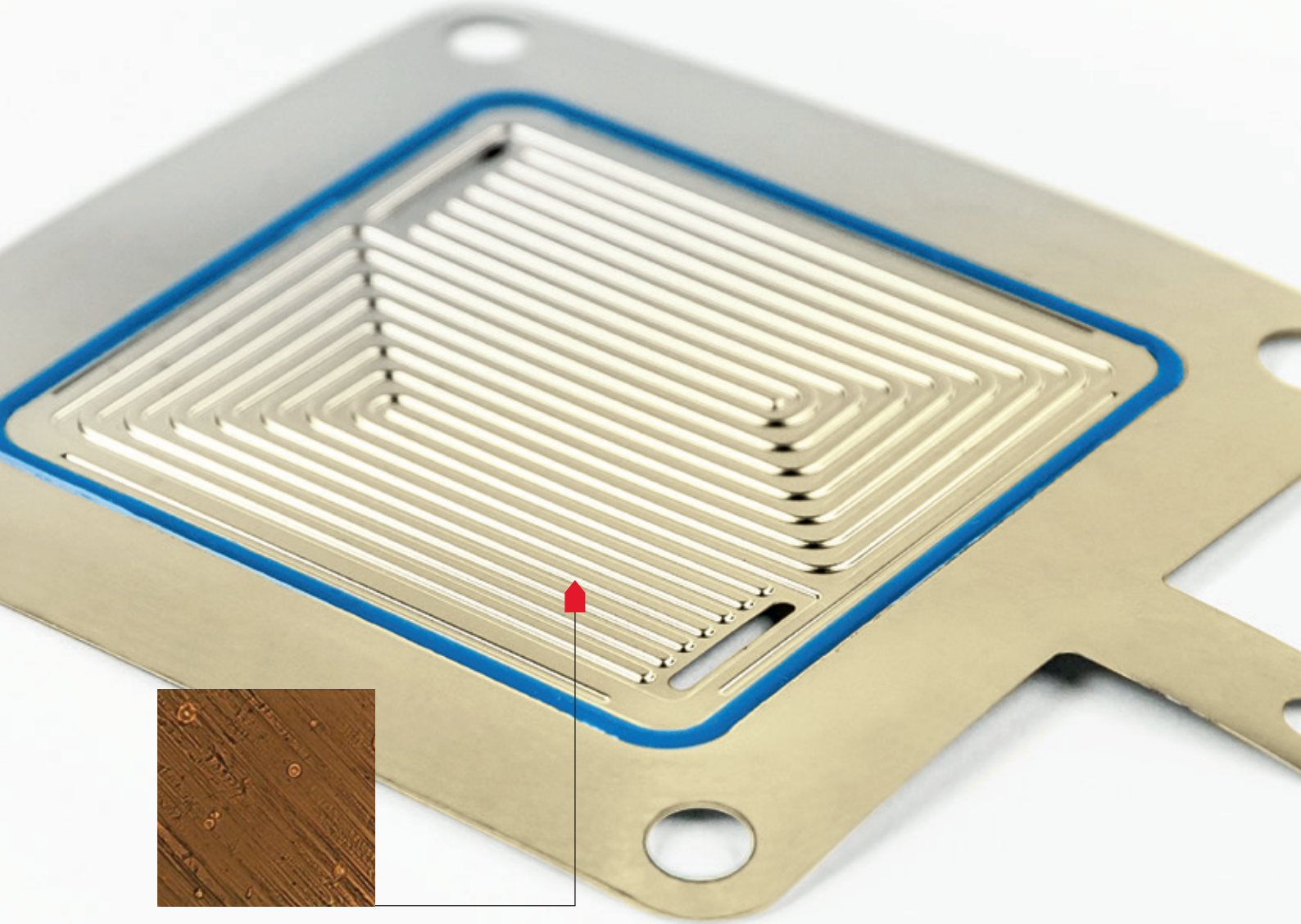
FUEL CELL DOT™ TECHNOLOGY



IHI GROUP

THE SURFACE ENGINEERS™ ionbond

FUEL CELL - DOT™

Superior and 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 and electrolyzers 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 a number of applications, the Polymer Electrolyte Membrane (PEM) stacks are moving from graphite towards the use of titanium and stainless steel bipolar plates. Particularly stainless steel for fuel cells has the right mix of formability, mechanical properties and affordability.

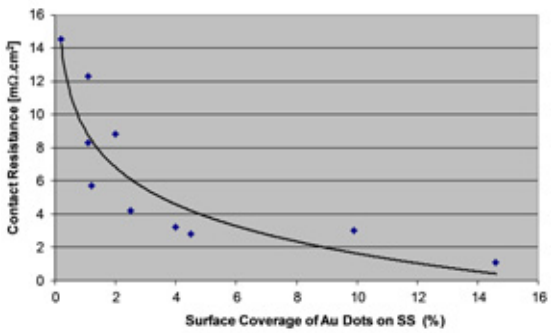
The fundamentals

The DOT™ technology is a duplex treatment. A coating is needed to protect the stainless steel bipolar plate from leaching metals in to the cell and poisoning the functionality of the membrane, leading to reduced performance of the stack over time. The initial layer is based on titanium deposited by the well-proven sputter PVD technology.

The second step is based on thermal spraying 'DOTs' of a noble metal. Because of the thermal spray temperature, the exposed titanium will form a corrosion resistant titanium oxide, and the noble metal DOTs fuse to the metallic surface, thereby providing excellent adhesion and conductivity.

A solid gold coating is seen as the reference as it offers the necessary corrosion resistance in parallel with low, steady electrical resistance. As the DOTs are in direct contact with the fuel cell membrane, they are the highly conductive pathways for the cell's electrical current. The electrical resistance is set by the total surface area coverage by the DOTs, but 2 to 6% surface area coverage with gold DOTs gives comparable results as solid gold coating with 100% coverage.

The reduced use of noble metals makes the DOT™ technology an affordable solution while maintaining high technical performance levels.



Interface contact resistance (ICR) of stainless steel plate with SGL 24BA at 150 PSI (1.03 MPa) vs. surface coverage of Au DOTs.

20 Cell Stack Test Interface Contact Resistance (mΩ.cm²)					
Plate	A	B	C	D	
Time (hrs.)	500	1000	1500	2000	Average
Start of test	4.55	4.25	3.71	4.06	4.21
End of test	2.95	3.61	2.97	2.84	3.20
Conditions: Proprietary 2000 hour Dynamic Cycling Test Protocol					

Technical Data

Interface Contact Resistance (ICR)	< 10 mΩ.cm²
Pressure at which ICR measured	150 to 200 PSI
Expected life time with low ICR	> 5000 hours
Coating thickness	< 200 nm
DOTs Material (Thermal sprayed)	Gold (Au)
Thickness of the Gold DOTs (average)	100 nm
Diameter of the Gold DOTs (average)	1 to 8 µm
Color	Gold

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