HEATSTACK

WHY FUEL CELLS?

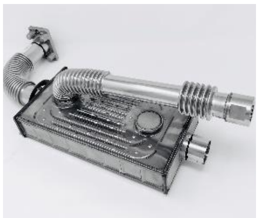
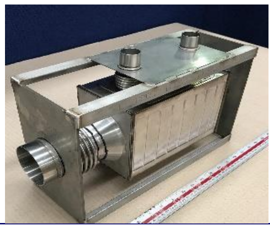
Fuel cells have shown great promise for use in residential micro-Combined Heat and Power (mCHP) generation due to their **high electrical efficiency and ability to run on conventional heating gases**, but high manufacturing costs remain key to widespread adoption in Europe. The objective of the project is to reduce the cost of mCHP domestic systems by 50% so that the whole life cost of mCHP become cost-competitive with conventional domestic heating systems, supporting the drive towards reducing greenhouse gas emissions.

ABOUT HEATSTACK

This 37-month project, funded through the FCH Joint Undertaking and Horizon 2020, is focused on **reducing the cost of the fuel cell stack and heat exchanger** – the 2 most expensive components within the fuel cell system – which together represent the majority of total system manufacturing costs. The project has partners in 4 EU countries – Senior Flexonics UK are the project coordinator, supported by PNO UK, research partner the University of Birmingham and 4 commercial partners: Sunfire, ICI Caldaie, Vaillant and Senior Flexonics CZ. Key technical achievements/progress from each partner:

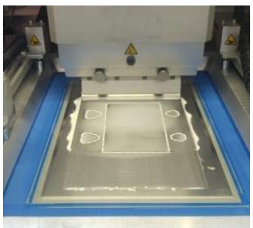
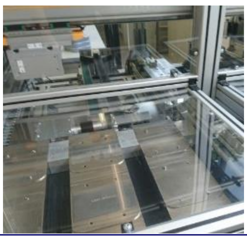
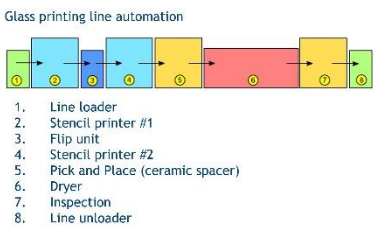
senior Flexonics

- **Production-ready CAPH** using AluChrom that gives **robustness, cost effectiveness and industry leading low levels of Cr leakage**
- Significant investment in equipment and tooling for process efficiency.
- Simulation for developing a **design that can be used in different applications** and which functions at different temperatures, pressures and flow rates.
- **Patent-pending CAPH** has a contra flow design, works up to 1000C, **proven effectiveness of over 90%** and very low pressure drop for both fluids.

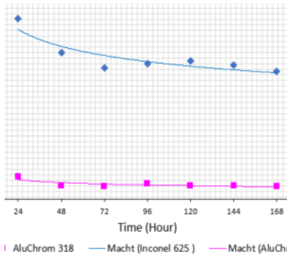
sunfire

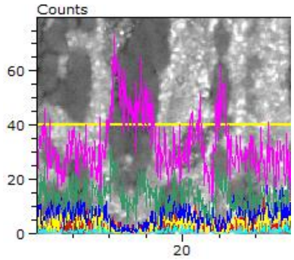
- **Printing of the glass seals** chosen as the method with the **best value** for industrial stack production
- Devices for printing designed and built, 2 printing slurries developed.
- The **first printing tests showed good results** achieved for thin layers.
- **Fuel cell stack production processes** development, with laser measurement in operation and a **first core unit design completed**.
- **Process automation** development includes a **completed first line design**.

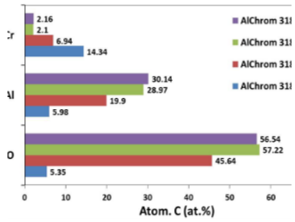




UNIVERSITY OF BIRMINGHAM

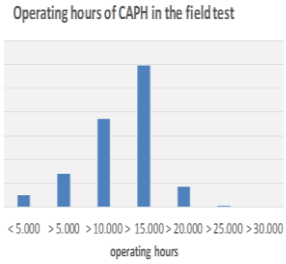
- **Denuder technique** used to quantitatively analyse the chromium vaporisation from Inconel 625 and AluChrom 318. Cr evaporation rate for AluChrom 318 is approx. one order of magnitude lower than for Inconel 625.
- Formation of a dense and continuous alumina scale on the alloy surface could effectively reduce the high temperature Cr leakage in the long term.
- **Low cost, low Cr evaporation and excellent high temperature corrosion resistance make AluChrom 318 highly suitable for CAPH application**.
- Applied research shows that **AluChrom has improved Cr leakage rates when compared to all other materials after just 150 hours**.
- With Inconel, Cr oxide forms on surface and remains there. SS 309 also forms Cr-Mn spinel, which spalls and breaks from surface. Aluminised SS309 loses Alumina surface and is replaced by Cr-Mn spinel. **AluChrom surface reduces Cr oxide content and increases Alumina**.







Vaillant



- **Field testing results** (from 2013 to 2017) **are positive for HEATSTACK** and total **over 3.4 million operating hours**.
- The maximum single CAPH operating times achieved at that point were 28,600 hours with Inconel and 19,700 hours with AluChrom.

ICI CALDAIE

- ICI integrated the Senior Flexonics heat exchanger prototypes into their test rig and adapted the fume line to **test in the widest range of conditions possible** and **improve the quality of data** collected
- ICI monitored the prototypes over the testing period so that a **thorough evaluation of performance** could be conducted.

PROJECT CONTACT INFORMATION

If you would like more information about the project, you can contact us via:

- Website: http://www.heatstack.eu/contact/
- LinkedIn: HEATSTACK Project
- Twitter: @HEATSTACK_EU

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