



VACUUM COATING EQUIPMENT & PRE-TREATMENT SYSTEMS

for Hydrogen Applications,
e.g. Bipolar Plates &
Electrolyzers

SINGULUS 

High Volume Production Systems

Advanced Vacuum Coating & Pre-Treatment Processes for Successful Manufacturing of Bipolar Plates for Fuel Cells and Electrolyzers

Introduction Hydrogen

GREEN HYDROGEN – POWERING THE FUTURE OF CLEAN ENERGY

As the world accelerates efforts to combat climate change and reduce dependence on fossil fuels, green hydrogen is emerging as a key solution in the energy transition. Its potential spans multiple industries, including electrolysis, transportation, and power generation. At the core of a sustainable hydrogen economy are electrolyzers and fuel cells. Electrolyzers efficiently produce hydrogen, with Proton Exchange Membrane (PEM) electrolysis being the preferred method for generating high-purity hydrogen from water and renewable electricity. Fuel cells, in turn, convert hydrogen into electricity, enabling emissions-free mobility and energy production. A critical component in fuel cells are coated bipolar plates (BPP), which play a fundamental role in driving efficiency and performance. These advanced materials are paving the way for a cleaner and more sustainable energy future.

Streamlined Inline Vacuum Coating Systems with Vertical & Horizontal Substrate Transport

HIGH-PERFORMANCE COATINGS FOR HYDROGEN APPLICATIONS

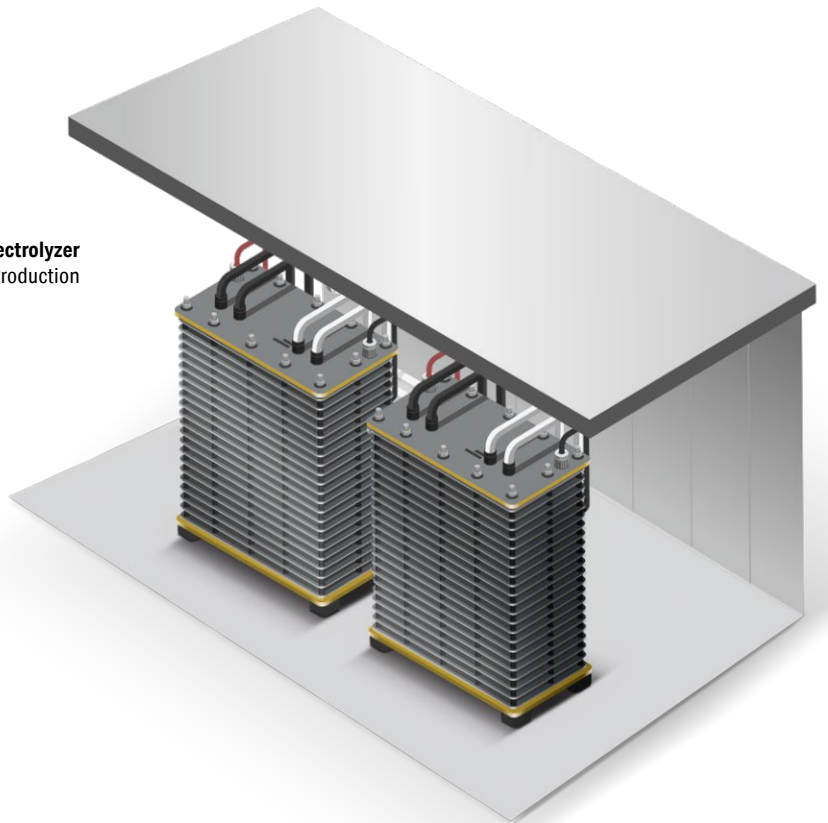
As the demand for green hydrogen grows, fuel cells and electrolyzers play a pivotal role in the energy transition. A key component in both technologies is the bipolar plate, which ensures efficient gas distribution, electrical conductivity, and durability. High-performance coatings are essential to enhance corrosion resistance, improve conductivity, and extend the lifetime of these critical components.

SINGULUS TECHNOLOGIES develops and manufactures advanced vacuum coating systems for the production of bipolar plates used in fuel cells and electrolyzers. Our inline PVD sputtering systems, including the VISTARIS PVD with vertical substrate transport and the GENERIS PVD series with horizontal substrate transport, enables the deposition of nanometer-precise high-purity specialized layer systems on metallic and composite substrates. These coatings optimize the electrical and chemical properties of bipolar plates, ensuring high efficiency and long-term stability in hydrogen applications.



VISTARIS PVD Inline Sputtering System
with Vertical Substrate Transport

Electrolyzer
Example for Hydrogen Production



Leveraging our expertise in thin-film deposition from the solar industry, SINGULUS TECHNOLOGIES provides cutting-edge solutions for large-scale manufacturing. Our PVD coating technologies enable the production of durable, high-performance bipolar plates, paving the way for efficient and sustainable hydrogen energy systems.

TYPICAL PERFORMANCE CHARACTERISTICS

- » Parallel processing of several substrates, different substrate sizes possible
- » Modular configuration, manual or semi-automated lab versions on request
- » Low cost of ownership and high uptime
- » Efficient substrate pre-treatment
- » Substrate heating before and during the deposition process
- » Dual side sputtering
- » Sputter sequence configurable
- » Rotatable cylindrical magnetrons for highest utilization of target material
- » Dedicated precious metal collection and full recycling supply chain

PVD SYSTEMS

Important Technical Data

Low Throughput

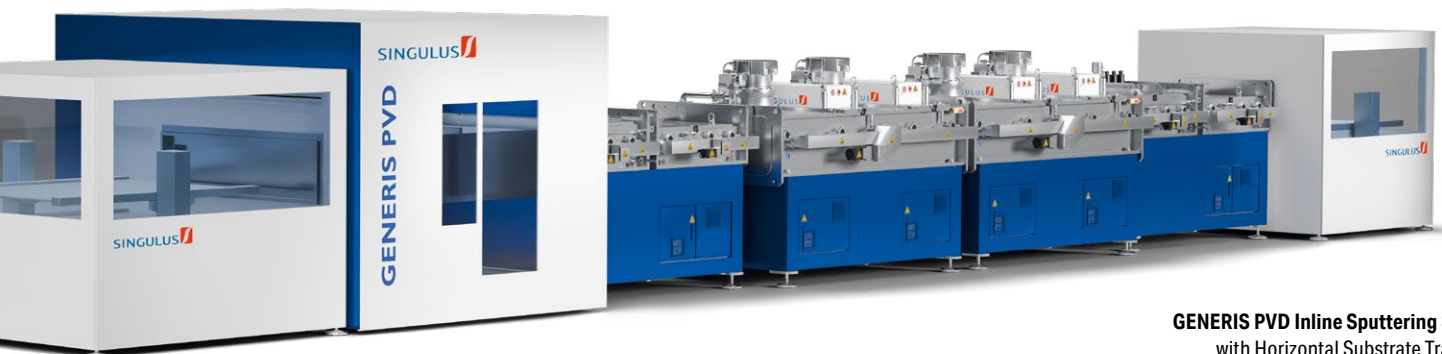
Deposition area	Approx. 510 x 1,600 mm
Transport mode	Multipass inline, Single/double ended

High Throughput

Deposition area	Approx. 850 x 1,600 mm
Transport mode	Inline, double ended

Ultra High Throughput

Deposition area	Approx. 1,400 x 1,600 mm
Transport mode	Inline, double ended



GENERIS PVD In-line Sputtering System
with Horizontal Substrate Transport



SILEX BPP Inline Wet Processing System
Pre-Treatment and Conditioning System

SILEX BPP Inline Wet Processing System

PRE-TREATMENT AND CONDITIONING SYSTEM FOR BIPOLAR PLATES

When addressing the surface treatment demands in hydrogen technology, SINGULUS TECHNOLOGIES excels with the pre-treatment system SILEX BPP, a reliable and field-tested solution. This modular inline system can be custom-tailored to meet the specific needs of each customer, ensuring unparalleled reliability and precision in its operations. A key advantage is its ability to deliver consistently prepared substrates, regardless of the quality variations in the incoming materials. This consistency guarantees uniform conditions for follow-up processes, thereby enhancing the performance of the final product.

SINGULUS TECHNOLOGIES stands at the forefront of cutting-edge solutions in wet processing, catering to the demands of high-efficiency applications across various industries. With a focus on innovation and versatility, our modular wet processing systems are engineered to deliver a diverse range of process options, ensuring adaptability to evolving technological needs.

Our machine concept embodies a commitment to meeting both present and future requirements

of capacity, flexibility, and reliability, making it an ideal choice for mass production environments. By leveraging advanced engineering and design principles, we provide solutions that not only meet industry standards but also anticipate and exceed the expectations of our customers.

SINGULUS TECHNOLOGIES wet processing systems have garnered a reputation for reliability and market-proven performance, offering a process guarantee tailored to the unique needs of each customer application.

SYSTEM DESCRIPTION AND FEATURES

- » Dedicated pre-treatment sequences for subsequent deposition processes
- » Matched throughput and substrate condition for vacuum deposition machine platforms and other post processes
- » Compatible for different substrates sizes and materials
- » Focus on low OPEX costs
- » High uptime with maintenance friendly access to installation area
- » Advanced process control by onboard data tracking
- » Wide range of optional features to support and adapt the pre-treatment process

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