sccer mobility
Swiss Competence Center for Energy Research
Efficient Technologies and Systems for Mobility

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Hydrogen for Electromobility: A Promising Energy Carrier

Electromobility has received important attention in the last few years, but its perception by the public and decision makers is often limited to battery powered vehicles. Alternatives such as hydrogen fuel cells should however be taken into account, as their specific advantages (in particular short refueling times) make electromobility as a whole acceptable by a much broader public. Within the SCCER Mobility, PSI and ZHAW work on a novel fuel cell concept aiming at reducing the major limitation to the deployment of fuel cells: their cost.

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Introduction

Battery and hydrogen fuel cell vehicles both feature an environmentally attractive option for mobility:

- Free of emissions (CO_2, NOx, soot) on the local scale.
- On the global scale, important potential for CO_2 emission reduction (easy integration with renewable sources).

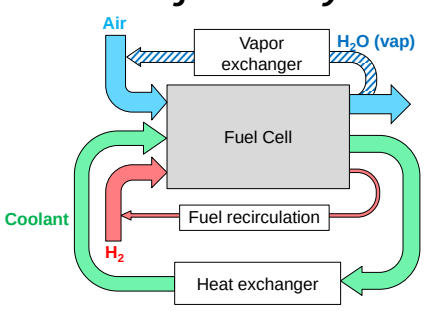
Currently, the major requirement for a large scale deployment of these technologies is a ***reduction of their cost.***

Advantages and drawbacks of fuel cell and battery electric vehicles

Requirement	Fuel Cell Electric Vehicle	Battery Electric Vehicle
Cruising range	+	–
Charging/refueling time	++	– –
Heavy duty traffic	+	–
Primary energy need	+	++
Cost	–	–

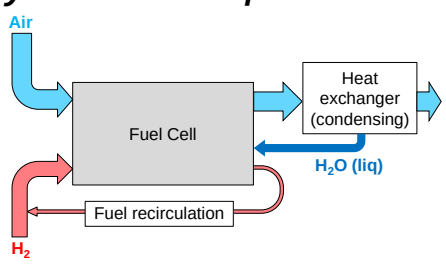
Cost reduction: novel evaporatively cooled fuel cell design

Classic fuel cell system



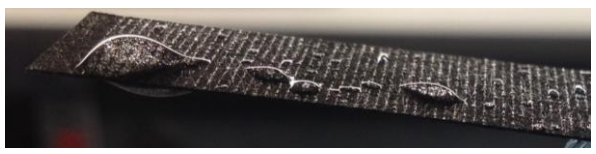
A vapor exchanger for humidification and a separate coolant loop are required.

FC system with evaporative cooling



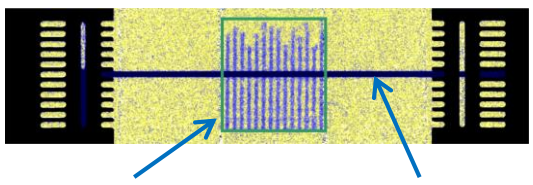
Humidification and cooling by water injection, simplifying the system and removing costly components. The distribution of injected water is challenging.

Our specific approach



Within the SCCER Mobility, we use a novel material with patterned wettability developed at PSI [1]. It allows to finely distribute the water without blocking the access of hydrogen and air.

Results and outlook

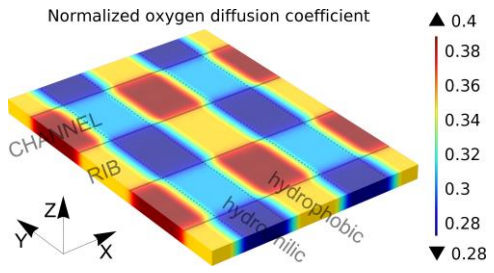


Fine distribution over the active area

Water injection channel

Neutron imaging of the water distribution in a laboratory test cell (4 cm2) using the proposed concept [2].

- Development conducted as a combination of experimental work at PSI and numerical simulations at ZHAW.
- Proof-of-concept realized with a laboratory cell during the 1st phase.
- Demonstrator on the kW scale planned during the 2nd phase.



3D simulation of a gas diffusion layer with patterned wettability for improved oxygen diffusivity [3].

References

[1] P. Boillat, F. Büchi, L. Gubler, A. Forner-Cuenca, C. Padeste, "A method to produce a gas diffusion layer and a fuel cell coprising a gas diffusion layer", Patent Application WO/2016/037833 A1 (Priority: 9.9.2014)

[2] M. Cochet, A. Forner-Cuenca, V. Manzi, M. Siegwart, D. Scheuble, P. Boillat, "Novel concept for evaporative cooling of fuel cells: an experimental study based on neutron imaging", *European Fuel Cell Forum (EFCF)*, Luzern, Switzerland, 6.7.2017

[3] J. Dujc, A. Forner-Cuenca, P. Marmet, M. Cochet, R. Vetter, J. Schumacher, P. Boillat, "Modelling the Effects of using Gas Diffusion Layers with Patterned Wettability for Advanced Water Management in Proton Exchange Membrane Fuel Cells", *Journal of Electrochemical Energy Conversion and Storage*, in press (2017).

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