1 Publishable summary

In situ H2 supply technology for micro fuel cells powering mobile electronics appliances **ISH2**

Key Objectives of the project

The key objective of the project was to develop a fuelling system for micro-fuel cells using hydrogen. The concept is based on in-situ production of hydrogen from primary fuels. Two novel solutions are proposed: one is based on using NaBH4 as the primary fuel and the other one on utilizing catalyzed electrolysis of methanol to reform it. The primary application area is fuel cell based power sources of mobile and portable electronic appliances in off-grid environment. The ISH2 project concentrated on research and development of the hydrogen forming technology and the electronic system to control the hydrogen flow according to the consumption of the fuel cell system. Development of micro-fuel cells is excluded; validation of the fuelling system was performed by using commercially available fuel cells. The main practical targets were to prove technical feasibility of both fuelling technology and to show that they fulfill the requirements of mobile/portable electronic appliances in consumer markets as to safety, usability and logistics**.**

Challenges

The targeted power range was 5 – 20 W. Within this range there are many electronic appliances for mobile use, like phones, laptops, cameras, etc, which suffer short operation time caused by easily draining batteries. The project liked to develop easy to use portable fuelling systems for fuel cell based chargers or use-extenders of those devices. Challenges are related in addition to safety issues, to technical design making the fuel cartridges usable for common people and finally to environmental issues making them recyclable or disposable. Borohydrid (NaBH4)-technology to make hydrogen producing cartridges is already well known, but needed still studying and development to make it functioning well in small scale and for a long use period. Catalyst based electrolysis of methanol was a new method, which needed more basic studies. In the project two different type of catalysts were studied, platinum and an enzyme (MHD). After

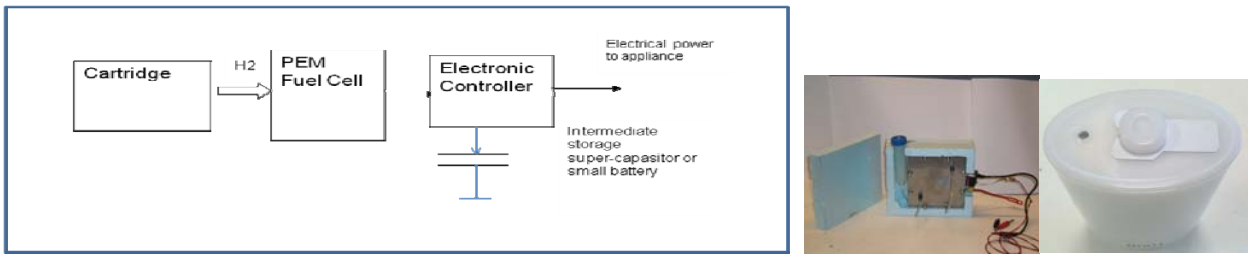
profound studies the platinum catalyst was chosen in the middle of the project for further development because of problems to obtain a high enough energy efficiency in hydrogen production when the enzyme catalyst was used.

Technical approach and deliverables

The technical approach adopted by the project was to develop the two technologies in parallel and test them in two application devices during the last project year. The test devices chosen were a smart mobile phone and a laptop computer. Both these devices are standard commercial appliances for which the project built a specific hydrogen driven non-grid charger or use-extender. The key targets in the development phase were:

- Prototype of 20 Wh $NaBH_4$-cartridge for a 5W mobile phone charger (CEA, myFC).
- Electrolyser cartridge-fuel cell system prototype for a non-grid long term power source for 10 W devices (Aalto, Hydrocell).
- Electrolyser-PEM fuel cell system prototype with a better methanol conversion (Wh/ml) than DMFCs (Aalto)
- Control electronics for the both fuelling concepts

The project produced a number of study reports as well two different prototypes as the deliverables.



Principle of ISH2-cartridge based power system and both type of hydrogen cartridges. Note: In the case of electrolysis the "cartridge" consists of methanol storage and the electrolyser.

Expected socio and economic impact

The project targeted to technical concepts and prototypes, which open up possibilities for further product development.

Both of the concepts of in-situ production of hydrogen from more easily transported fuels are not limited to the small power range. Preliminary investigation to enlarge the area to 100 W – 1kW has been done during the project. This will open applications e.g. to build power packs for portable tools, small backboard motors etc.

As a future perspective, electrolysis by the aid of enzyme opens up also 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 was reached in the project, which is considerably lower than that of water electrolysis. Simultaneously the BOD value of the waste could be decreased. This is one way to continue the study made in the project with biocatalyst.

Information

Internet: http://autsys.tkk.fi/en/ISH2

Project reference: FCH JU 245294
Call for proposals: 2008
Application Area: Early Markets
Project type: Research and Technological Development
Topic: Early Markets 4.2. Fuel Supply technology for portable and microfuel cells
Contract type: Collaborative Project
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