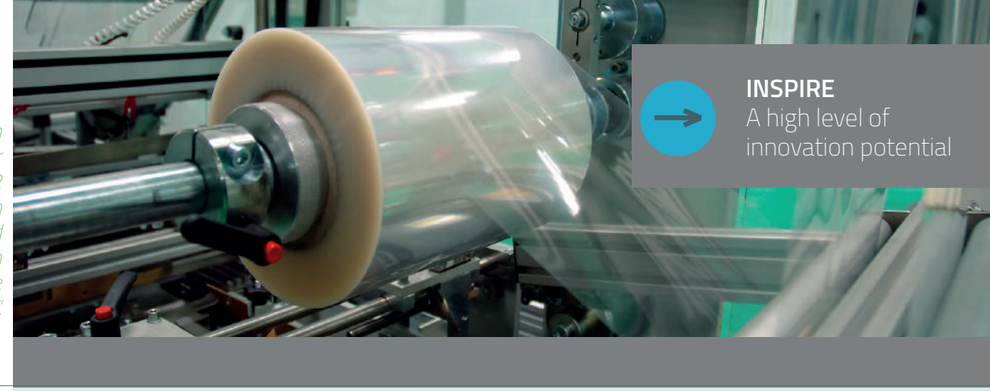
INSPIRE MEMBERS INCLUDE FUEL CELL COMPONENT SUPPLIERS, ACADEMIC INSTITUTIONS AND CAR MANUFACTURER BMW GROUP

This project is a close collaboration between industrial and academic partners to bring forward materials and components already showing considerable promise in current FCH JU projects, integrate them for enhanced performance and demonstrate their capability to be manufactured in volume

Funded by the Fuel Cells and Hydrogen 2 Joint Undertaking (FCH2 JU) under grant agreement No 700127. FCH2 JU receives support from the European Union's Horizon 2020 Research and Innovation Programme, Hydrogen Europe and Hydrogen Europe Research".



INSPIRE
A high level of innovation potential

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INSPIRE
Integration of Novel Stack Components for Performance, Improved DuRability and LowEr Cost

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INSPIRE
Integration of Novel Stack Components for Performance, Improved DuRability and LowEr Cost

INSPIRE – A HIGHLY SUCCESSFUL PROJECT FOCUSED ON VALIDATION OF THE NEXT GENERATION OF AUTOMOTIVE FUEL CELL STACK TECHNOLOGY

The headline achievement of inspire is its world-leading power density of **1.5 w/cm² @ 170 kw peak power and a cell pack volumetric density of 5.7 kw/l or 4.8kw/l** including stack case and housing.

While the INSPIRE project has now ended (October 2019), its output lives on. The catalyst development work in INSPIRE was built on previous FCH JU projects such as CATHCAT and CATAPULT, and the most promising developments have now made their way into GAIA for further implementation. The PtNi catalyst, now scaled-up to 2 kg batch size, is also now available for commercialisation. The PBI-supported membrane output from the project, combined with that of VOLUMETRIQ, is also being pursued further in GAIA.

A new gas diffusion substrate developed in INSPIRE has now been released as a commercial product – SGL 22BB. Finally, the MEA and BPP are also available at high volume (TRL6) and the stack developed in INSPIRE is ready for exploitation.

The outreach of INSPIRE is also providing support – thanks to a common test platform, baseline components and protocols – to GAIA, CRESCENDO, CAMELOT and ID-FAST. However, it is the links formed during this interdisciplinary project, **rewarded by the FCH JU "2019 best success story award"**, that are providing the EU with a strong fuel cell supply chain and academic backbone going forward.

It has been my pleasure to lead this project and I would like to take this opportunity to thank all involved in its success.

MARCH 2019
FCH JU PEMFC DEVELOPMENT WORKSHOP, MARSEILLE, FRANCE

The INSPIRE team hosted a workshop in Marseille on 5th and 6th March 2019, combining together 10 FCH JU H2020 projects focused on PEM fuel cell components for poster sessions, forums and project presentations.
Overall this was a very successful workshop which enabled FCH JU projects with common interests to share their successes and best practises and create new links which will benefit the industry throughout. The INSPIRE team want to thank all that attended and took such an active part in the discussions.

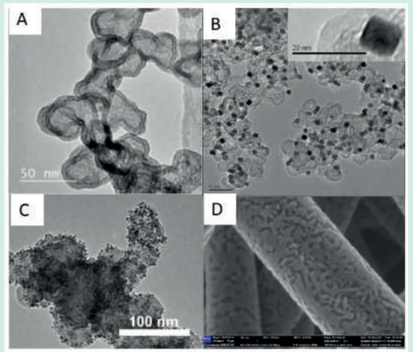
Achievements & Outputs

High Performance Catalyst Development

Two new PtNi catalysts from JM, with kinetic mass activities more than 50% higher than the benchmark catalyst and exceeding 0.44 A mg^{-1} Pt, have been incorporated into cathode catalyst layers and evaluated as MEAs in single cells for stability and high current density performance.

MEAs with two new cathode layers incorporating the best PtNi catalyst have exceeded the performance of the benchmark catalyst layer at high current density (1.5 A cm^{-2}) on H_2/air by at least 7%, under a wide range of operating conditions. Other approaches, including extended Pt layer/Ni nanofibre catalysts at CNRS, octahedral PtNi(Mo)/C nanoparticle catalysts at TUB, and hybrid Pt@Fe-NC catalysts at CNRS have shown promising mass activities and stabilities in Accelerated Stress Tests that warrant continuing studies, including in full MEAs.

In the longer term, high mass activity and high stability are expected from the complementary routes to Pt thin film deposition being developed on carbon fibre-carbon nanotube electrodes, transition metal doped carbons and NbTiOx-tie layer protected carbon fibres and particles, as well as from other alloys such as PtGd.



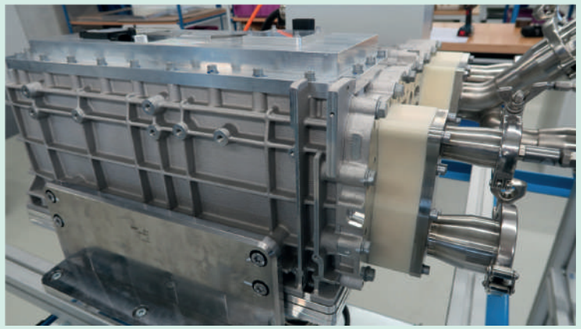
A. Continuous oxide layer deposited by ALD on commercial carbon support
B. Shaped PtNi/C nanoparticles using wet chemical route
C. High dispersion ALD Pt/C catalyst
D. Thin Pt ALD film on nanofibre

Stack Component Development

The development of the stack components within the INSPIRE consortium was carried out as a close interaction between the development of the MEAs, the Bipolar Plates (BPP) and the design of the stack hardware. To achieve optimum performance and durability properties, the media flow properties were optimised to a high level of homogeneity for the pressure drop, channel flow share, reactant transport to the electrodes and stable water management within the active area flow field and between the several hundred cells of the stack.

Beyond the stack operational requirements, the plate design also addressed the necessary properties and capability to enable the efficient mass production of the BPP.

The INSPIRE project has delivered its third generation of MEA/BPP/stack design, with the optimised MEA, BPP gas distribution and reactant conversion demonstrating a power density of 1.5 W cm^{-2} at 0.6 V and a peak power of 170 kW at 0.56 V.

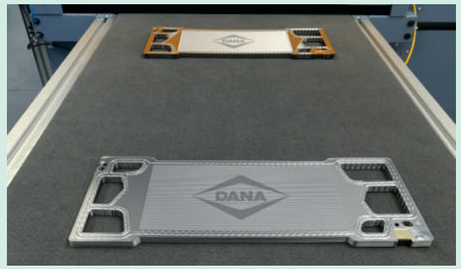


MEA Achievements

Three new MEA generations have been developed in the second half of the INSPIRE project. The GEN 2.0 MEA variants produced drew on new catalyst materials developed in the INSPIRE project including a de-alloyed PtNi and an advanced Pt catalyst on a developmental support material, both targeting reduced MEA PGM loadings. The alloy catalyst demonstrated improved mass activity and performance up to 1500 $mAcm^{-2}$ before the mass transport losses associated with the lower ECA and loading of the alloy catalyst became dominant. The advanced carbon support samples were also provided at a low Pt loading of 0.25 $mgPtcm^{-2}$ and these samples demonstrated good mass transport properties but were hindered by the low Pt loading under the demanding INSPIRE operating conditions. The designs also incorporated and improved seal design and an asymmetric GDL configuration to further improve performance and stability.
The third generation MEA was fabricated using high volume mass manufacturing processes. This MEA incorporates the improvements in seal and GDL design but due to the high-volume manufacture of the supply of over 1400 MEAs and the demanding high current density operation at the INSPIRE conditions, the cathode loading was increased to 0.4 $mgPtcm^{-2}$. The performance achieved with this MEA was 1.3 Wcm^{-2} in the stack under the INSPIRE operating conditions, and 1.5 Wcm^{-2} under the EU harmonised protocol conditions.

BPP Achievements

Within the GEN 3.0 development of the bipolar plate and membrane electrode assembly, the involved partners JMFC, SGL, BMW and DANA worked closely together to reduce the tolerance of the components and to improve the water and gas management of the plates. A new channel design as well as a novel GDL grade improved the liquid water removal and the gas supply at the bipolar plate. This could be achieved by several iterations of simulations, and close interaction and exchange of experience among the project partners. That resulted in a high-performance bipolar plate, adjusted to the membrane electrode assembly and gas diffusion layer requirements. The integrated seal and the applied conductive coating ensured a fast and simple process for the stack assembly. With more than 1000 delivered bipolar plates and membrane electrode assemblies, two full stacks and several short stacks could be assembled. Within Work Package 6 the performance target of 2.5 Acm^{-2} and 1.5 Wcm^{-2} was exceeded. The durability targets are still under verification with short stacks, as well as with a full stack.



FCH JU AWARDS

INSPIRE Best success story award

The Fuel Cells and Hydrogen Undertaking (FCH JU) has announced the winners of the 2019 FCH Awards.
The Best Success Story winner: '*Driving forward fuel cell technologies*', involves five projects, **INSPIRE**, GAIA, VOLUMETRIQ, CRESCENDO, and PEGASUS which are making fuel cells more affordable and competitive.

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Publications

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Conference Presentations