-sided coating
Strip material	stainless steel, carbon steel
Strip width	300 mm
Strip speed	≤ 60 m/min
Strip thickness	0.3 mm to 0.7 mm



Flexible batch system

Batch-type metal strip coater with variable pre-treatment and coating stations, flexible strip guidance for single-sided and double-sided coating, and reverse mode operation.

Coater type	batch
Coating mode	single-sided coating & double-sided coating
Strip material	aluminium, copper, stainless steel, carbon steel
Strip width	300 mm
Strip speed	10 m/min
Strip thickness	0.1 mm to 1.0 mm



High-volume system for wide substrates

high-volume production coater that uses the air-to-air process from coil to coil and that can be continuously operated for up to 120 hours.

Coater type	air-to-air
Coating mode	single-sided coating
Strip material	aluminium, copper, stainless steel
Strip width	900 mm to 1 250 mm
Strip speed	up to 20 m/min
Strip thickness	0.2 mm to 0.8 mm

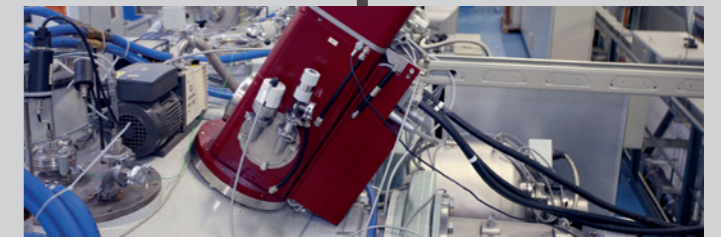
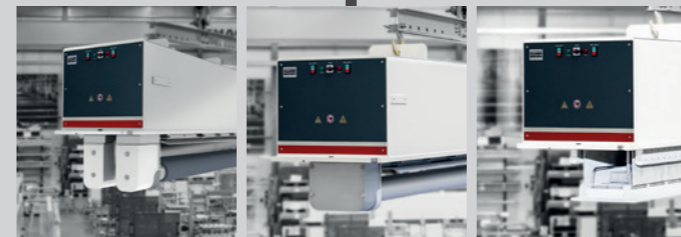
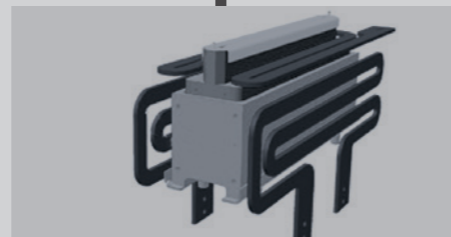
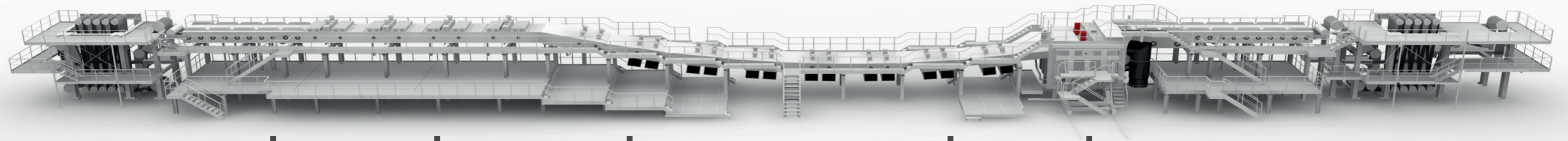


VON ARDENNE key components

The success of our metal strip coating platform rests upon its highly flexible and broad configuration range, our technological experience and know-how, and the key components developed and manufactured by VON ARDENNE.

Depending on the required platform configuration, a VON ARDENNE metal strip coater may include some or even all of these components: Strip lock systems, plasma pre-treatment, magnetrons for sputtering, inline measurement and process control system, electron beam evaporation, and thermal evaporation.

Due to the modular concept of all our metal strip coaters, these components can also be provided as upgrades or retrofits after the initial installation of the equipment.



Strip lock system

The strip entry and exit sections enable the continuous transport of the strip from atmospheric pressure to vacuum and from vacuum back to atmospheric pressure. An array of lock rollers in the entry chamber, which is arranged in the direction of the strip transport, gradually reduces the pressure. In combination with the vacuum pumps, these lock rollers provide the required pressure on the adjacent process compartments. The same is true vice versa for the exit chamber.

Strip valves are located inside the entry and after the process section or between the different processes (e.g. sputtering/ electron beam). Therefore, the entire process section or parts of it can be kept under stable vacuum conditions when the transport is stopped.

Plasma pre-treatment

Substrate surfaces are often contaminated even after atmospheric cleaning processes, for instance with oxides of the substrate material, water film from the environmental air moisture or residual contaminants from wet chemical pre-treatment processes.

Pre-treatment in vacuum is only the last step of cleaning and surface activation in order to achieve substrate surfaces which are ready for vacuum coating. However, it is a key prerequisite for the good adhesion of coatings.

Methods of vacuum pre-treatment:

- Heating (thermal or EB heating)
→ substrate temperature is increased
- Glow discharge pre-treatment
→ removal of water film
- Sputter etching
→ removal of substrate material and surface activation

Thermal evaporation systems

VON ARDENNE can supply different types of thermal evaporators, mainly for evaporating metals with lower melting temperatures, such as magnesium.

Boat evaporators are available for systems with low productivity and R&D coaters. They are distributed over the strip width to achieve the requested coating homogeneity.

Jet evaporators are suited for coaters with a high productivity. They produce a directed stream of a gaseous evaporant directed through a hot channel or distributed by nozzles across the strip width. The hot channel version allows a utilization of up to 90 percent of the evaporant deposited on the strip.

Magnetrons

Thanks to many years of experience gained from designing and installing advanced sputtering equipment, we can offer a complete portfolio for applications ranging from AC to DC processes. Our magnetrons are either planar or rotatable and have a fully integrated gas inlet system.

RSM/RSM - 2X ROTATABLE SINGLE MAGNETRON

RSM/RSM magnetrons have a distinct advantage: Their power is individually adjustable per tube as they have two independent power supplies. The target lifetime can be adjusted to the stoichiometry and campaign time. Furthermore, the thermal impact on the substrate is lower compared to MF technology.

RDM - ROTATABLE DUAL MAGNETRON

Rotatable magnetrons with best coating rates, energy efficiency and material yield are integrated in our metal strip coating systems and guarantee a stable and long-term production campaign. They surpass planar magnetrons in at least four aspects: coating rate (because of higher power limits), target inventory, target utilization and the self-cleaning of the target from parasitic coatings. The latter is particularly important for high insulating dielectric films.

WSM - PLANAR SINGLE MAGNETRON

WSM planar single magnetrons can be operated at low cost for thin-film deposition in a simple metal strip coating process.

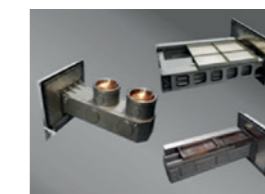
Electron Beam Systems

VON ARDENNE develops and manufactures electron beam systems which are used for the high-rate evaporation of metals, alloys and compounds in our metal strip coaters. The first electron beam gun was developed in 1960 at the Manfred von Ardenne Research Institute. Our more than 55 years of experience are reflected in over 400 electron beam systems installed worldwide.

Each evaporation chamber of our metal strip coating systems is usually equipped with two electron beam guns which are used

- as energy sources for the evaporating process. The guns generate electron beams of high power density which are shot onto the evaporation crucible units.
- to heat up the evaporant which is filled into the crucible. The crucible is on the bottom of the chamber.
- for highly productive coating systems. They offer up to ten times higher evaporation rates than magnetron sputtering.

Electron beam crucibles:



Different crucible types are available. They are mounted on the inside of the evaporation chamber door and are suited for metals, melting and subliming oxides.

OUR STRENGTHS



IN-HOUSE TECHNOLOGY & APPLICATION CENTER

- ... Sample coatings of customer applications
- ... Development of customized layer stacks
- ... Product & process verification and optimization
- ... Testing of new technologies and components



GLOBAL PROJECT EXPERIENCE

VON ARDENNE equipment is used in over 50 countries.

We have established an installed base of hundreds of coating systems worldwide, ranging from small tools to equipment for large-area coating applications for several markets.



CLOSE PARTNERSHIP

VON ARDENNE entertains a close network of partners for even more profound R&D work and to identify future technologies. It consists of:

- ... Fraunhofer Institutes such as IPMS, FEP, IST and ISE
- ... Institutes of the Helmholtz Association (Jülich, Berlin)
- ... Universities (Kiel, Dresden, Sheffield)
- ... Companies such as FAP GmbH, scia Systems GmbH



PROFESSIONAL SIMULATION SUPPORT

We offer professional simulation technology to ensure best process quality with regards to plasma, heat and cooling. Furthermore, our simulation tools help demonstrate, develop and improve layer properties and define or optimize processes, details and the performance of our systems.



COMPREHENSIVE SERVICE PORTFOLIO

- ... VON ARDENNE services hubs around the world
- ... On-site service (on request)
- ... Remote access from our technology department (if required)
- ... Regular technical and technological trainings offered
- ... Spare & wear part warehouse close to customers
- ... Lifecycle extension of wear parts



UPGRADES & RETROFITS

As soon as your business is growing, your VON ARDENNE equipment will grow accordingly - thanks to its modular design and the upgrades we provide. We will also supply you with the necessary technology upgrades if you decide to change your applications.

Furthermore, when your equipment is ageing, we will retrofit your systems with new components, no matter if they are VON ARDENNE or third-party machines.



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.



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