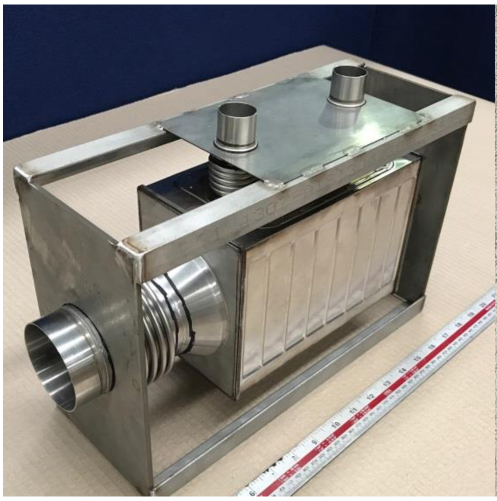
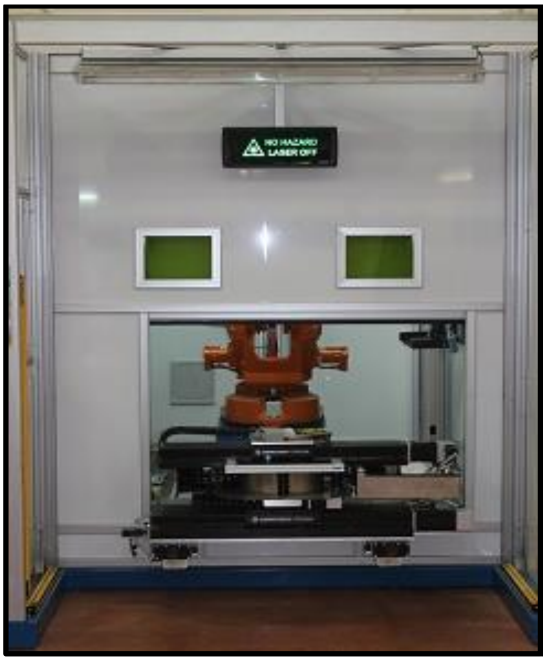
HEATSTACK Year 1 Project Summary

The first year of the HEATSTACK project was recently completed and there are a number of key achievements and results that we can publicise.

Project coordinator Senior Flexonics has developed a production-ready CAPH using AluChrom that gives robustness, cost effectiveness and industry leading low levels of Chromium leakage. Simulation has allowed the development of a design that can be used in different applications, which functions at different temperatures, pressures and flow rates, within the boundary condition range of ICI Caldaie's specifications. Here are a couple of images of this new design:




Senior Flexonics have also made significant investment during the year 1 of HEATSTACK in new equipment and tooling in order to achieve process efficiency that will benefit future production. Here are a images of a new machine:



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 700564. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY.

Sunfire have assessed 6 methods for producing fuel cell stacks during the first year of HEATSTACK, with printing of glasses being the chosen method because it offers the best value for industrial stack production. The devices needed for printing have been designed and built, with 2 printing slurries also developed. The first printing tests have shown good results for thin layers and this can be seen in the image below that shows a thin layer with the left side wet and the right side dry.

Comprehensive progress in materials research has been made by the University of Birmingham, who employed a denuder technique to quantitatively analyse the chromium vaporisation from Inconel 625 and AluChrom 318. The research undertaken has produced several key findings, for example the Cr evaporation rate for the AluChrom 318 is approximate one order of magnitude lower than that for the Inconel 625. Also, the formation of a dense and continuous alumina scale on alloy surface could effectively reduce the high temperature Cr leakage in the long term. Crucially, the low cost, low Cr evaporation, and the excellent high temperature corrosion resistance offered by AluChrom 318, make it highly suitable for CAPH application. The charts below illustrate some of the research.

Figure: EDX line scan from steel through the oxide scale of AluChrom 318 after 1000 hours exposure at 850 °C in air containing 3% H_2O (6.0 L/min).

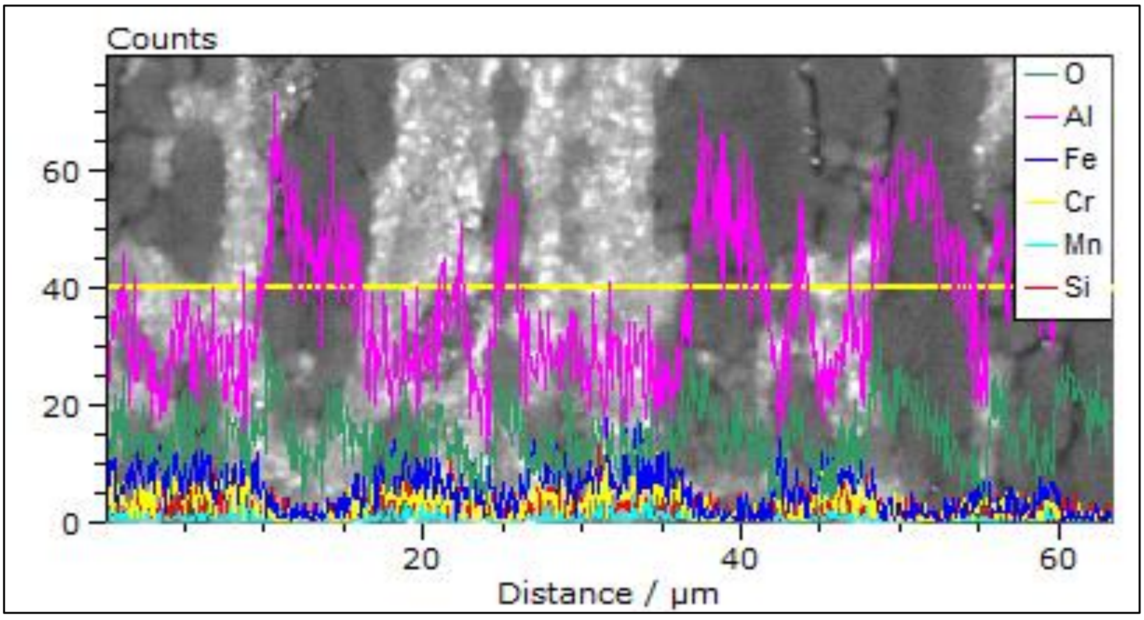


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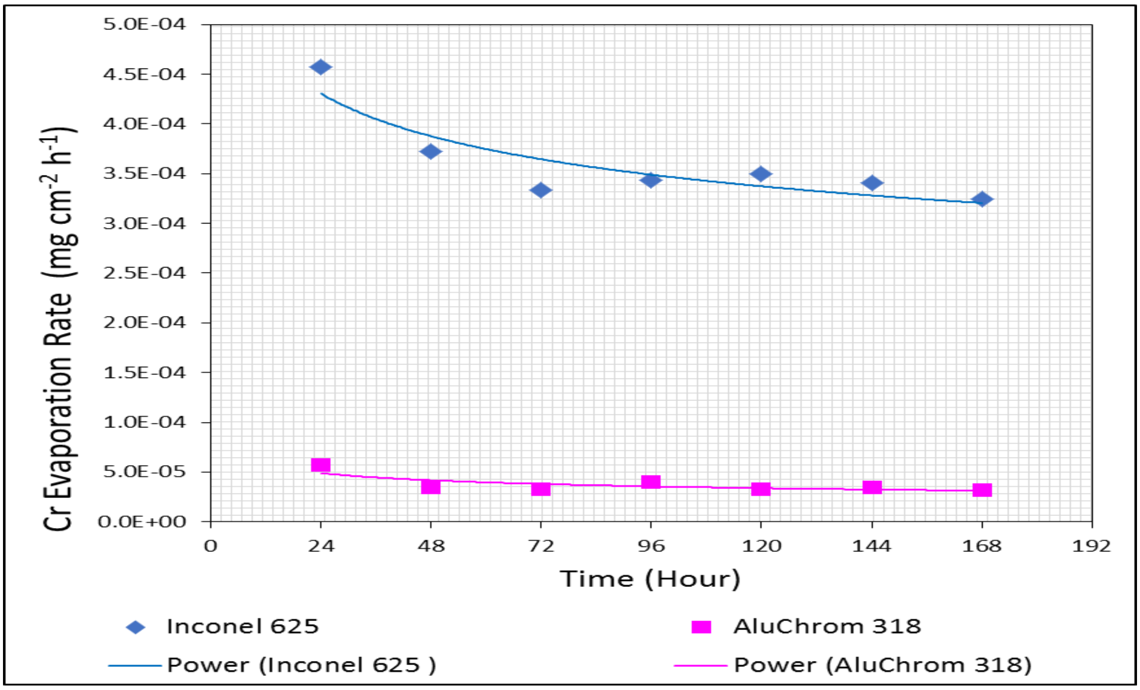
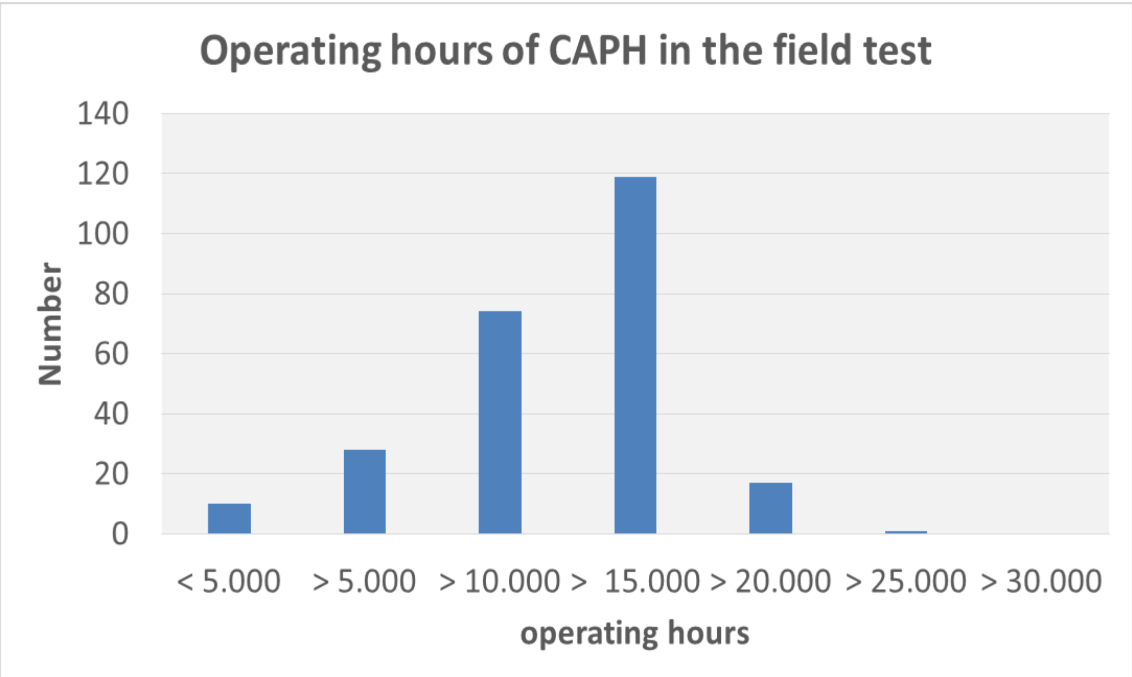
Figure: Rate of Cr evaporation as a function of time for Inconel 625 and AluChrom 318 at 850 °C in air containing 3% H_2O (6.0 L/min).



The results of Vaillant's G5 field testing for operating hours of CAPH have also proven positive for HEATSTACK. This field testing, which has been undertaken from 2013, totals over 3.4 million operating hours as of April 2017. Within this, over 200 systems have achieved operating hours in excess of 5,000 hours. So far, the maximum single CAPH operating time with Inconel is 28,600 hours and the maximum single CAPH operating time with Aluchrome is 19,700 hours. The chart below shows the distribution across all systems in the field for the G5 testing programme:



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