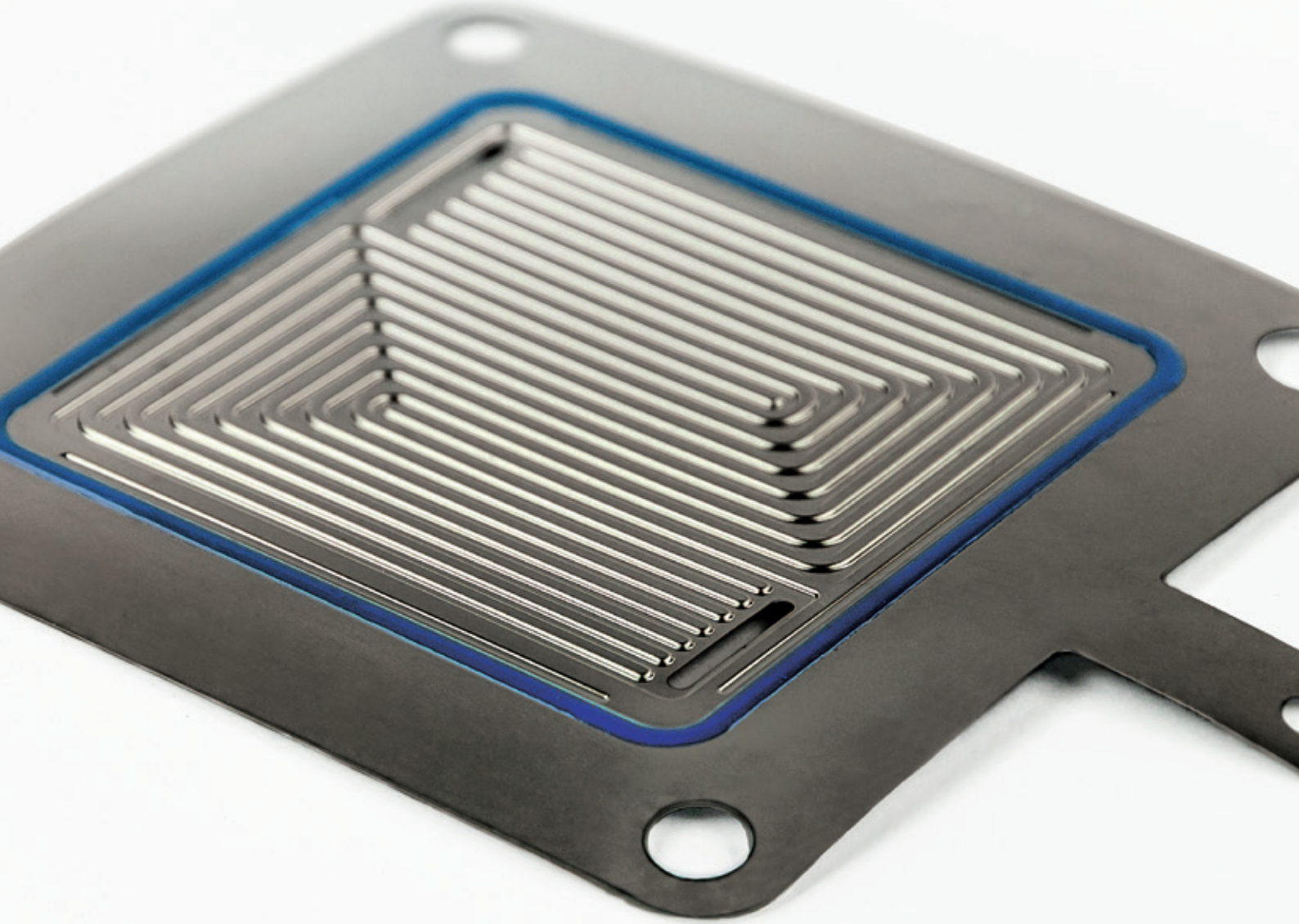
FUEL CELL CARBON TECHNOLOGY



IHI GROUP

THE SURFACE ENGINEERS™ ionbond

FUEL CELL - CARBON

Low cost coating for metallic bipolar plates

The global hydrogen economy is expanding at a fast pace. To support this expansion, the demand for fuel cells for automotive applications is expanding as well. In order to gain acceptance, fuel cell stacks need to meet some tough requirements. They need to show stable, reliable performance at high demand levels over time. In addition to these performance and durability requirements, they need to achieve acceptable price performance levels.
In the automotive industry, the Polymer Electrolyte Membrane (PEM) stacks are moving from graphite towards the use of titanium and stainless steel bipolar plates, which provide the right mix of formability, mechanical properties and affordability.

In the 1990s automotive suppliers started to use plasma coatings to reduce wear and friction in their engines. Ionbond has been collaborating with the leaders in the market to develop the most productive coating concepts offering the best coating performance. Today, Ionbond is known for providing the highest performing carbon-based coatings for many applications.

The fundamentals

The carbon coating is needed to enable electrical conductivity and to protect the stainless steel bipolar plates from leaching metals into the cell and poisoning the functionality of the membrane, leading to reduced performance of the stack over time. The carbon coating is deposited by the well-proven sputter PVD technology.
Good performance in terms of adhesion, conductivity and corrosion resistance are obtained by implementing plasma surface cleaning and a special metal-based adhesion layer in the total coating solution. The carbon coating process is optimized to enable good durability during normal automotive operating conditions, and to withstand high voltage peaks that may occur during cold start events.

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Test condition	Performance	Interfacial Contact Resistance (mΩcm²) **
Fresh	Initial quality test	0.7 ± 0.7
0.0 V for 24 h	Anode side	1.4 ± 0.9
0.8 V for 24 h	Cathode side	1.0 ± 0.8
1.4 V for 10 min	Cold start conditions*	3.4 ± 0.8
1.4 V for 1 h	Extreme conditions	6.2 ± 1.4
	*voltage peaks > 1.4 V can occur during 10 min (cumulative) over the 5000 h fuel cell stack lifetime (depending on flow management)	**needs to be < 10 mΩcm² acc. to DOE protocol 2017

All tests conducted by Fraunhofer ISE.
Electrolyte formulation: 1 mM H_2SO_4 (pH≈3) with 0.1 mg/l HF. Test conditions: 80 °C, Ar saturation during 0.0 V; O_2 saturation during 0.8 V and 1.4 V.
All potentials refer to the reversible hydrogen electrode.