

VON ARDENNE 

PACKAGING VACUUM COATING EQUIPMENT & EXPERTISE

**PACKAGING**  
**VACUUM COATING**  
**EQUIPMENT & EXPERTISE**

Barrier coatings for  
flexible packaging  
with highly productive  
vacuum coating systems

# BARRIER COATINGS FOR FLEXIBLE PACKAGING

with highly productive vacuum coating systems

The importance of packaging materials is often neglected or questioned. Nevertheless, they play a crucial role. Packaging materials are not only needed to transport the contents. They also protect them from external influences.

Barrier layers are used to protect a product from environmental conditions such as water vapor or oxygen. Vacuum deposition is one way to apply these layers to flexible substrates. Applications range from packaging for highly sensitive electronic components, such as LEDs or solar cells, to food packaging. Different processes are used depending on the requirements of the market.

VON ARDENNE offers roll-to-roll solutions for the next generation of barrier layers on flexible polymer films with PVD technologies for various applications. For example, together with several research institutions, we have developed sputtering processes for effective high-barrier layers for the packaging of electronic components.

However, our main focus is on transparent SiO<sub>x</sub> barrier layers for sustainable food packaging. With our roll-to-roll coating systems, our customers are able to meet the requirements of their markets.

In-house development capabilities and know-how



Adapting equipment design to specific requirements of customers

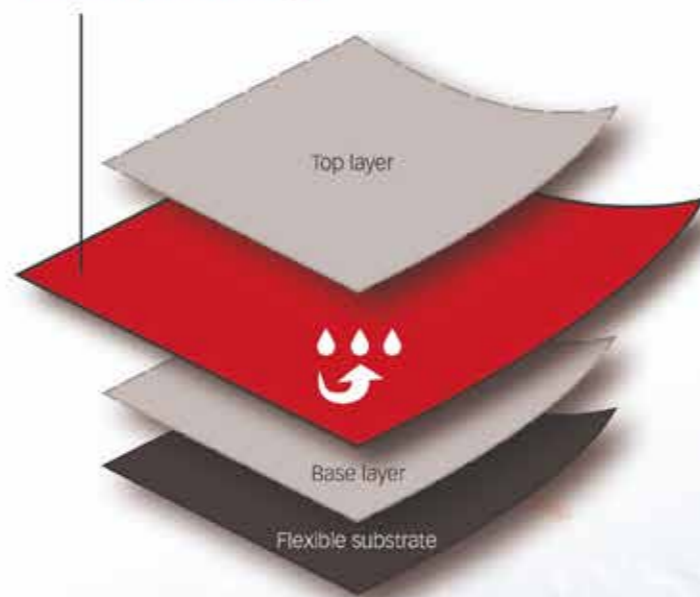


Scalable platforms for highly productive equipment



## Transparent SiO<sub>x</sub> Barrier Layers

SiO<sub>x</sub> barrier layer applied by VON ARDENNE electron beam technology



Our SiO<sub>x</sub> barrier layer enables recyclable and metal-free packaging for a sustainable future. And it meets the upcoming regulations.



### SIOX-COATED BOPP

WVTR [g/(m<sup>2</sup> d)] 0.3\* [UNCOATED BOPP: 6.8]

OTR [cm<sup>3</sup>/(m<sup>2</sup> d bar)] 2.1\* [UNCOATED BOPP: 1060]

\*depending on substrate



# RECYCLABLE FOOD PACKAGING

Sustainable mono-material packaging through transparent barrier layers

The development of sustainable food packaging has gained enormous importance in recent years. And flexible packaging with transparent vacuum barrier layers plays a major role.

This monomaterial packaging saves weight and can be recycled in an energy-saving manner. As a result, they have a lower carbon footprint compared to rigid packaging made of metal or glass. And compared to aluminum-coated films, monomaterial films have the advantage of being easier to recycle.

Of course, the main task of the packaging must also be guaranteed: to ensure a long shelf life. Therefore, it is necessary to develop monomaterial packaging that offers sufficiently high barrier properties against water vapor and oxygen while maintaining good flexibility. These are precisely the properties exhibited by polymer films coated with SiO<sub>x</sub> by roll-to-roll vacuum deposition.



In-house Technical Application Center & know-how for process development & sampling



Highest productivity through world leading electron beam technology



Fast & easy maintenance due to optimized system design



FOBA Roll-to-Roll Vacuum Web Coating System




# FOBA


## HIGHLY PRODUCTIVE ROLL-TO-ROLL COATING


in excellent quality

FOBA systems are roll-to-roll coating systems for flexible substrates. They are a good choice if you want to deposit functional coatings at high rates on polymer film or metal foil. They use proven VON ARDENNE electron beam evaporation technology. FOBA systems are ideal for high-volume production. They are available for applications requiring one or two electron-beam deposition layers.

You can rely on our many years of experience in providing vacuum coating equipment for large-area coatings. We have incorporated this experience and our know-how in technology and substrate handling into this platform.

**Highest productivity**   
through world-leading electron beam technology

**Outstanding product quality**   
through closed-loop process control

**Low downtime**   
due to quick & easy maintenance



**MINDIGO** 

**DIGITAL SERVICES & PRODUCTS**

<b>PROCESS SUITE</b> Automation & Monitoring	<b>ANALYSIS SUITE</b> Data Review & Analysis	<b>SERVICE SUITE</b> Smart Services
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## APPLICATIONS



Recyclable Food Packaging



Lithium-Ion Batteries



## TECHNICAL DATA

Subject to change without notice due to technical improvement.

### Variety of substrate materials

e.g. PET, PP, PA, PE, PLA, pre-coated paper

### Substrate thickness range

4.5 µm to 200 µm

### High operation speed

up to 1200 m/min

### Good coating width

max. 2800 mm

### Coating materials

metals (eg. Al, Cu, Ti, ...) and oxides (SiO<sub>x</sub>, AlO<sub>x</sub>, ...)

### Typical thickness non-uniformity

< +/- 8 %

### Coil outer diameter

max. 1250 mm

### Coil length

max. 100 000 m (at 12 µm substrate thickness)

### Pre-treatment

several options available

### Closed-loop layer thickness control

implemented

# ELECTRON BEAM SYSTEMS

## HIGH POWER FOR HIGH QUALITY

in melting & evaporation

With the EH150V, EH 300V and EH800V electron beam guns, we offer you components for high-performance applications. This applies to melting and refining as well as evaporation of metals, alloys and composites.

As our customer, you will benefit from the comprehensive know-how we have acquired through more than 400 electron beam systems in operation all over the world. It includes beam generation, generator technology, beam focusing and digital beam deflection processes. These processes enable dedicated power distribution and timing control on the area impacted by the electron beam.

At our Electron Beam Technologies Development Center, we are striving to continuously improve our key components. Here, we also manufacture and test our high-quality electron beam guns.

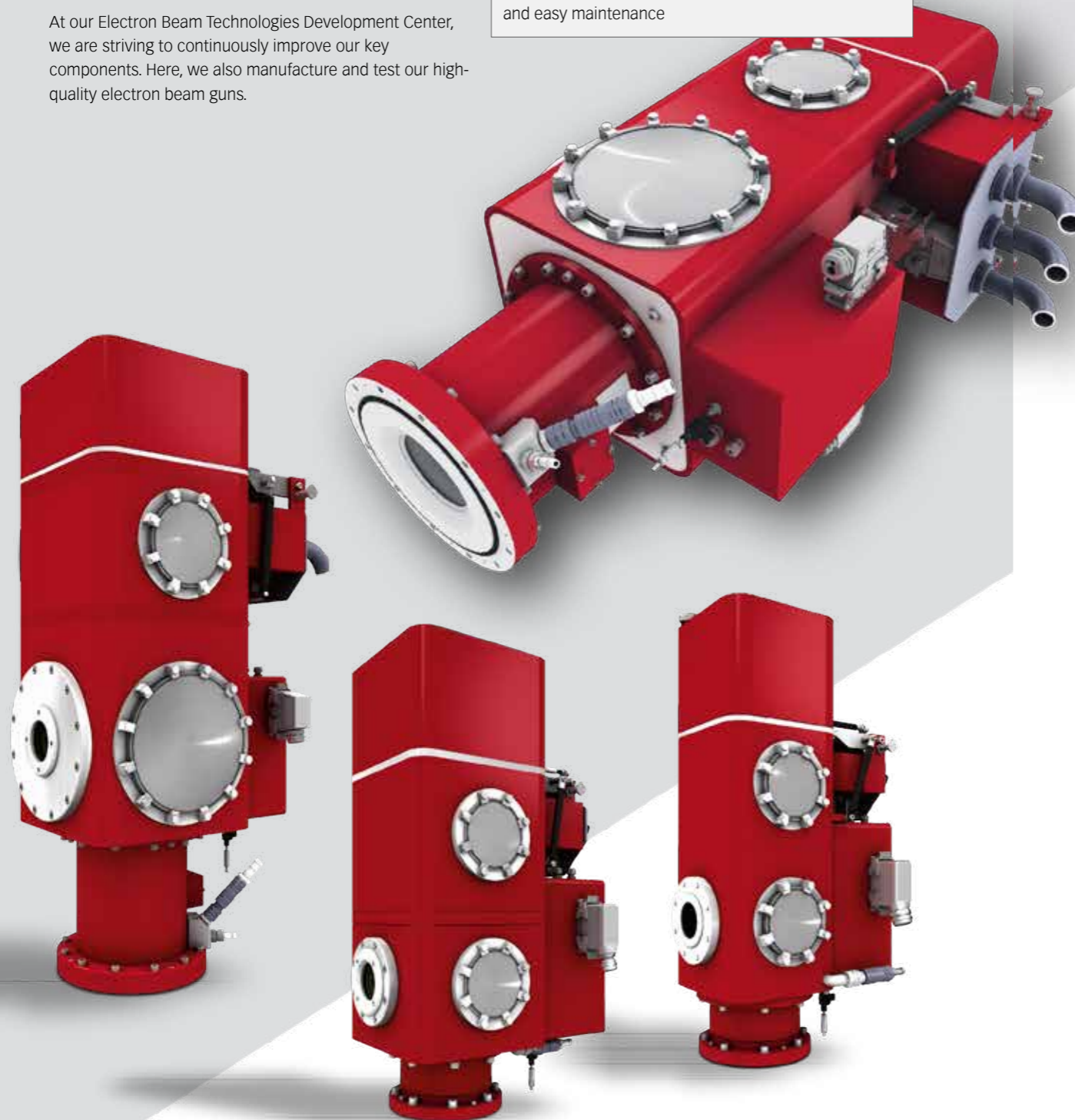
Reliable & proven  
as a series product in many applications



Modular design  
with clear interfaces for system integration



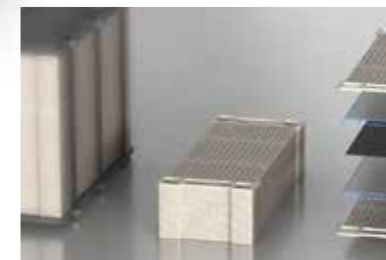
Simple handling  
and easy maintenance



## APPLICATIONS



Recyclable Food Packaging



Metallic Bipolar Plates



Lithium-Ion Batteries



Turbine Blades



## TECHNICAL DATA

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	EH150V	EH300V	EH800V
<b>Maximum beam power</b>	150 kW	300 kW	800 kW
<b>Beam power control range</b>			
Power control by VARIOCATHODE (space charge limited mode)	~ 20 % to 100 %	~ 20 % to 100 %	~ 20 % to 100 %
Power control by bombardment power (temperature limited mode)	~ 0 % to 20 %	~ 0 % to 20 %	~ 0 % to 20 %
<b>Max. acceleration voltage</b>	35 kV	45 kV	60 kV
<b>Average lifetime of cathodes at max. beam power</b>	100 h to 200 h	100 h to 200 h	200 h to 300 h
<b>Maximum deflection angle</b>			
1 kHz system (coil/amplifier)	± 40°	± 40°	± 45°
10 kHz system	± 25°	± 25°	± 25°
20 kHz system	-	-	± 40°
<b>Minimum spot diameter (at distance of 1 m, max. beam power and max. acceleration voltage)</b>			
At process pressure of 5*10 <sup>2</sup> Pa	≈ 10 mm	≈ 15 mm	≈ 30 mm
At process pressure of 5*10 <sup>1</sup> Pa	≈ 15 mm	≈ 20 mm	≈ 50 mm
<b>Maximum process pressure</b>	≈ 5 Pa	≈ 5 Pa	≈ 2 Pa
<b>Recommended size of vacuum pumps</b>			
Turbomolecular pump at cathode chamber	300 l/s	300 l/s	500 l/s
Turbomolecular pump at cathode chamber	300 l/s	300 l/s	1600 l/s
Roughing pump for both turbomolecular pumps	20 m <sup>3</sup> /h	20 m <sup>3</sup> /h	35 m <sup>3</sup> /h
<b>Pump-down time</b>	< 10 min	< 10 min	< 15 min
<b>X-ray leakage</b>	< μSv/h	< μSv/h	< μSv/h
<b>Total cooling water consumption</b>	0.5 m <sup>3</sup> /h	0.5 m <sup>3</sup> /h	2.2 m <sup>3</sup> /h
<b>Compressed air supply (dry)</b>	0.5 MPa	0.5 MPa	0.5 MPa
<b>Height (with closed lid)</b>	900 mm	1010 mm	1400 mm
<b>Maximum radius (without vacuum pumps)</b>	350 mm	350 mm	400 mm
<b>Weight</b>	150 kg	190 kg	550 kg
<b>Connection flange of the gun</b>	DN 160 ISO-F	DN 160 ISO-F	DN 250 ISO-F
<b>Connection flanges for vacuum pumps</b>			
Cathode chamber	DN 100	DN 100	DN 160
Intermediate chamber	DN 100	DN 100	DN 250

## MATERIALS [SELECTION]

**Metals (reactive):** e.g. Al, Ti, Ni, Cu, Cr

**Metals (refractory or high-melting):** e.g. Mo, Ta, Nb, Zr, Hf, V

**Precious metals:** e.g. Ir, Rh

**Alloys:** e.g. Ti<sub>6</sub>Al<sub>4</sub>V and many others (e.g. for aerospace)

**Metal oxides:** e.g. Al<sub>2</sub>O<sub>3</sub> (e.g. packaging), ZrO<sub>2</sub> (e.g. TBC) and many others

# 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.

# WORLDWIDE SALES AND SERVICE

VON ARDENNE GmbH (headquarters) | Am Hahnweg 8 | 01328 DRESDEN | GERMANY

Sales: +49 (0) 351 2637 189 | [sales@vonardenne.com](mailto:sales@vonardenne.com)

Service: +49 (0) 351 2637 9400 | [support@vonardenne.com](mailto:support@vonardenne.com)

VON ARDENNE Vacuum Equipment (Shanghai) Co., Ltd. | +86 21 3769 0555 | [sales-vave@vonardenne.com](mailto:sales-vave@vonardenne.com); [support-vave@vonardenne.com](mailto:support-vave@vonardenne.com)

VON ARDENNE Malaysia Sdn. Bhd. | +60 4408 0080 | [sales-vama@vonardenne.com](mailto:sales-vama@vonardenne.com); [support-vama@vonardenne.com](mailto:support-vama@vonardenne.com)

VON ARDENNE North America, Inc. | Ohio office | +1 419 386 2789 | [sales-vana@vonardenne.com](mailto:sales-vana@vonardenne.com); [support-vana@vonardenne.com](mailto:support-vana@vonardenne.com)

VON ARDENNE Vietnam Co., Ltd. | +84 28 6272 3189 | [sales-vavn@vonardenne.com](mailto:sales-vavn@vonardenne.com); [support-vavn@vonardenne.com](mailto:support-vavn@vonardenne.com)

VON ARDENNE India Pvt. Ltd. | [sales-vaid@vonardenne.com](mailto:sales-vaid@vonardenne.com); [support-vaid@vonardenne.com](mailto:support-vaid@vonardenne.com)

