VON ARDENNE

METALLIC BIPOLAR PLATES

VACUUM COATING EQUIPMENT & TECHNOLOGIES

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HYDROGEN

MINIMIZE YOUR MANUFACTURING COSTS

WITH HIGHLY PRODUCTIVE COATING SOLUTIONS

For metallic bipolar plates

As a manufacturer of bipolar plates for PEM fuel cell systems and electrolyzers, you are faced with the challenge of meeting the needs of a rapidly growing market. In addition, you have the task of raising the industrialization of your processes to a new level.

We offer you ideal solutions for cost-effective and highly productive manufacturing, tailored to your current and future requirements.

Our coating systems are based on platforms that allow you to scale from research and development to large-scale production.

Corrosion protection & long lifetime

through electrochemical & mechanical resistance

Improved conductivity

due to reduced interfacial contact resistance (ICR)

Scalable processes

from R&D to mass production at low cost of ownership

Advantages of bipolar plate coating

Bipolar plates should be as durable, conductive and cost-effective as possible. To meet these requirements, metallic bipolar plates are coated with functional layers. PVD technologies are typically used for this purpose.

For the PEM fuel cell, we went one step further and developed and validated our own carbon-based layer stacks. The aim was to meet the demanding range of requirements for bipolar plate coating in an optimal and scalable way.

We will support you from the research and development phase to the establishment of an industrial coating solution for bipolar plates.

SCALABILITY = PRODUCTIVITY

Throughput:
Less than 500k m²/year — **More than 15,000k m²/year**

Cost level:
EUR/BPP — **Cent/BPP**

OPTIONS

COATINGS

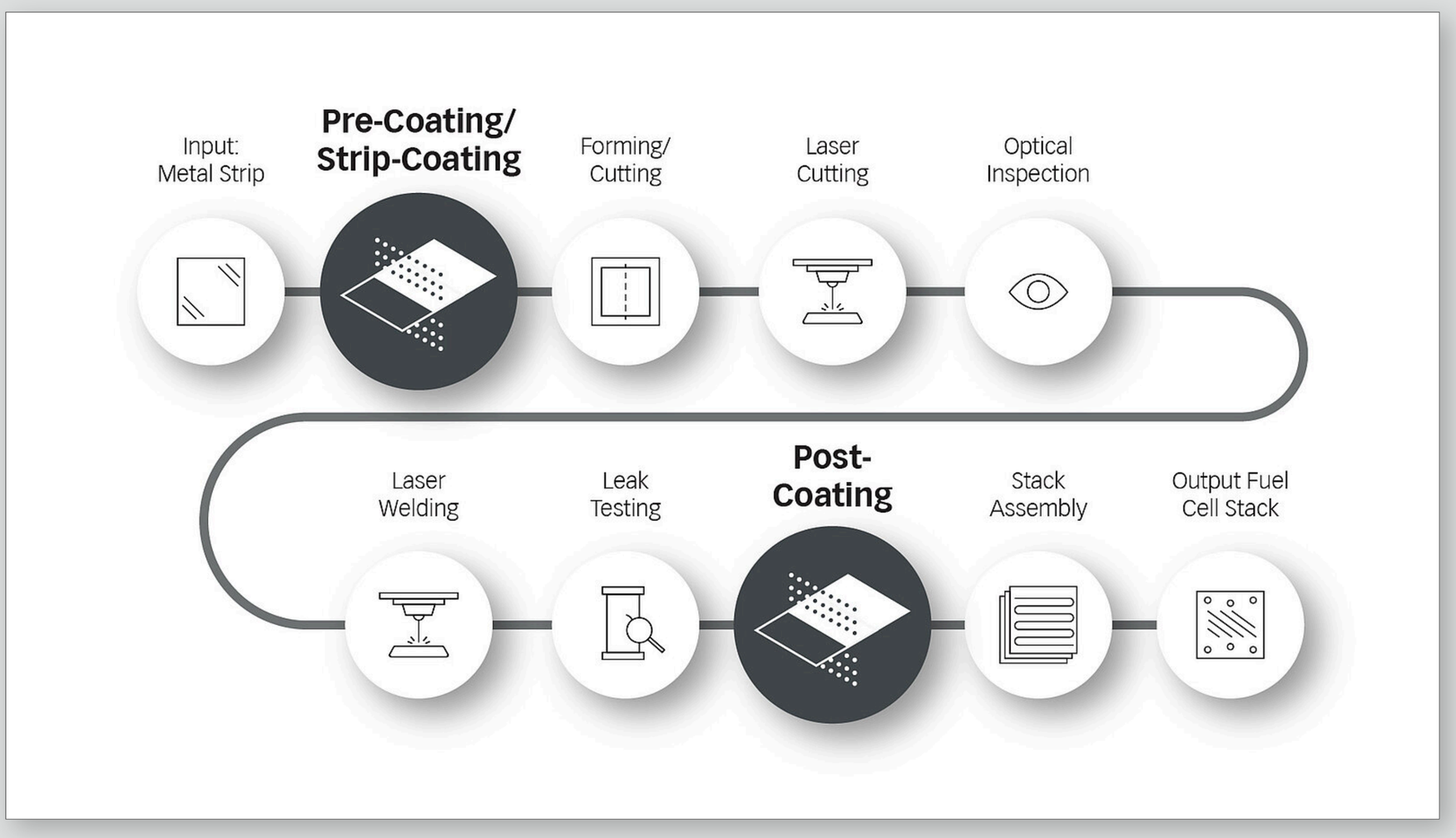
COATINGS FOR METAL STRIP & BIPOLAR PLATES

To offer you optimal pre- and post-coating solutions, we combine our equipment and PVD technology portfolio.

Pre-coating describes the coating of metal strip straight from the coil and focuses on high productivity at unrivaled low cost.

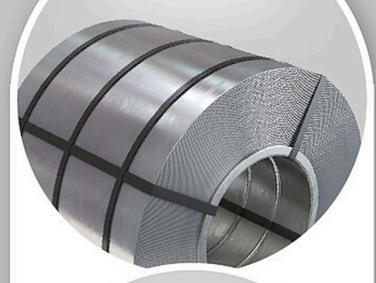
Post-coating, on the other hand, is a more conservative coating approach. Here, completely welded bipolar plates are coated on both outer surfaces while avoiding any interaction of the coating with the forming and welding process.

A third alternative is **mid-coating**, which means that anode and cathode halfplates are coated after the forming process but prior to their assembly into a bipolar plate.

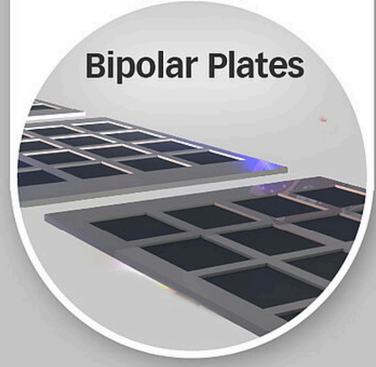


SUBSTRATES

Metal Strip

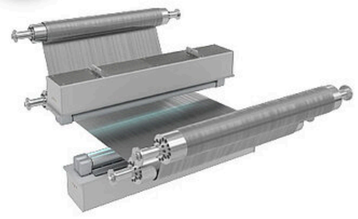


Bipolar Plates

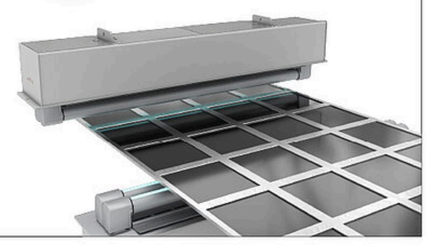


MAGNETRON SPUTTERING

Pre-Coating

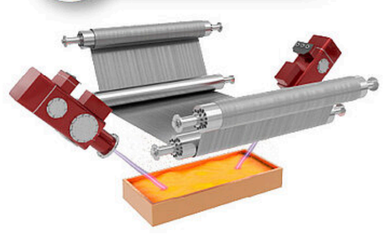


Post-Coating

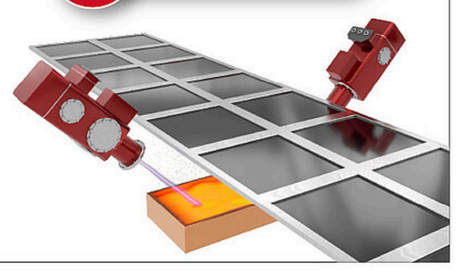


ELECTRON BEAM TECHNOLOGY

Pre-Coating



Post-Coating



EQUIPMENT SOLUTIONS

For the coating of PEM fuel cell and electrolyzer bipolar plates, we can provide a wide range of PVD equipment - from standardized platforms to individual solutions that are tailored to your needs. This portfolio ranges from R&D over pilot to high-volume production equipment for the coating of strip material (roll-to-roll, R2R) and plates (sheet-to-sheet, S2S).

In addition, we offer to discuss your coating requirements with you and to adapt our coater concepts to perfectly match your plate designs and production volumes. Beyond that, we can calculate the total cost of ownership for you.

MSC1250 A2A

Metal Strip Coating System

HISS

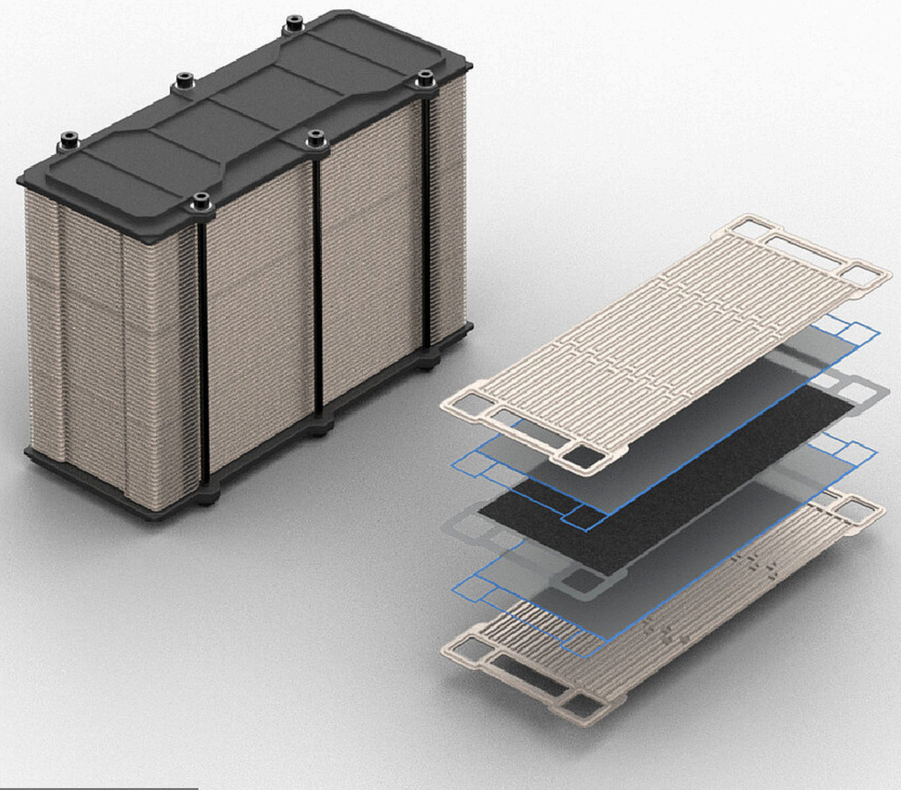
Horizontal Coating System

MSC500B

Metal Strip Coating System

XEA|NOVA® L

Inline Coating System



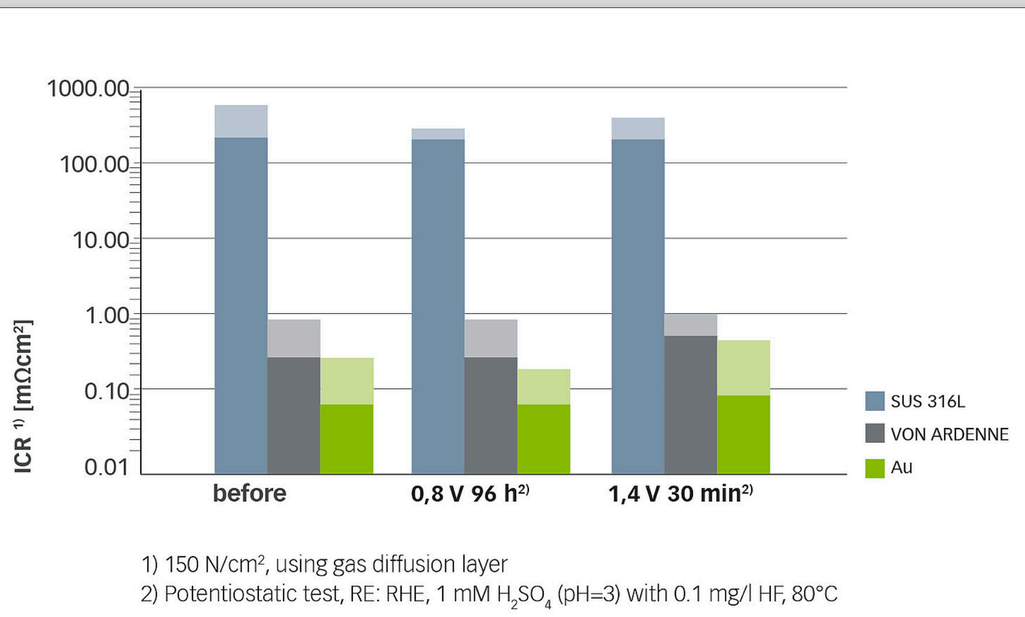
Fuel Cell Stack

PERFORMANCE

COATINGS FOR PEM FUEL CELLS

Our carbon-based layer stacks for PEM fuel cell applications are optimized for a low interfacial contact resistance (ICR), good adhesion and high corrosion resistance. The ICR, corrosion performance and durability of these layer stacks are comparable to the gold reference coating and have been qualified by renowned testing institutes.

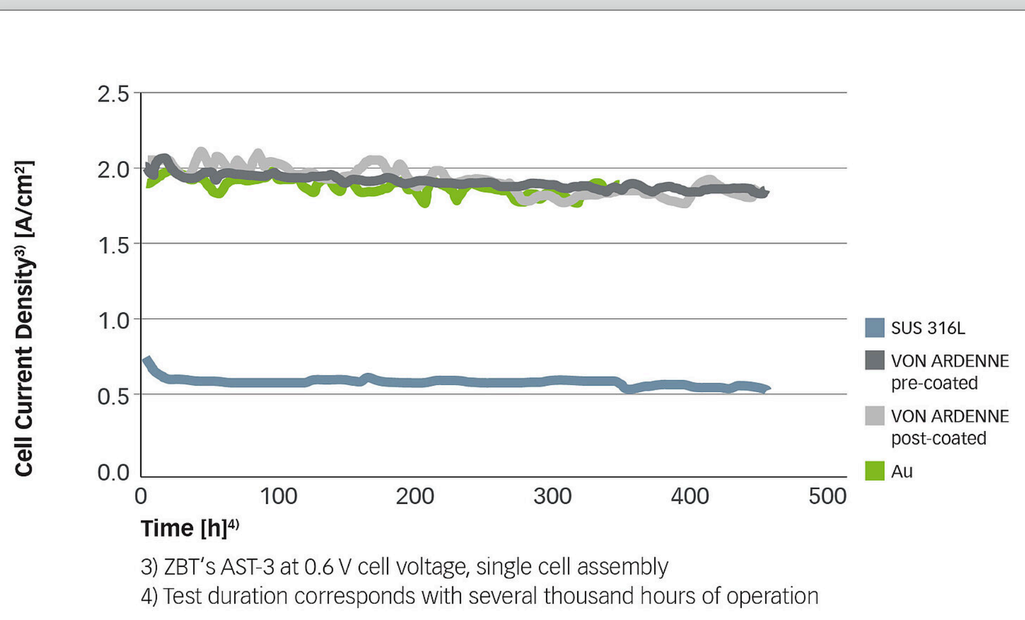
Electrochemical corrosion test with Fraunhofer ISE



1) 150 N/cm², using gas diffusion layer
2) Potentiostatic test, RE: RHE, 1 mM H_2SO_4 (pH=3) with 0.1 mg/l HF, 80°C

VON ARDENNE carbon coatings are corrosion resistant at fuel cell potential. Even after exposure to higher potentials, they show low contact resistance, similar to a gold coating.

Accelerated stress test (AST) with ZBT

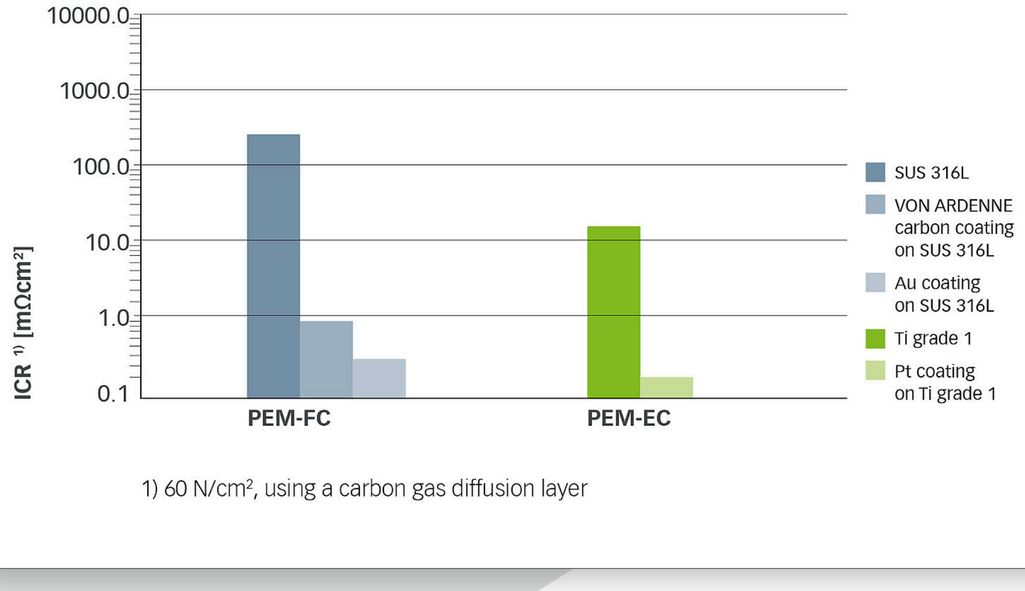


3) ZBT's AST-3 at 0.6 V cell voltage, single cell assembly
4) Test duration corresponds with several thousand hours of operation

In the accelerated stress test, the performance of VON ARDENNE coatings (pre- and post-coating) can also reach the performance of a PVD gold coating.

COATINGS FOR PEM ELECTROLYZERS

VON ARDENNE also offers precious metal coatings for PEM electrolyzer applications. These coatings reduce interfacial contact / through-plane resistance (ICR/TPR) and provide corrosion protection at electrolysis anode potential.



1) 60 N/cm², using a carbon gas diffusion layer

JOINT TESTING, SAMPLING & IMPROVEMENT

FROM SIMULATION TO PILOT PRODUCTION

Sampling & Layer Development

With a wide range of equipment

In our Technology & Application Center, we work with you and for you on the next generation of your coating applications. From the simulation of layer stacks and their functionality, to sample production on a laboratory and pilot scale, to the measurement and evaluation of coating and substrate properties, we are prepared to meet a wide range of requirements. This gives you the opportunity to test the function of the coating for your product in advance on relevant sample sizes.

Gaining knowledge through simulation

of layer composition & properties

Sampling & qualification of properties

from a single source

Targeted integration of coating steps

into your value chain

Technology & Application Center Dresden

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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

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.

Close Partnership

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

- Fraunhofer Institutes
- Institutes of the Helmholtz Association
- Universities
- Companies

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.

Comprehensive Service Portfolio

- VON ARDENNE service hubs around the world
- On-site service
- Remote access by our technology department
- Regular technical and technological trainings
- 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.

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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