In situ H2 supply technology for micro fuel cells – ISH2SUP (245294)

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Partners

Partners: Aalto University (FI), CEA (FR), Hydrocell (FI), myFC(SE)

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Motivation

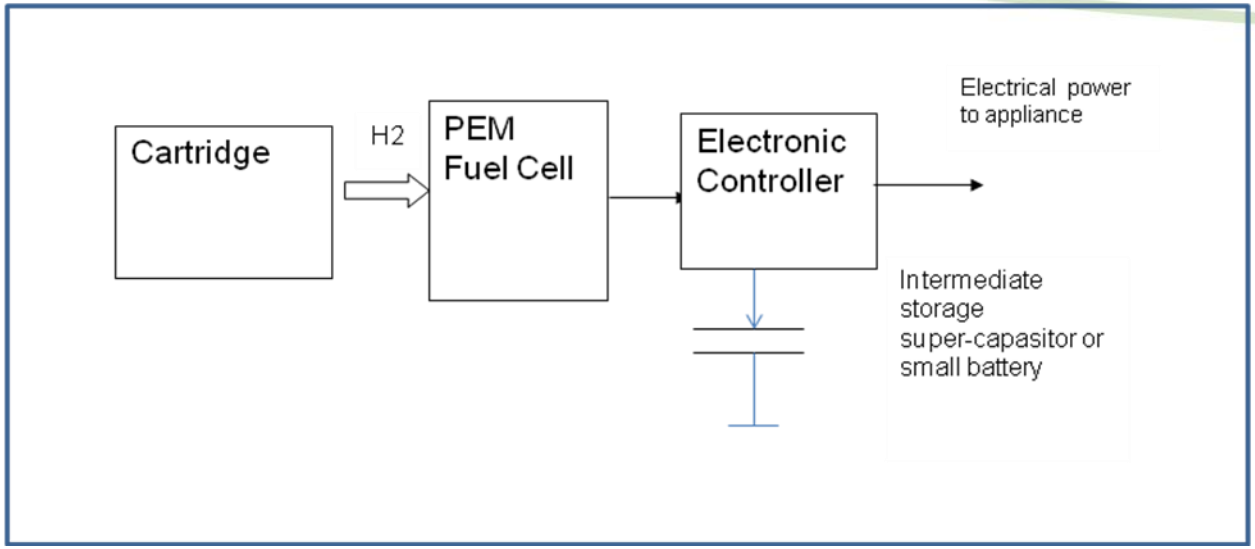
- Market pull for mobile and portable fuel cell based power sources
  - Increasing power gap of many mobile electronics devices, like laptops, smart phones, cameras, etc
  - Light mobile power for outdoor activities
  - Emerging markets with poor availabilty of grid or no grid especially in developing countries
- Most of the on-going developments are based on PEM technology, either DMFC or H2-PEM
- H2-PEM would be preferred over DMFC provided hydrogen would be easily, safely and sufficiently available in situ.

-> There is a need of easy to use and logistically feasible fuel cartridge technologies to make hydrogen really mobile.

Goals

- Development of controllable hydrogen production units, which utilize sodium borohydride ($NaBH_4$) or methanol as the primary fuel - the fuel cartridge
- Integration of the fuel cartridge and a micro fuel cell unit
- Prove feasibility of the concept taking into account all the safety regulations
- Targeted test case applications
  - 5 W mobile charger of 5 h operation time
  -10 W portable power source for Laptop non-grid usage
- Envisioned application: a replaceable/disposable fuel cartridge providing hydrogen gas in-situ and on-demand to a fuel cell power unit acting as a use extender for a laptop, a smart phone, an internet camera etc.

Main principle



ISH2SUP- concept – a micro hybride power system

Approaches

- The targeted power range is 5 – 20 W. In this range there are many electronic appliances for mobile use, like phones, laptops, cameras, etc
- In most of the applications the cartridge is intended to be used in the connection with a use extender rather than with a battery charger, which means that the power needed is lower than the device's charger power.

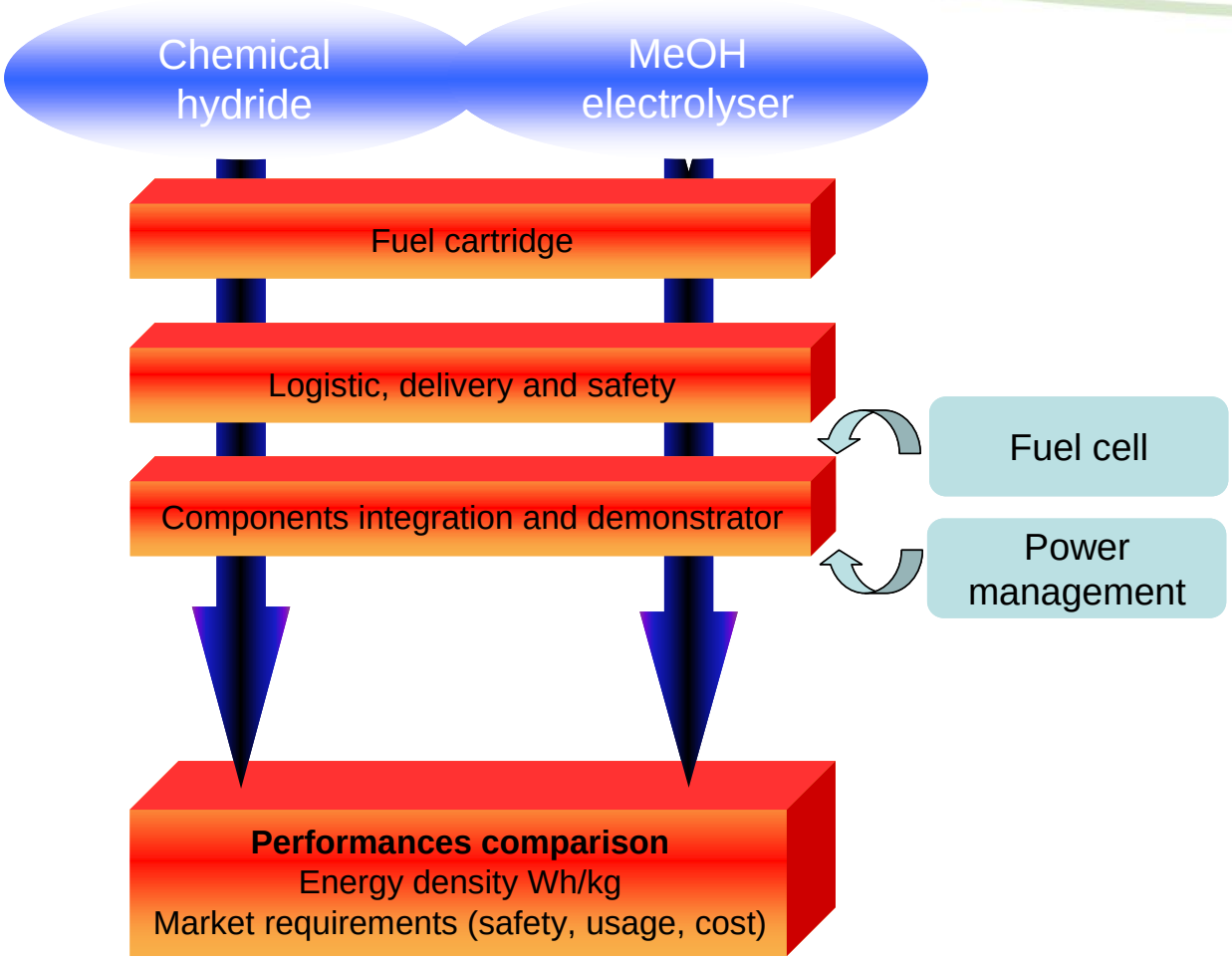
Two principles:

- Production of hydrogen gas from a primary fuel
  - Methanol
  - Sodium borohydride
- Conversion of the generated hydrogen to electricity by a micro PEM fuel cell

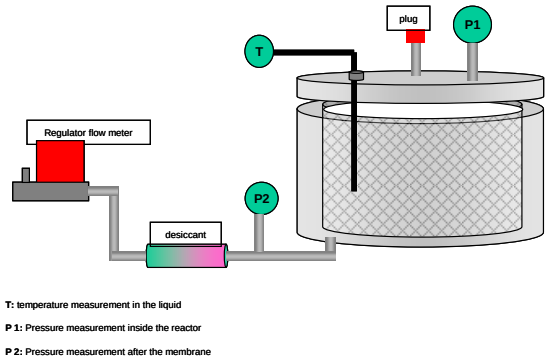
  - in the case of methanol conversion the energy needed (0,7-1Wh/lH2) is provided by the fuell cell

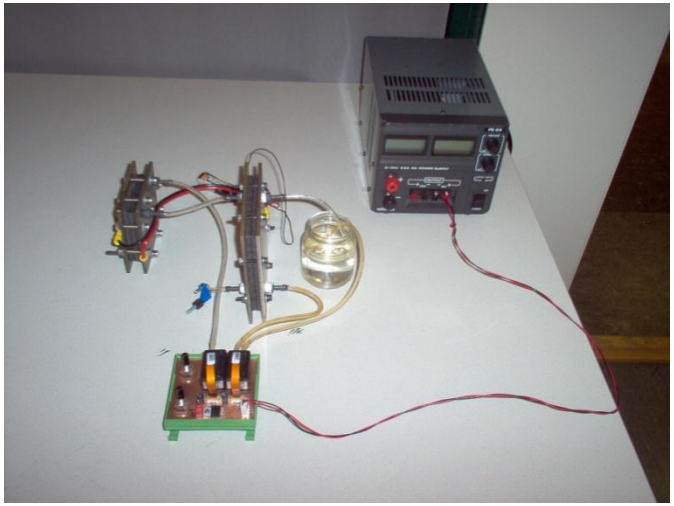
Overall approach

Fuel technology



The project is in the middle, the principles are in testing phase





A NaBH testing facility

$$NaBH_4 + H_2O \rightarrow 4\,H_2 + Na(OH)_4$$

An electrolyser test facility

$$C\,H_3\,O\,H + H_2O \rightarrow CO_2 + 3\,H_2$$ metal (Pt) catalyst

$$C\,H_3\,O\,H + H_2O \rightarrow C\,HOO\,H + 2\,H_2$$

enzyme (MDH)catalyst

State of the Art

- Portable fuel cell power sources have been developed very actively during last 10-15 years.
- Most of the developments are based on DMFC technology. Only few commercial success this far, however.
- Use of H2-PEM technology is limited because of limited hydrogen portability.
- ISH2SUP-project is targeted to improve this situation by providing two technologies to generate hydrogen in-situ in low temperature.

Aligment to MAIP/AIP

- ISH2SUP –project belongs to “Early Market” Application area
- Project concrete goals are set to demonstrate and evaluate possible product prototypes already during the project time.
- The companies involved are interested to integrate the results in their products, but there are also other interested companies.
- Any products ready to markets cannot, however, be reached during the project.

Expected results

- Prototype 20 Wh $NaBH_4$-cartridge for a mobile phone use extender or 5W charger (myFC).
- As a bigger size 120 Wh container for alkaline fuel cells (Hydrocell).
- Electrolyser cartridge-fuel cell system prototype for a non-grid long term power source for 10 W devices, e.g. mini-laptop (Hydrocell).
- Electrolyser-PEM fuel cell system prototype comparable to DMFC with better Wh/ml MeOH conversion (Aalto)
- Control electronics for both of the fuelling concepts.

Cross-cutting issues

- WP4 in the project is devoted to the safety issues, regulations and standards related to the logistics of the fuel cartridges.

- The project include a special activity (dissemination manager) to disseminate results both scientifically and publicly to demonstrate people new possibilities to operate electronic devices in non-grid environment.

Enhancing cooperation and future perspectives

Technology transfer:

- The research partners CEA and Aalto both have a national/in-house project in the same area including other partners than those participating ISH2SUP.
- Company partners myFC and Hydrocell are currently developing products which are directly connected to the RTD-work in ISH2SUP project.
- Technology transfer is regulated by the Consortium Agreement

Project future perspectives:

- The project DoW includes a contingency plan concerning possible difficulties to get the enzyme catalyst work properly. This plan has been already realized partly.
- The project is targeting to prototypes, which open possibilities to further product development. Decisions to that direction will be made during the next year.
- Both of the concepts studied for hydrogen in-situ production are not limited to the small power range. Preliminary investigation to enlarge the area to 100 W – 1kW will be done during the project. This will open applications e.g. to portable tools, small backboard motors etc.
- Electrolysis by the aid of enzyme opens up interesting possibility to produce hydrogen from different kind of bio-decomposable wastes including alcohols or sugars. The energy level around 3 W/l H_2 may be obtain, which is considerable less than in water electrolysis. At the same time BOD-value can be decreased. This is one way to continue the study made in the project with biocatalyst.