



I²BRENN

Intelligent monolithic integrated fuel cell cascades including hydrogen storages

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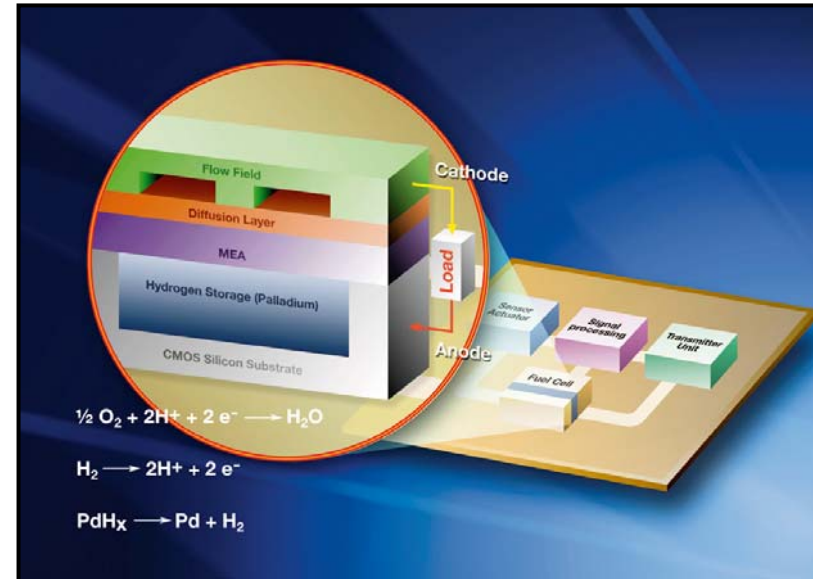
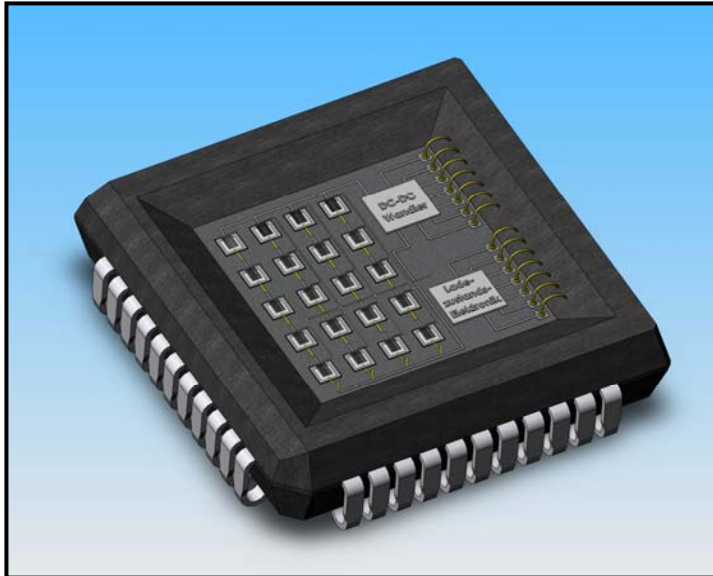
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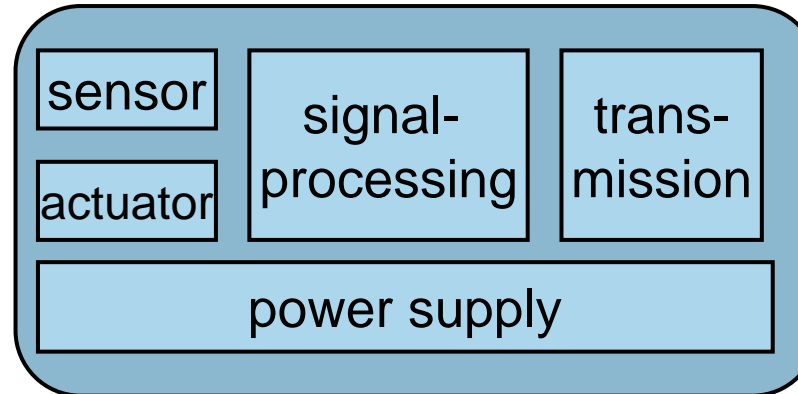
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Aim of I²Brenn



**Chip integrated PEM fuel cell cascades
as on chip power supply**

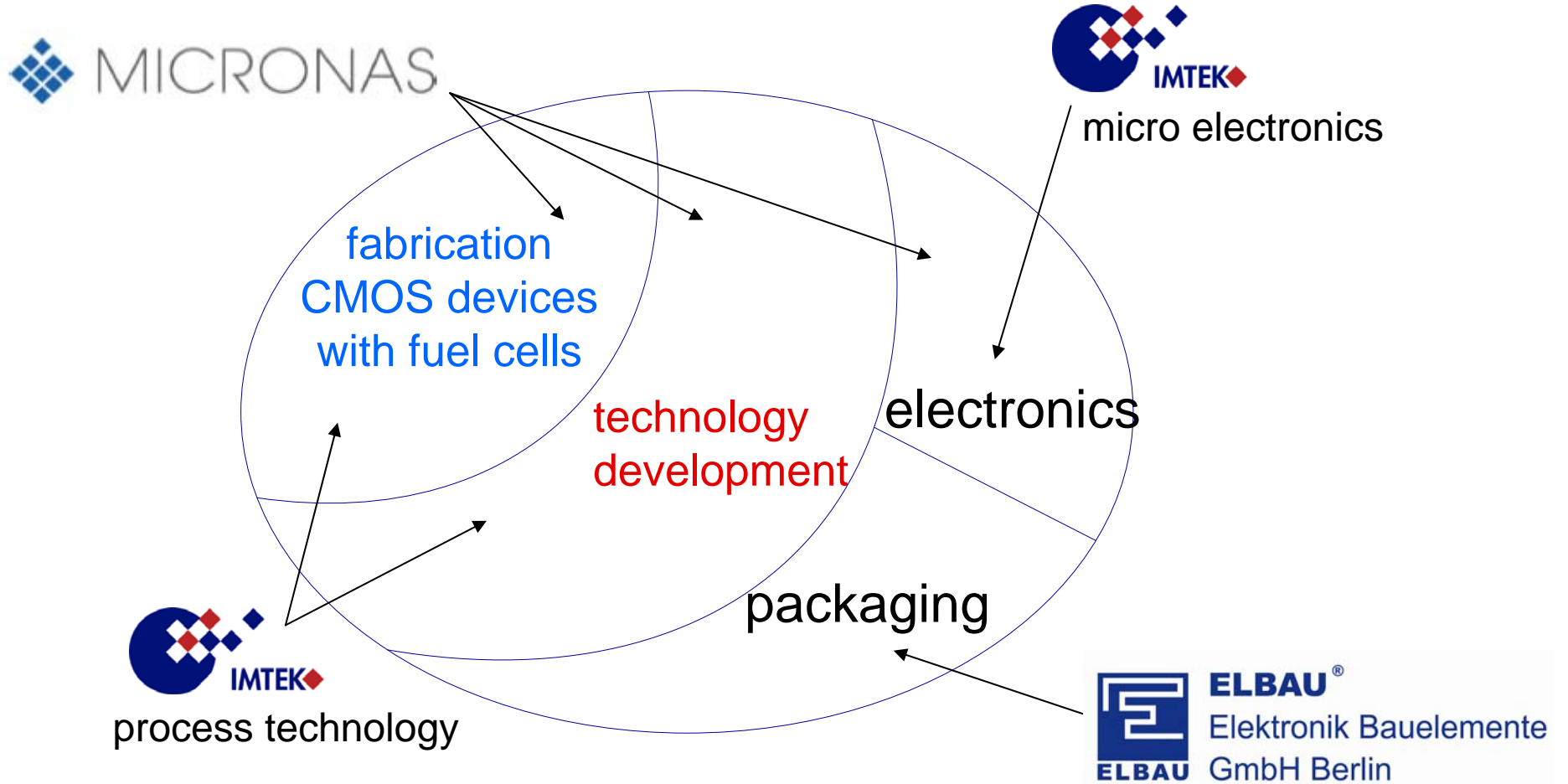
Set-up of autonomous micro systems



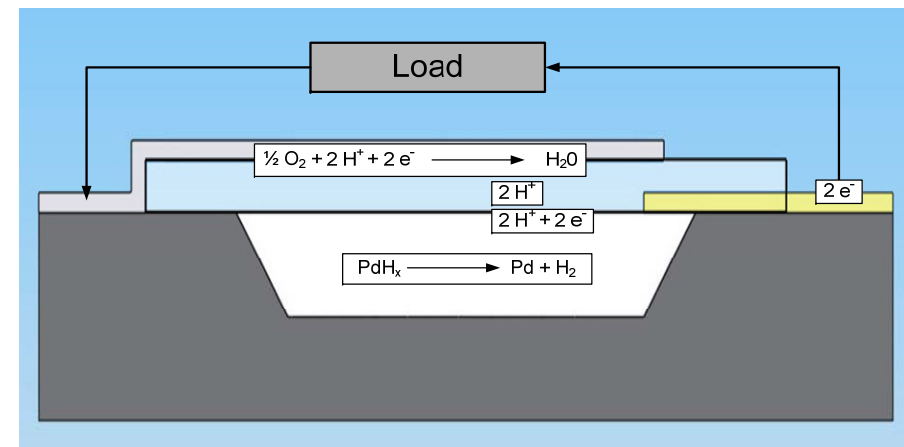
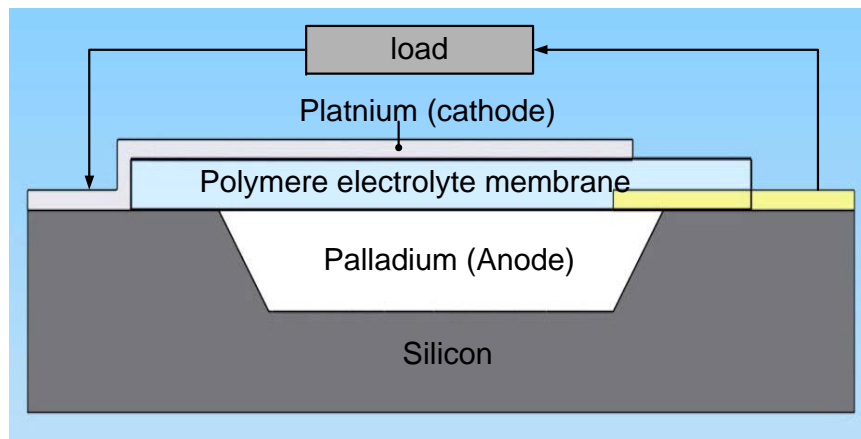
Application areas:

- monitoring of environmental parameters
detection of environmental toxins
- monitoring of temperature, humidity, acceleration by goods transportation
- measuring of temperature, humidity, gas concentrations for an intelligent building management

Project partners



Working principle of the „Chip integrated fuel cells“

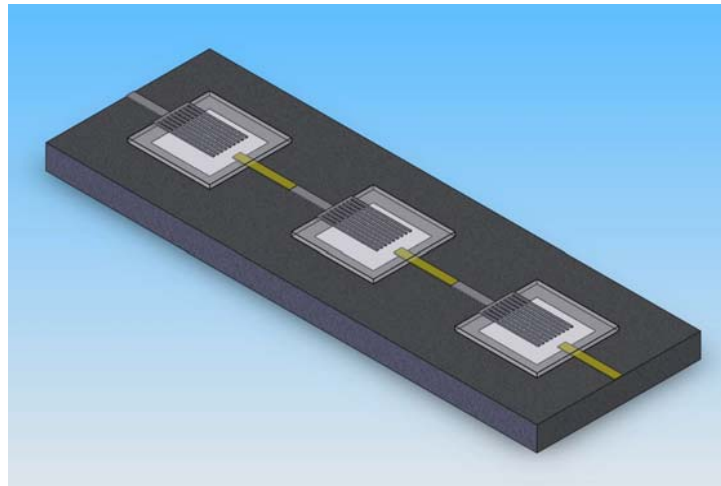


Integrated palladium hydrogen storage

- no peripheral components
- no diffusion layer, no flow fields
- cell voltages between 0.5 and 0.7 Volts

➔ Increasing output voltage

Increasing output voltage by cascading fuel cells

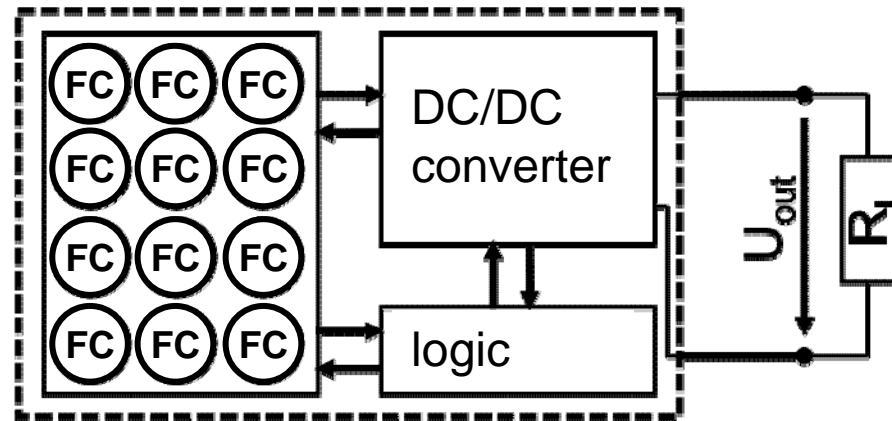


Connection of the cells in series

- output voltages of 3.3 volts
- power output of the cells depends on working point and state of charge

➔ Concept for dynamic, adaptive connection of fuel cell cascades

Intelligent wiring of the fuel cell cascades



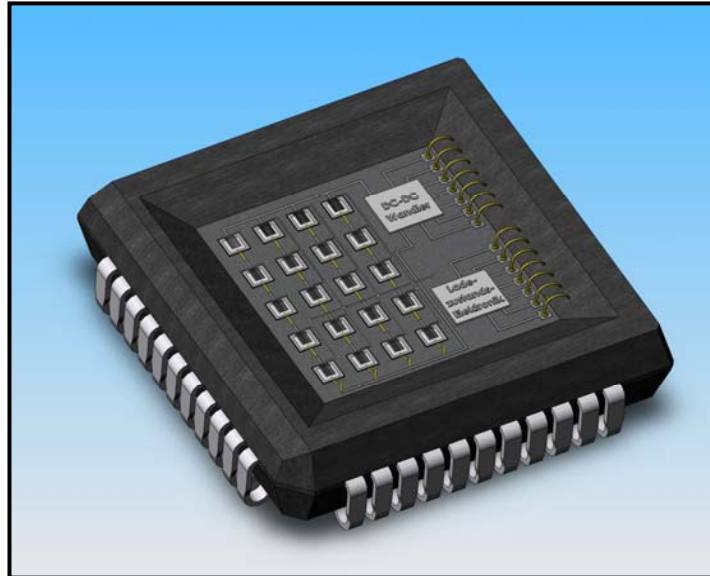
Stabilized output voltage

- DC/DC converter regulates output voltage to a constant level

Energy management

- dynamic adaptive connection the fuel cell cascades by CMOS devices

Assembly & Packaging



Requirements of the package

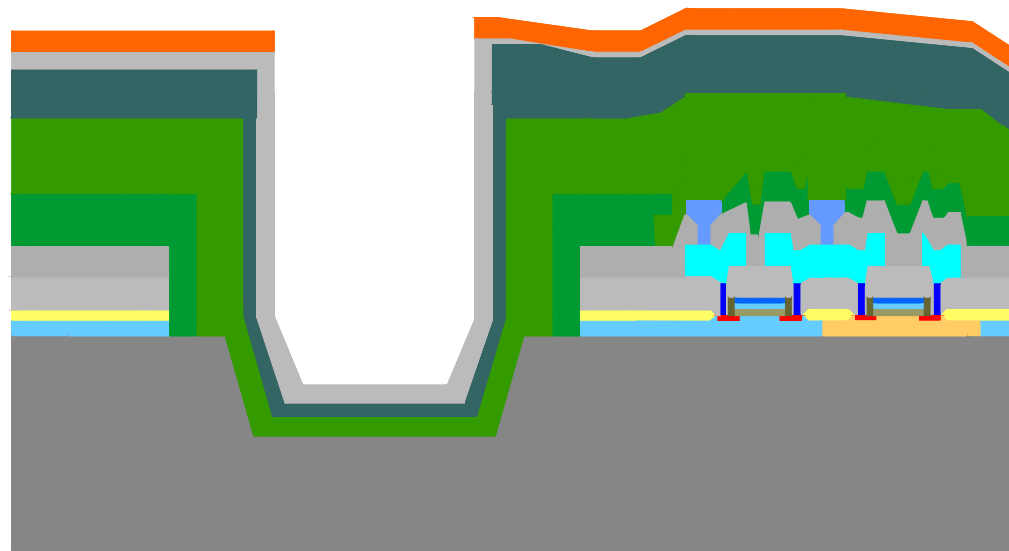
- oxygen permeability for operation of the fuel cells
- protection of the CMOS devices from environment

Fabrication concept

CMOS process with cavities

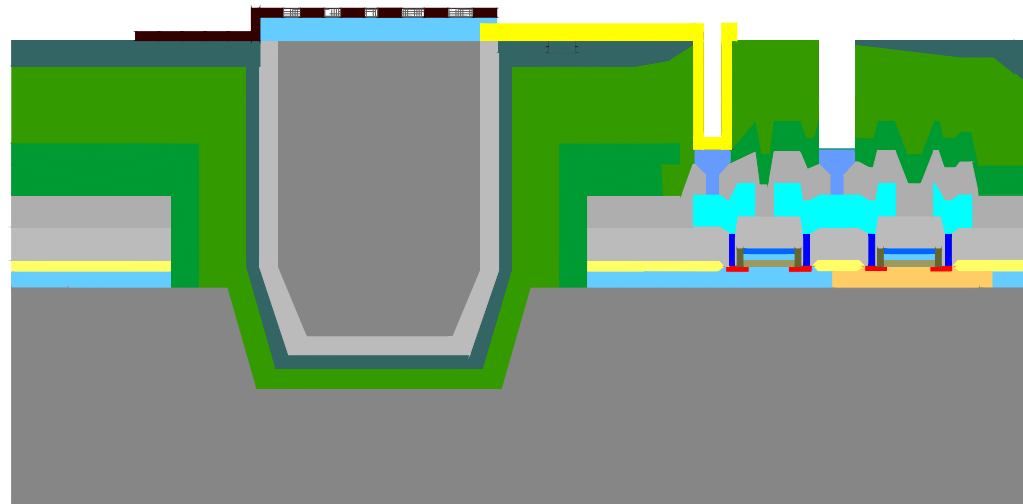
Integration of the functional layers

- etching the cavities by an anisotropic KOH process
- electrical insulation between hydrogen storage and silicon substrate
- integration of hydrogen diffusion barriers
- seed layer for electro plating of the hydrogen storage
- masking the silicon surface by a photo resist



Fabrication of the fuel cells

- electrical connection of the palladium storages
- deposition of the polymer electrolyte membranes
- deposition of the self breathing air diffusion cathodes

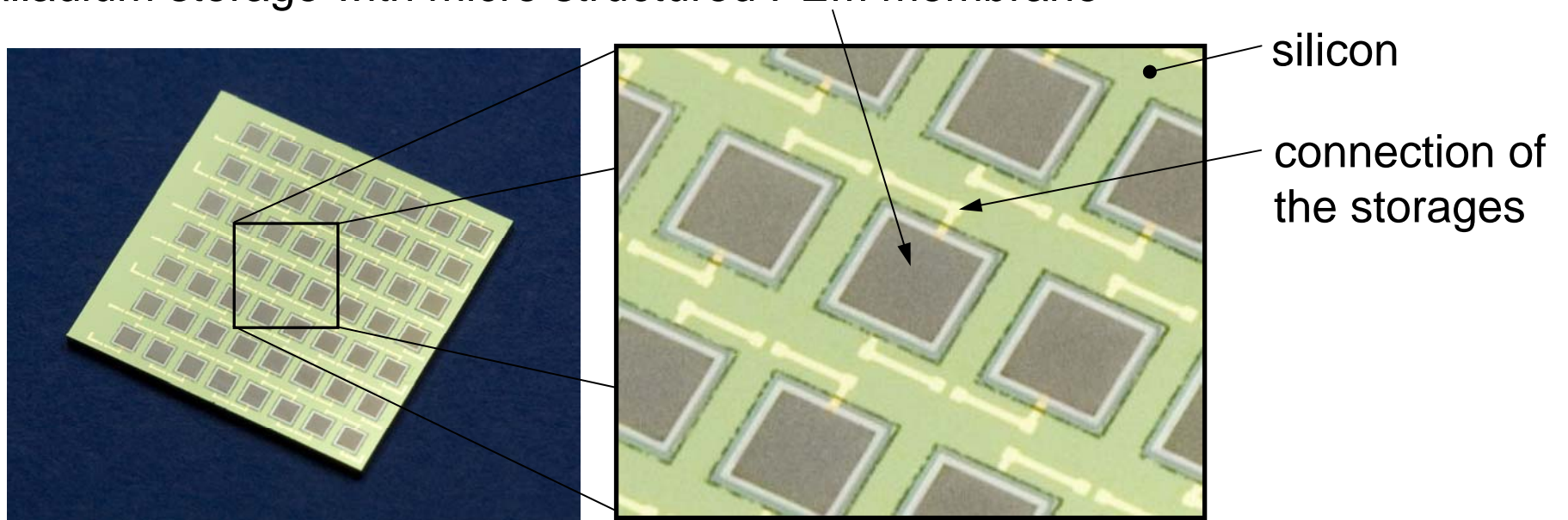


Experimental results

Fabrication of the fuel cell cascades

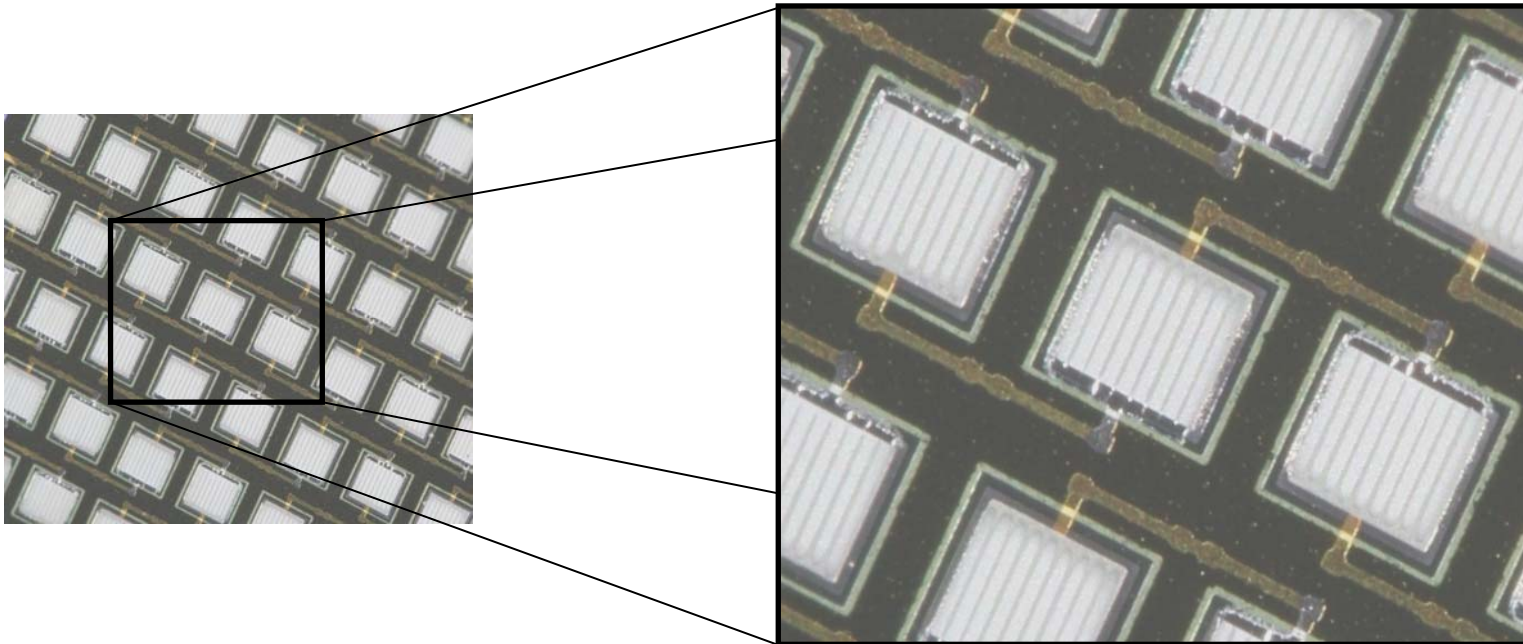
- electrical connection of the hydrogen storages
- deposition of the polymer electrolyte membranes

palladium storage with micro structured PEM membrane



Fabrication of the fuel cell cascades

- deposition of the self breathing air diffusion cathodes



Conclusion & Outlook

Conclusion:

- development of a CMOS process with cavities
- process flow has been evaluated

Outlook:

- electrical characterization of the fuel cell cascades
- system integration of fuel cell cascades with CMOS devices



END