AGENCE NATIONALE DE LA RECHERCHE

ANR

Presentation of the funded projects in 2008 for the Hydrogen and Fuel cells Programme

Hydrogen and fuel cells programme

Year 2008

Title	AIRELLES-1 - Innovating MEA for PEM Electrolysis Coupled to renewables (IMPEC)

Abstract

AIRELLES project proposes fundamental and technological research and development actions in the field to Membrane Electrodes Assemblies (MEAs) for PEM electrolysis. The main objective of the proposed works are to dramatically reduce hydrogen production cost especally for applications coupling this technology to renewables.
In order to reach this economic objective, we have to reach the following technical objectives :
• improve efficiency as well as increase current density ;
• increase working pressure over 50 barg without using any additional mechanical compressor ;
• improve lefitime and analysis phenomenons involved perfrormances degradation of such equipments especially when coupled to renewables.

This project then proposes to develop and manage lifetime tests of innovanting catalysts, membranes and MEAs following a protocol that fit the use of an
The novating positionning of this project lies firstly on the proposed innovations in the flied of catlyst, membrane and MEA réalization.
In addition, this project proposes to adress multiple combinations of MEAs at 25 cm² scale

At last, this project will analyse and try to better understand degradation phenomonon of PEM electrolysers. This point is not adress in international scientific litterature.

This project also proposes innovating solutions that try to solve limitations revealed by HELION in the framework of DEPEM HP project in term of hydrogen flux through the membrane. This innovative solutions should lead to be able to reach higher working pressure and then to directly generate the require storage pressure without using any additional comrpessor at electrolyser outlet.

At last, the project will develop a impedance spectroscopy modelling and diagnosis. These works will be the first step to a more ambitious pronostic and diagnosis route.

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ANR funding	673 809 €
Start- duration	December 2008 - 30 months
Contract	ANR-08-PANH-001

Hydrogen and fuel cells programme

Year 2008

Title	ARTEMIS - Start up time reduction and fuelcells system optimization for electric emergency application

Abstract

Based on works and systems previously made (5 to 30 kWe systems including the system operating at CEA Saclay since late 2006), HELION offers an innovative solution of fuel cell-based backup power systems. Using a proprietary process, this solution positively responds to current systems disadvantages (autonomy, pollution, noise, reliability, and so on ...). Feedback on the 30 kWe system running at CEA Saclay is globally positive. However, points for improvement were noted. On the one hand, the quantity, yet significant, of batteries needed during the system start-up phase or power demand should be reduced, and secondly, the system sustainability under specific operating conditions (start-up at a low temperature or operation at low power) should be improved. ARTEMIS falls within the framework of the industrialization of these backup power systems and aims to respond positively to these two aspects.

This project will continue the developments leading to significant scientific and technological innovations in terms of start-up time reduction and sustainability, particularly in specific operating conditions. In this respect, the project includes 4 tasks.
Task 1 will help to define the optimal strategy for stops and stand-by modes under reactive gases, in order to significantly reduce the start-up time (about thirty seconds today, this start-up time should be closer to the second at last) without MEAs degradation due to aging : this will reduce the quantity of batteries required, having an impact on the structure and the system cost.
The second task of the project is to explore the specific operating conditions (rapid power on, low power operation and low temperature startup) to develop solutions preventing rapid degradation of MEAs in these working conditions.

Task 3 is specifically dedicated to the MEAs ageing study to understand and master mechanisms to assist in reaching objective solutions of previous tasks.
In task 4, a fuel cell core model, addressing non steady state configurations, will be developed to assist in theoretical studies carried out tasks 1 and 2 for understanding the phenomena.

Partners

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ANR funding

684 670 €

Start- duration

December 2008 - 28 months

Contract

ANR-08-PANH-002

Hydrogen and fuel cells programme

Year 2008

Title	CATIMINHY - Active layers developed by hybrid printing technologies
Abstract	Innovation in PEMFC components is limited by the preponderant use of a few traditional fabrication technologies. More over, a specific aim is to reduce the platinum quantity because of its increased cost. CATIMINHY project consists in the realisation of actives layers by hybrid printing technologies. A technological breakthrough is proposed: the realisation of a 5 layers MEA (Membrane Electrode Assembly) by processes coming from printing. Most of components must be deposited successively, without hot pressing. Thanks to the enhancement of interfaces, the limitation of the contact resistances, the thinning of the various layers, this concept will bring gains in performances and an optimization in the platinum quantity. This breakthrough will be made a reality thanks to the study of innovative deposition technologies based on techniques already used in other industries like printing. These processes, allowing an automated production by batch, will also be applied in a short term, by the realisation of a pilot line for conventional MEA, CCM type (Catalyst Coated Membrane).
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ANR funding	1 541 563 €
Start- duration	December 2008 - 36 months
Contract	ANR-08-PANH-003

Title	CONDOR - Proton conducting ceramic fuel cell: development, optimization and realization of PCFC stack module operating at intermediate temperature domain (400-600°C)

Abstract

This projet aims to develop at high scale the fabrication of ceramic materials likely to be used as electrolyte and electrodes into PCFC system (Proton Ceramic Fuel Cell). The issue is to avoid in the same time the disadvantages of PEMFC and SOFC technologies :
- an operating temperature lower than those of SOFC systems allowing the use of cheaper materials (commercial interconnect materials, seals) and a better resistance to thermal cycles.
- an operating temperature higher than those of PEMFC systems allowing to avoid water management problems, to increase the CO tolerance of electrodes and the reaction kinetics and to better use the heat outlet,
By adding the advantages of both fuel cells, PCFC technology would bring a real simplification of fuel cell systems with respect to the technical industrial specifications.

The previous ANR2005 TECTONIC project (coordination: EDF) showed the feasibility of this technology and the high interest for using such materials into PCFC cells operating at intermediate temperatures (400-600°C). Indeed, experimental work allowed making and testing under a long term, a complete PCFC cell of 5 cm² of active surface area using advanced perovskite electrolyte materials having high ionic conductivity (>10 mS à 500°C) as well as performing electrode materials. Currently, it is proposed a second phase aiming at manufacturing a complete PCFC stack of 20W power and at validating under micro-CHP profiles. It will be stressed on optimizing the electrical and physico-chemical properties of the cell components within a nanostructured approach during the synthesis and the manufacturing steps of the materials.

A more detailed study will be performed on the electrochemical testing of selected PCFC cells and stack under static and dynamic micro-CHP profiles. The main target will be to reach performances equivalent to those obtained with PEMFC and SOFC advanced cells (0,6 V @ 1A/cm²). The economical modeling and life cycle analysis of the technology will be made in order to evaluate the impact of the use of such materials and manufacturing procedures on the cost reduction of system and on the environment respect.

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ANR funding	1 215 149 €
Start- duration	December 2008 - 36 months
Contract	ANR-08-PANH-004

Hydrogen and fuel cells programme

Year 2008

Title	CYRANO-1 - Hydrogen Pipelines for Storage of Sustainable Energy-1
Abstract	Sustainable energies provide electric power intermittently depending on climatic conditions. These energy productions are not always consistent with the period of higher energy demands. An energy storage associated with sustainable energy productions could reliably compensate the need for additionnal energy during the higher demands. The CYRANO-1 project studies the windmachine electric productions associated with hydrogen gas pressurized in a pipeline as an energy storage mean which also ensures the energy transmission. The windmachine electric production is converted into hydrogen gas which is compressed and stored in a pipeline. The pipeline feeds a fuel cell which reinforces the electric distribution during the high energy demand when the windmachine production is not powerful enough. The system "windmachine-electrolyte-hydrogen pipeline-fuel cell" will be design for a population of 500.000 citizens, which is about the population of an island (Guadeloupe, Reunion) or of french territorial division. This project is a technical-economical study, regulatory and safety analysis of an integrated system "Windmachine-hydrogen pipeline-fuel cell" to guarantee the additional electric feed from sustainable sources for a population of 500.000 citizens during the high demands. It will raise design solutions of this integrated system "CYRANO-1" to guarantee the supplementary electric feed for a population of 500.000 citizens during the high demands. These results and this approach will be exploitable for other population sizes and usable for other sustainable sources (photovoltaic) or other storage techniques (wheel of inertia, compressed air).
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ANR funding	271 124 €
Start- duration	December 2008 - 30 months
Contract	ANR-08-PANH-005

Title	DIMITRHY - Data and instrumentation for hydrogen risk mitigation in public applications of fuel cell systems

Abstract

Motivated by the lack of experimental data allowing industries, research centers and regulatory body to evaluate the risk level of hydrogen systems and so to propose adapted regulations and standards to promote the safe use of hydrogen, the DIMITRHY project (Data and instrumentation for hydrogen risk mitigation in public applications of fuel cell systems) aims at producing reference data on the mitigation measures to reduce the occurrence and consequences of hydrogen leaks on fuel cell systems used by the public.
This project uses the DRIVE (PANH 2005) project as a starting point (Experimental data for hydrogen risk evaluation, numerical tools validation) and extends the partnership and the scope of the project by including stationary applications (where as DRIVE was focusing on an automotive application) and extending the research to the mitigation measures.

The work program is divided in 3 tasks:
- The mitigation of explosive atmospheres, where the flammable cloud extension and duration is reduced by detection, natural ventilation, forced ventilation and optimized geometry of the fuel cell systems.
- The mitigation of explosions, where the consequences of an explosion are reduced by reducing the confinement of the explosion through optimal vent sizing.
- A systemic approach will be followed. First, a mapping of stationary (AIR LIQUIDE & HELION) and automotive (PSA PEUGEOT CITROËN automobile & AIR LIQUIDE) applications will be performed and will lead to the parametric definition of geometrical characteristics, leak scenarios and environments to be used in the two other tasks.

Then, at the end of the project, these parametric studies will enable us to draw design and installation recommendations based on the best experimental data and phenomena understanding.
Our work will be based on a coupled experimental and analytical approach and will benefit from the partners experience and complementarities.
The results of the DIMITRHY project by contributing to fill the existing lack of data and models will allow for an early integration of the risk mitigation in the design stage and provide installation recommendations.

Partners

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ANR funding

1 034 957 €

Start- duration

December 2008 - 36 months

Contract

ANR-08-PANH-006

Title	ENDEMAT - Durability of constituent materials from type-4 compressed gaseous storage tanks

Abstract

Currently, the design, fabrication, qualification, and use of composite pressure vessels for compressed gas storage is performed using empirical methods based on experience from natural gas pressure vessels, breathing apparatuses, and defense and aerospace applications (where the large majority of these applications use service pressures less than 300 bar).
Additionally, the superposition of multiple safety factors or safety margins during the design and development of vessels for use at very high pressures and the lack of a consensus or continued research on the qualification and/or re-examination of composite pressure vessels (such as pressure testing, visual inspections, manufacturing quality control, binary tests of qualification and requalification, and rudimentary use of acoustic emission testing) attest to the gaps in current knowledge concerning the damage and durability of the materials from which composite pressure vessels are made.

This lack of knowledge presents a sizable barrier in the development of composite pressure vessels for high-pressure gas storage, notably for hydrogen at 700 bar. Because of the high pressure and the nature of the gas, poor vessel design can have important consequences for the safety, reliability, performance, cost and thus for the social acceptance of these systems in both the short and long term.
With this in mind, the proposed study seeks to address the durability and reliability of the three main components of a pressure vessel:
- the polymer comprising the internal liner (either polyamide thermoplastic or polyurethane thermoset)
- the boss-liner junction (polymer-metal adhesion and mechanical strength of the junction will be examined)
- the composite overwrap and notably the polymer matrix / carbon fiber interface in this reinforcing layer.

In this regard, the proposed project is particularly original. Contrary to other past and current projects which were concerned with new materials or new designs, this project aims to study degradation mechanisms and processes specific to the different components of a pressure vessel and to determine their durability under normal operating conditions (accidental situations are not considered). Ultimately, this knowledge will be used to optimize the design and performance of pressure vessels and may even contribute to the definition of testing procedures.

This project is based partly on fundamental modelling and experimental research, which is mainly focused on materials currently used in national, international, and industrial development programs for hydrogen storage (namely polyamide-6, carbon-epoxy composites) as well as on materials having high potential in the final stage of development (polyurethane). An additional component of the project will test composite vessels whose design will be aided by the results of these fundamental studies.
The work proposed and agreed to by the consortium will allow us to combine and further develop our competencies and knowledge in order to address to the issues confronting hydrogen storage for transport and stationary applications. Additionally, the project is expected to produce benefits for other applications of industrial gases notably natural gas storage and transport.

Partners

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ANR funding

1 089 529 €

Start- duration

December 2008 - 36 months

Contract

ANR-08-PANH-007

Title	EnzHyd - Enzymes and organometallic catalysts in hydrogen fuel cells

Abstract

Facing the rising environmental impact of oil powered transports, fuel cells have the wind in their sails. The fast growing market of fuel cells foresees coming difficulties because their present technology is based on platinum nanoparticles as oxidation as well as reduction catalyst. As a rare precious metal, platinum would never sustain the mass production of such fuel cells. But new catalysts, of a molecular kind, have been recently discovered and showed interesting catalytic activities. First, enzymes called hydrogenases catalyse hydrogen oxidation in wet soil microorganisms. Second, copying their chemical structure, organometallic complexes have been designed and a few now show catalytic activity toward hydrogen oxidation. Third, cobalt complexes catalyse oxygen reduction. The EnzHyd project proposes to realise two hydrogen fuel cells without platinum, using as hydrogen oxidation catalyst hydrogenases in the first case, biomimetic organometallic complexes in the second case, and using cobalt complexes as the oxygen reduction

catalyst. The work will first focus on the discovery and development of new organometallic catalysts both for the fuel cell cathode and anode. Concerning the anode catalysts, screening a large variety of compounds will be preferred to extensive chemical synthesis. As for cathode catalysts, the work will focus on nitrogen containing polymers as cobalt ion ligands to reduce production costs. On the second hand, our work will focus on the realisation of passive mini-fuel cells using the best molecular catalysts available, i.e. hydrogenases and the organometallic catalysts described in the literature, to test their abilities in conditions as real as possible. If new good catalysts were ever to be discovered during the project, they would be tested in fuel cells using this protocole. The first challenge will be the coupling of catalysts to carbon nanotubes, chosen as conductive support because of their very high conductivity and their demonstrated ability to couple electrochemically to small and large redox molecules.

The second challenge will be to adapt the fuel cell fabrication process to such new catalysts, quite tolerant to organic pollutants as well as carbon monoxide, but quite sensitive to exposure to oxygen and heat. In the end, this project will allow the first evaluation of these molecular catalysts in an operating fuel cell, the measurement of their performances and it will unveil their qualities and disadvantages.

Partners

CEA - IRAMIS/SPEC (coordinator)
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ANR funding 818 328 €

Start- duration December 2008 - 36 months

Contract ANR-08-PANH-008

Title	ICARE - Coated interconnects for high temperature steam electrolysis

Abstract

The ICARE project concerns the development of reliable metallic interconnects that constitute one of the major current bottlenecks of the High Temperature Steam Electrolysis (HTSE) technology. In HTSE conditions (oxygen rich atmosphere at the anode side and steam at the cathode side, both at 800°C) interconnects should not oxidize too rapidly nor form isolating oxide layer in order to maintain a low area specific resistance between interconnects and electrodes. Moreover, they must be chemically stable in order to avoid any emission of polluting compounds such as chromium oxide.
The problem addressed in the ICARE project is the development of metallic interconnects with adapted surface properties. The solutions to be studied concern the association metallic alloy / surface coating.

The project is organised around the issues addressed with a first step dedicated to the precise identification of coating requirements in HTSE environment in order to define specifications for metallic alloys/coating couples. A special attention will be paid to any possible cell contamination due to interconnect alloying element evaporation phenomena. Metallic alloys considered as potential interconnects will be: -a ferritic stainless steel F18TNB fabricated by Arcelor Mittal Stainless, which constitutes a lower cost alternative to the Crofer 22 APU and – a low thermal expansion coefficient alloy based on the Fe-Ni-Co family, which could offer innovative solutions for HTSE application.
The second step of the project concerns the development of coatings adapted to these alloys either by physical deposition means or by wet processing. In both cases the deposition step will be tightly linked to the stabilisation treatments (such as thermal treatments under controlled atmospheres). Coating constituting materials will be chosen in the spinel family and in the perovskite one.

The project leads to a final step dedicated to the performance evaluation in representative HTSE conditions of the developed coating/alloys associations.

The degradation mechanisms of coated metallic surfaces in HTSE condition, in particular their oxidation and the effect of current density on the oxide growth will be carefully studied with dedicated experimental tools either developed or adapted within the project. Indeed, the objective of the ICARE project is to understand and control interconnects evolution in order to propose a satisfactory technological solution.

To cover the entire research approach of the ICARE project, from industrial development to basic analysis of involved mechanisms, the consortium gathers industrial partners directly involved in the deployment of HTSE technology (ArcelorMittal and the SME PVDCo), academic laboratories already well recognised in the field of high temperature material reactivity in severe environments (ICB and SIMaP) around a national technological research centre (CEA-Liten), already highly involved in hydrogen technology development, which coordinates the project.

Partners

CEA/LITEN (coordinator)
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ANR funding

998 236 €

Start- duration

December 2008 - 48 months

Contract

ANR-08-PANH-009

Title	ICARE-CSP - Investigation, characterization and development of Fuel Cell air-compressors (Power>10kW)

Abstract

Many different technological bolts are still to be overcome before seeing on the market real competitive and efficient PEM fuel cell systems. Among them, one of the most important is linked to air compression. Indeed, this fuel cell subsystem is one of the most energy consuming subsystems, it can also be very noisy in some cases and it is very difficult to find on the market optimally designed fuel cell air compressors. These results have been underlined in the SPACT80 and FISYPAC programs.

The ICARE-CSP project proposes an original research and experimental study focused on the air compression systems designed for PEM fuel cells (both for transportation and stationary applications and also both considering pure hydrogen as fuel or a reformate). This project (duration 2 years only) will firstly propose an up-to-date state-of-art of the technology. It will also define generic requirements for fuel cell air supply systems, considering stationary and transportation applications. Moreover, several air compressors, designed for fuel cell applications and available on the market, will be tested on specific test benches, so as to evaluate objectively the performances of these compressors. Finally, an optimized air supply system will be implemented and evaluated in real life on a fuel cell power generator already existing on a hybrid vehicle (ECCE vehicle) and optimized control laws will be proposed so as to increase the efficiency and the reliability of the air compressors.

The ICARE-CSP project will propose guidelines for the design and the realization of optimized PEM fuel cell air compressors. In this way, this project can be seen as an important milestone on the way of an emerging fuel cell's air compressors industry.

Partners

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ANR funding

603 199 €

Start- duration

December 2008 - 24 months

Contract

ANR-08-PANH-010

Title	METALICA - Hydrogen cartridge in polymer containing low cost metal hydride

Abstract

The battery industry for many years has been dealing with a difference between supply and demand in energy for many portable applications. The increase in small portable electronic functionality and increased power requirements has generated the need to extend the run time of many devices. For this reason Fuel Cell technology is a good fit because of its ability to supply theoretically high energy densities solutions. Even if the fuel cell technology is currently mature, major issues remain for this technology to become commercially available. Also, the fuel and the associated cartridge still require many developments.

The METALICA project consequently aims to develop a recyclable plastic cartridge containing low cost metal hydride. Three families of materials will be studied, along with their thermodynamic and kinetic properties. Regardless of the targeted application, it is necessary to package them in a light, reliable, and safe reservoir. The scientific and industrial consortium will lead this project to develop major results based on these issues in order to develop a successful commercial product.

This project should be able to offer an alternative energy source based on fuel cell technology with a 600 Wh/l energy density.

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Start- duration	December 2008 - 36 months
Contract	ANR-08-PANH-11

Hydrogen and fuel cells programme

Year 2008

Title	OXYGENE - Anode oxidation control of a SOFC stack within a micro-CHP boiler

Abstract

One of the persisting problem of the SOFC technology is the degradation due to the re-oxidation of the anodes. Actually, Ni/YSZ cermet high sensitivity not only induces a mechanical degradation of cells during on/off cycles but also in operation under high fuel utilization, which is needed to achieve the high electrical efficiency required by micro-CHP system. This re-oxidation issue is highly problematic as a micro-CHP boiler requires at he same time a high electrical efficiency, a low degradation rate of the cells and a robust technology able to withstand numerous on/off cycles.

The aim of this project is not to develop a new oxidation-proof anode material, but to identify the operating mode and on/off conditions of a Ni/YSZ anode SOFC stack, that allow to prevent the degradation due to the re-oxidation of the anodes. This will be achieve through a a high level understanding of the oxidation mecanism within a cermet anode. Recommandations will be formulated on the acceptable operating condition range for a cermet anode (fuel utilization) and on the range of the gas conditions by the anode to avoid the mechanical degradation of the cells while switching on or off a SOFC system..

Beyond the recommandations, a reflection will be led on the architecture of the fuel cell stack and on the switch on/off procedure to avoid the limitation on fuel utilization and anode gas atmosphere. These new architectures and innovating procedures will allow the emergence of a Ni/YSZ based SOFC fuel cell, reaching high electrical efficiency with no degradation, and able to withstand numerous of on/off cycles.

Partners	GDF SUEZ (coordinator) CEA / LITEN CNRS - SIMAP CNRS - LEPMI CNRS - IJLRA
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Start- duration	December 2008 - 36 months
Contract	ANR-08-PANH-12

Title	MODERNHY-T - Models and Tools for dimensionning and evaluation of innovative hydrides tank for transport

Abstract

The project deals with the development of a hydrogen chain as a clean way for energy transportation. The hydrogen chain is only relevant if hydrogen can be stored properly. More particularly, this project aims at developing hydrogen hydrides tanks for transport applications, focused on tanks combining medium pressure (under 200 bars) and hydride storage. The efficiency of hydride tank, for a given material, is directly related to thermal management.

Speaking about system design, the innovation will come from the way the granular hydride material is handled and placed inside the heat exchanger. The main goal is thus to gain efficiency and decrease volume of tank by maximising contact between powder and heat exchanger, in order to fully benefit from high volumetric capacity of hydrides. This task is particularly tricky when considering swelling and shrinking of the hydride during absorbing and desorbing cycles. Considering these objectives, empty spaces between hydride and heat exchanger are excluded, but dilatation of the granular material entrapped in tightly confined spaces is creating strong stresses in the container. Moreover, when the hydride material shrinks, thermal contact with container fades away, and worse, it can disappear.

At the moment, the man of the art is at the moment unable to calculate the mechanical strength of a container filled with swelling hydride powder. Literature is just reporting basic observations of – sometime strong – stresses increasing in the container walls, but no predictive model is proposed to tackle the problem. Our study aims at building such a model in order to ensure safe mechanical dimensioning and thermal efficiency of the hydride container.

To reach the objective, we need to fully characterize the granular material – thermally and mechanically and while cycling (absorption/desorption) – and to develop innovative heat exchanger answering exigencies described above.

The swelling and shrinking property of hydrides is a common property linked to the majority of hydride behaviour (from a simple TiFe hydride to complex hydrides like NaAlH4). Nevertheless, we propose to focus our attention on one of the most efficient hydride of the moment (a BCC hydride TiVCR) within the frame of developing hybrid hydrogen storage tanks which seems interesting for transport applications.
This project consists in an applied research work, with a more fundamental side combining experimental and modelling tools concerning the mechanical behaviour of hydrides, and in the same time, the coupling of this behaviour with thermal effects. The applied side of research is strongly present since a test demonstrator will be fabricated following specifications from two French "end-users". This will validate advances made during the project.

Partners

CEA/LITEN (coordinator)
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ANR funding 511 920 €

Start- duration December 2008 - 36 months

Contract ANR-08-PANH-013

Title	MAFALDA - Experimental and Modelling Analyses for the PEFC Active Layers Degradation Assessment

Abstract

The membrane-electrodes assembly (MEA) durability in state-of-art Polymer Electrolyte Fuel Cells (PEFC) is one of the main shortcomings limiting the large-scale development and commercialization of this technology. Typical PEFC lifetime is around 300-500 hours under some operating conditions representative of automotive applications. At least 3000 to 5000 operational hours are required for these applications and up to 40000 hours for stationary applications.
In this context, the MAFALDA project proposes a coupled experimental/modelling approach focusing on the understanding and on the improvement of the electrochemical performance and durability of the PEFC MEA. The development of a theoretical tool is essential for industrials and for the scientific community to evaluate the MEA degradation and to predict their durability in function of their properties and operating conditions.

Because of the strong coupling between different physicochemical phenomena, interpretation of experimental observations is difficult, and analysis through modelling becomes crucial to elucidate Membrane Electrodes Assembly (MEA) degradation and failure mechanisms.

In this framework, the project is made of two main parts:
- The first part is dedicated to ageing experiments on test stations. Some ex-situ electrochemical experiments will also be performed to focus on specific mechanisms responsible of degradation. The objectives of this working package are to establish a strong data base thanks to a relevant experimental design.

- In the second part, the global multi-scale model will be developed, on the basis of an existing model at CEA. For the parameters whose value is not always accessible experimentally, DLR, NESL et Ulm will use specific theoretical tools to provide some particular data to the global model.

Experimental and modelling parts will deal with both home-made and commercial MEA. Home-made MEA offer the possibility to fully control all parameters of the components. This will allow to validate the model on a large range of manufacturing and operating conditions. Then, the model will be applied to commercial MEA in representative automotive conditions.

The partnership of MAFALDA project is based on a close scientific and technical collaboration between different French and German research laboratories and institutes (CEA, DLR, ENSL, Ulm) and an industrial partner (PSA).

Partners

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ANR funding

678 545 €

Start- duration

December 2008 - 36 months

Contract

ANR-08-PANH-014