

qSOFC

Automated mass-manufacturing and quality assurance of Solid Oxide Fuel Cell stacks

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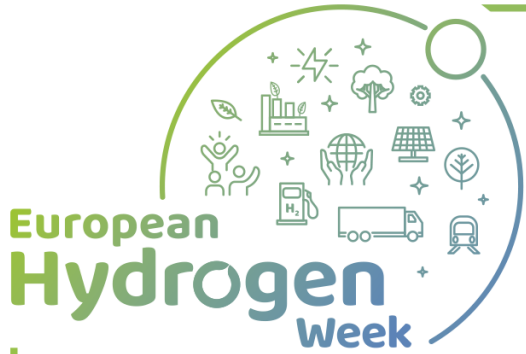
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qSOFC project (2017-2020)

- Develop mass manufacturing and quality assurance methodology for key parts of SOFC stack manufacturing value chain
 - Interconnects (steel, coating, ic-manufacturing, quality control, tracing)
 - Cells
 - Stacks
- Target: 50 MW/year stack production volume at 1000 €/kW

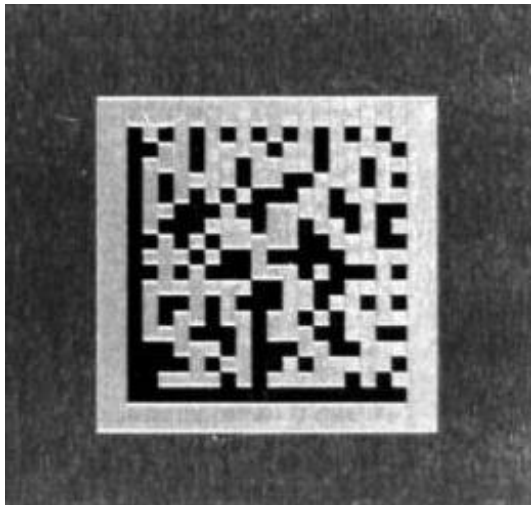
Interconnect manufacturing Challenge

- No faulty interconnects allowed in stacks => fault detection needs to be 100%
- Interconnect usually consists of several parts, some of them coated
- Steel parts need to go through a series of processing steps



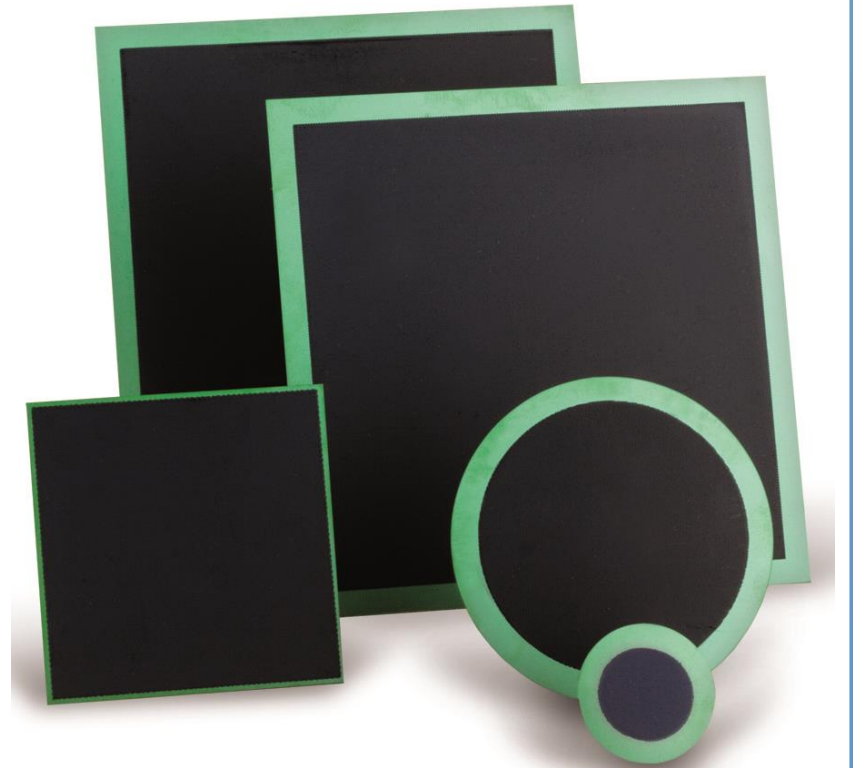
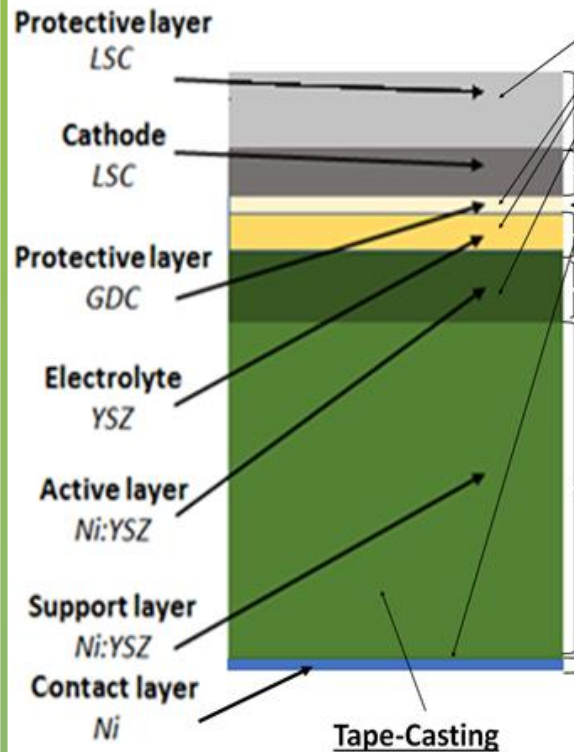
Interconnect manufacturing Solution

- Failure mode and effect analysis carried out of the whole interconnect manufacturing process
 - Processes modified throughout to allow fault detection
 - Improved production yield
- Data matrix coding (DMC) of the interconnects
 - Full backward traceability
- Steel production and coating lines at Sandvik are ready for mass-manufacturing volumes



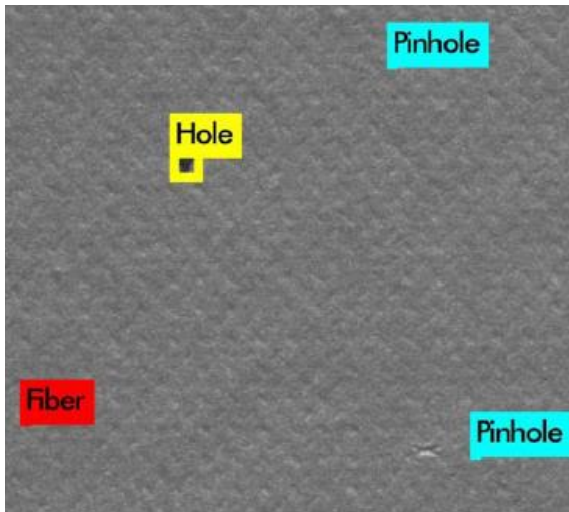
Cell manufacturing Challenges

- Even relatively small defects can have significant effect on performance, especially in thin layers
- Cell consists of several thin layers
- => 100% inspection needed



Cell manufacturing Solution: automated inspection

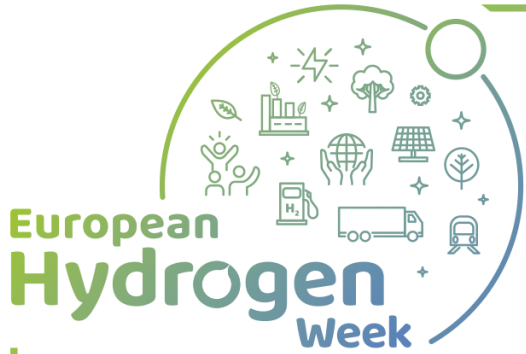
- Automated machine vision inspection of cell layers developed by HaikuTech
- 100% visual inspection of every fired half-cell
- The system has been validated at Elcogen AS cell production
- In-line inspection of cell in 10 s
 - Detection and classification of defects down to $\sim 10 \mu\text{m}$ ($3.5 \mu\text{m}$ pixel size)



Stack manufacturing Challenges

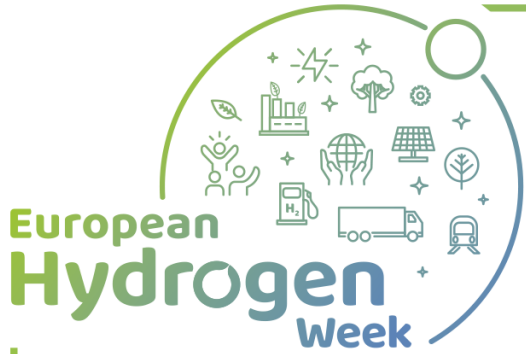
- Stack conditioning & QA inspection before shipping to customer
 - Heating
 - Sintering
 - Anode reduction
 - QA testing
 - Cooling





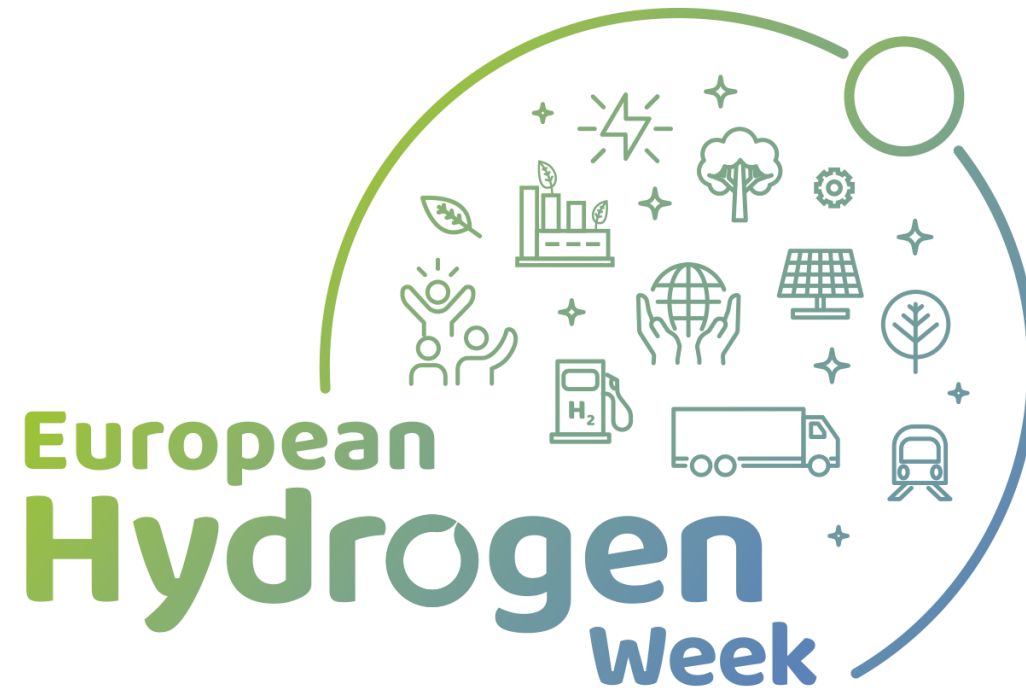
Stack manufacturing Solution

- Investigation of different ways of reducing conditioning & QA time during conditioning
 - 30 stacks tested
 - Statistical analysis of the results
- The quality needs to be preserved!
- With the develop method a reduction of 75% of conditioning time was achieved leading to stack CAPEX reduction
- This is the most cost-efficient way to increase capacity - no CAPEX needed!



qSOFC summary & next steps

- The project has reached all of its high-level targets
- During the project, methods have been developed to allow scaling up of manufacturing volumes
- This puts the European fuel cell industry into a good market position once the volumes increase to mass manufacturing levels
- Positive results obtained from qSOFC & INNOSOFC projects have contributed to Elcogen and the European Investment Bank (EIB) signing a 12 M€ quasi-equity loan facility for further research and development, supported by the European Commission under the InnovFin program
 - Factory capacity target 50 MW/year, located in Tallinn



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