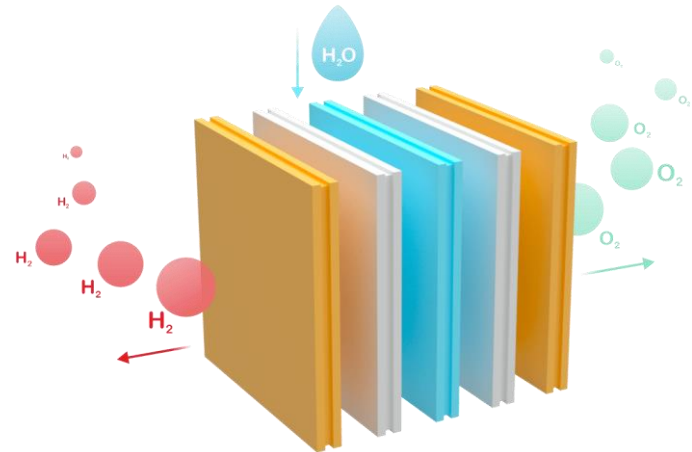


A novel stack concept for membrane-based water electrolysis with hydraulic cell compression – A prototype of an alkaline WE with improved materials and properties

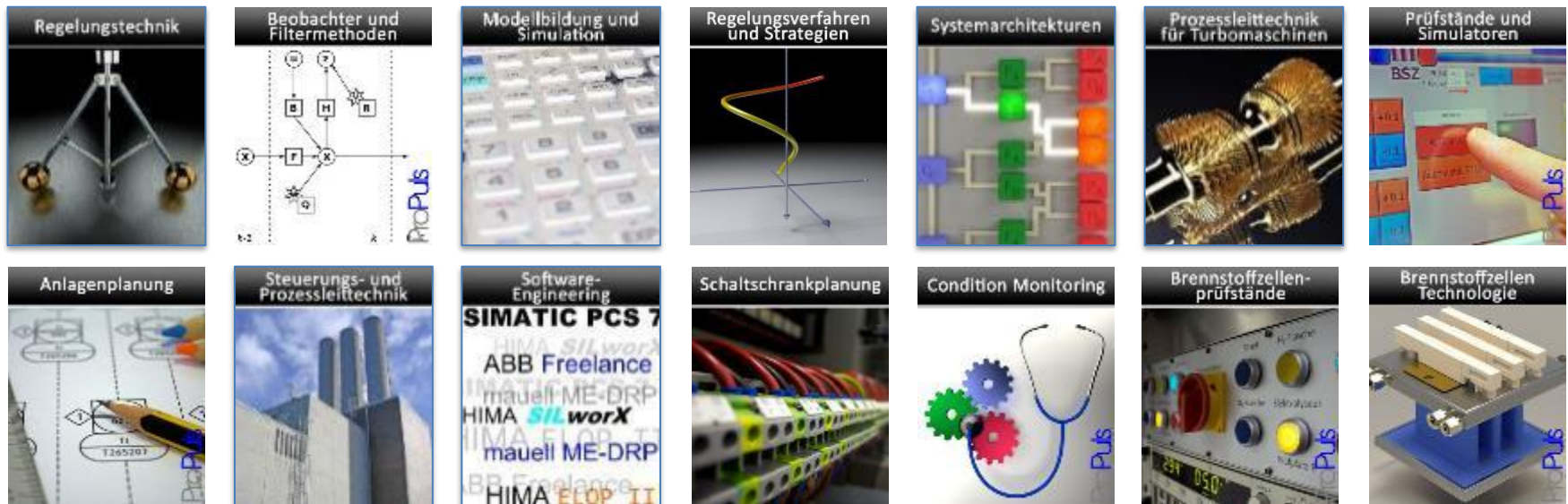
**Dr. Ulrich Rost**

Member of the managing board  
Acquisition & strategical projects



# We bring intelligence to your $H_2$ -application!

- Engineering office for energy systems (electrical energy, heating, chilling, bio-gas, hydrogen)
- Modern solutions for automation and controls
- Software engineering and validation
- Prototyping, customized test benches and test systems (R&D)
- PEM/AEM water electrolysis (R&D)



# Objectives of ProPuls within the NEWELY project

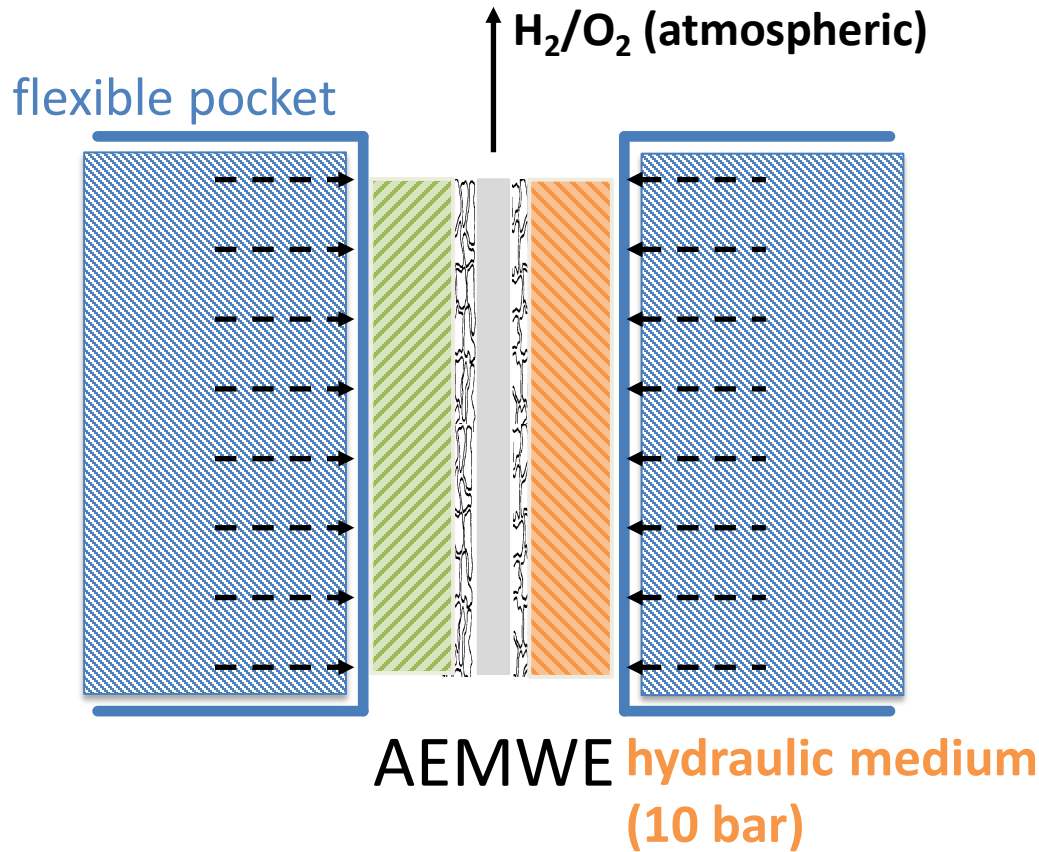
- Development and assembly of novel laboratory AEMWE cells based on hydraulic cell compression for comparative small-scale tests (active cell area = 25 cm<sup>2</sup>)
- Design and manufacture of a high-pressure AEMWE stack based on advanced materials and structures (active cell area = 200 cm<sup>2</sup>)
- Planning and realization of a laboratory test bench to accommodate and operate NEWELY test cells as well as the NEWELY prototype



2020 (BoP)

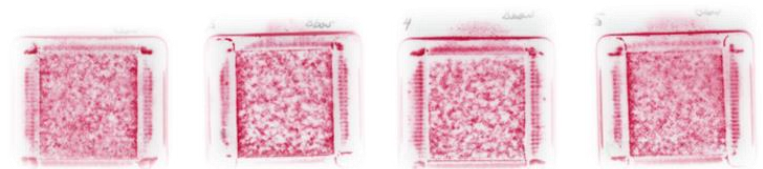
2023 (EoP)

# Modular AEM electrolyzer design based on hydraulic cell compression



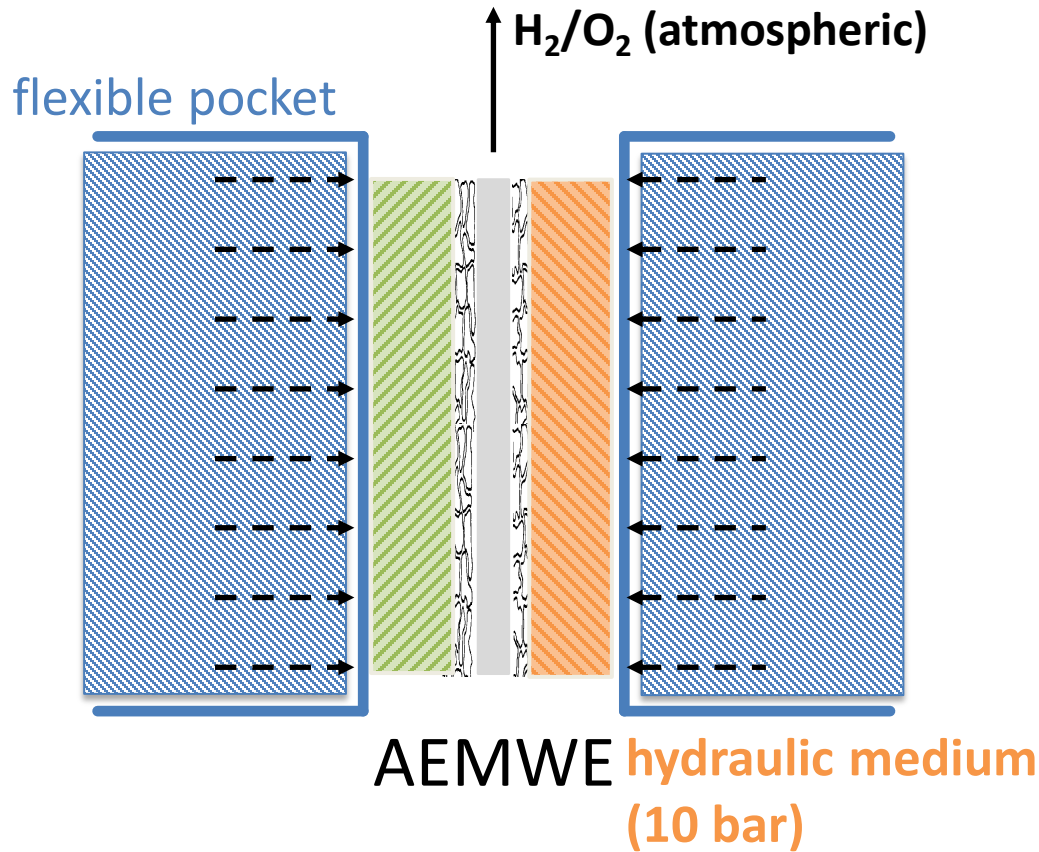
## Basic principle:

- Active cell components are entirely surrounded by hydraulic medium
- This ensures homogeneous cell compression (no hot spots, any size and any number of cells possible)
- This ensures homogeneous waste heat transfer
- Fuel cell, battery and electrolyser designs possible



Pressure sensitive films of 4 individual cells

# Modular AEM electrolyzer design based on hydraulic compression



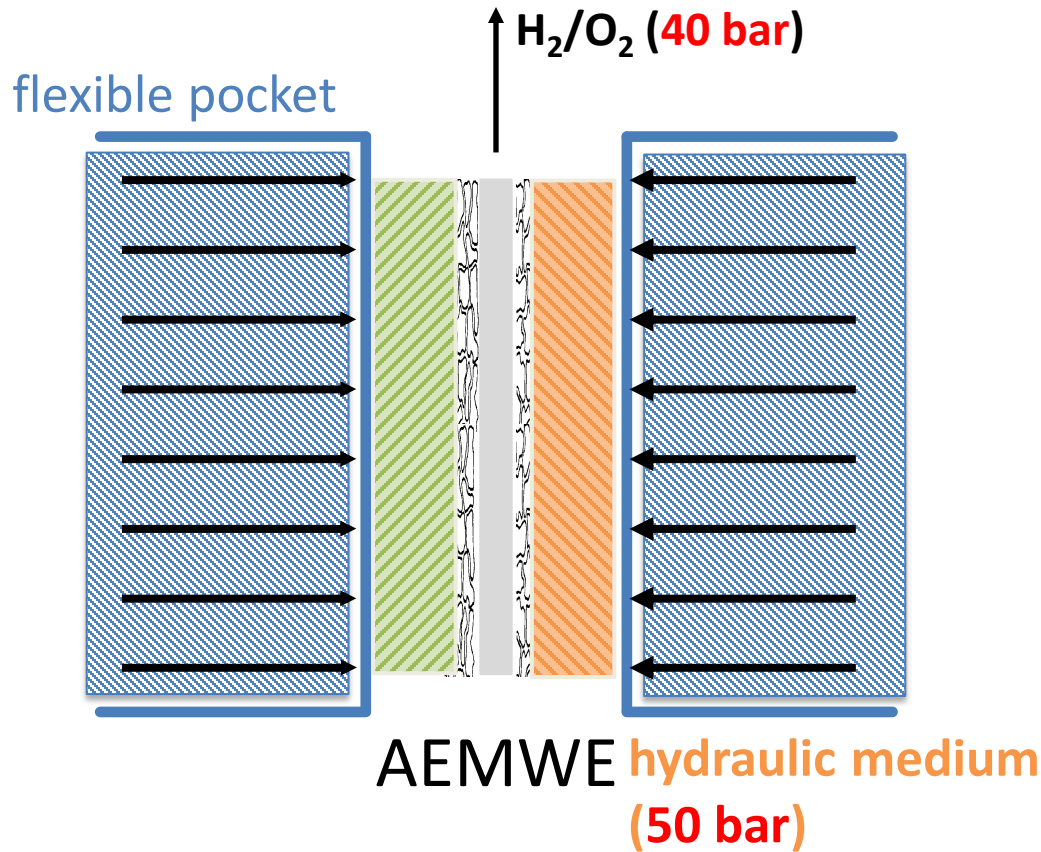
## Advantages:

- Increased stack safety for FC and EL design
- High current densities and high operation temperature
- Waste heat recuperation
- Easy stack assembly due to modular stack design

## WO2011/069625:

Vorrichtung zur Energieumwandlung, insbesondere Brennstoffzellenstack oder Elektrolyseurstack

# High-pressure electrolyzer design based on hydraulic compression



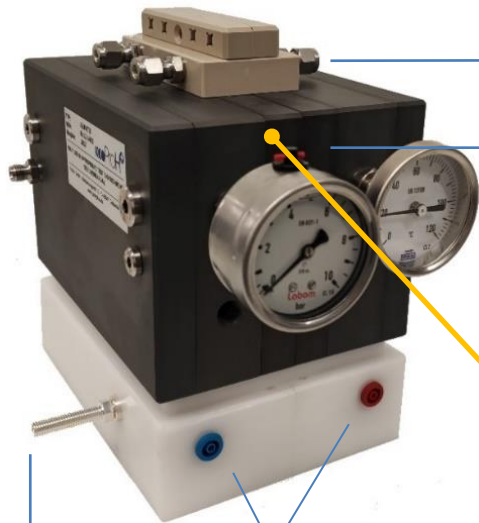
## High pressure EL operation:

- Control of hydraulic media's pressure level according to inner cell pressure – e.g., always keep a pressure difference of 10 bar
- Planar cell design for high-pressure cell components
- The outlet pressure is just dependant on the outer pressure housing and electrolyzer components

## WO2014/040746:

Verfahren und System zum Betreiben eines Elektrolyseurs

# The NEWELY test system – CRM free cell setting #1

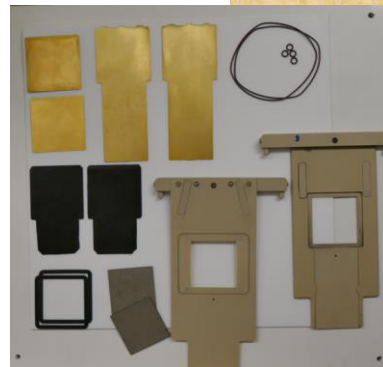
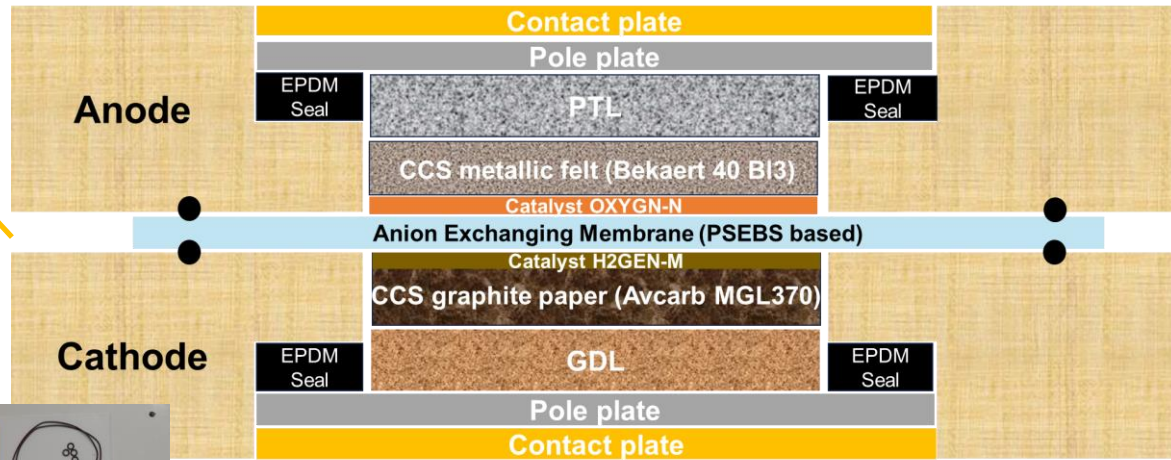


Media manifold up to 5 bar outlet pressure

Pressure housing up to 20 bar or even higher

Cell voltage

Power contact up to 150 A

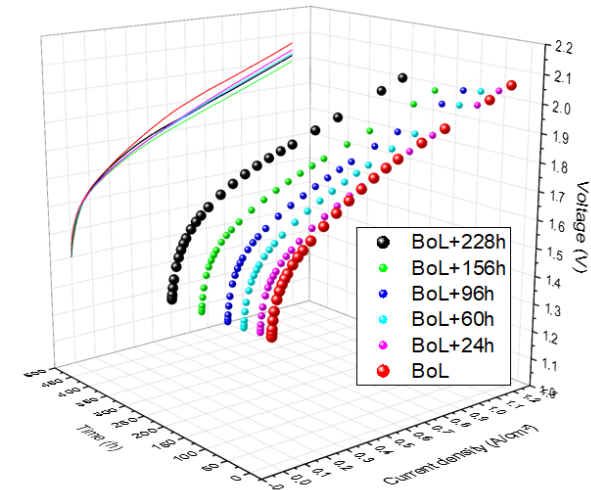
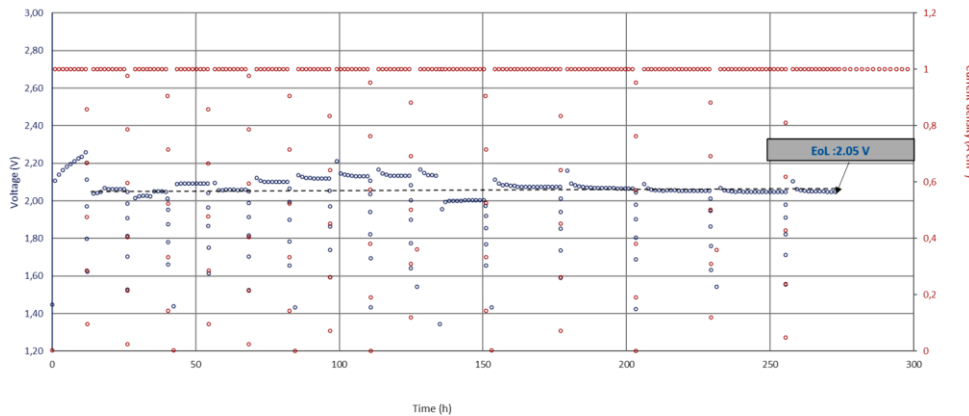


# The NEWELY test system – CRM free cell setting #2

## A standardized AEMWE laboratory device for round robin tests

- Reproducible test results due to controllable homogeneous cell compression and temperature distribution (4 and 25 cm<sup>2</sup> so far)
- Several powerful cell settings were discovered, CRM-free and PGM-based
- ProPuls is the supplier of testing hardware for an EU wide AEMWE round robin test (SUSTAINCELL)

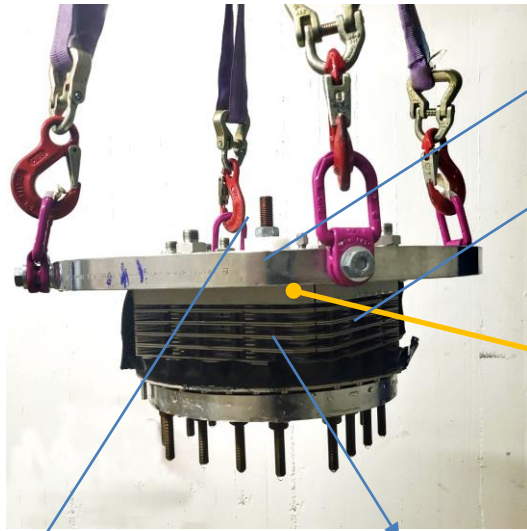
Evolution of the voltage @  $i = 1 \text{ A cm}^{-2}$



F. Fouda-Onana – CEA – AEM ELECTROLYSIS (NEWELY Project)



# The NEWELY prototype – a CRM free rainbow configuration



Pressure housing

Five cells with different active material configuration (200 cm<sup>2</sup>)

Media connectors

Flange

Pressure housing

Porous transport layers

Power contacts

Process water channels

Hydraulic medium

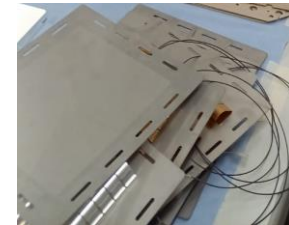
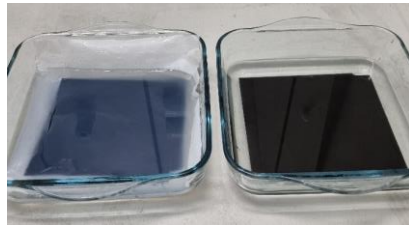
Catalyst coated membrane

Spring contacts

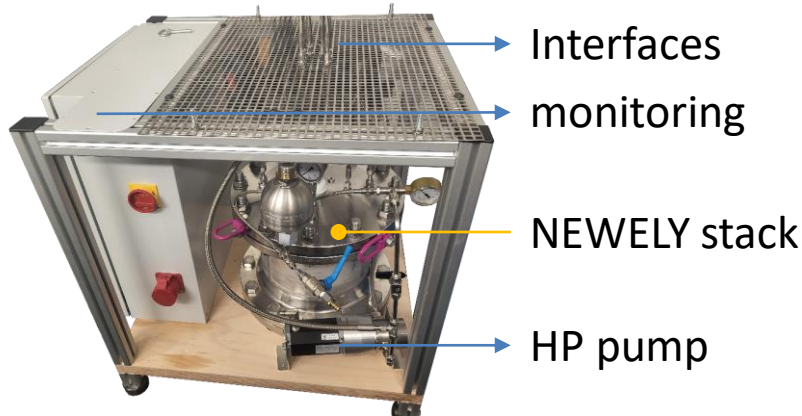
Single cell voltage measurement

Power contact 200 A

## An advanced stack platform to host newly developed materials

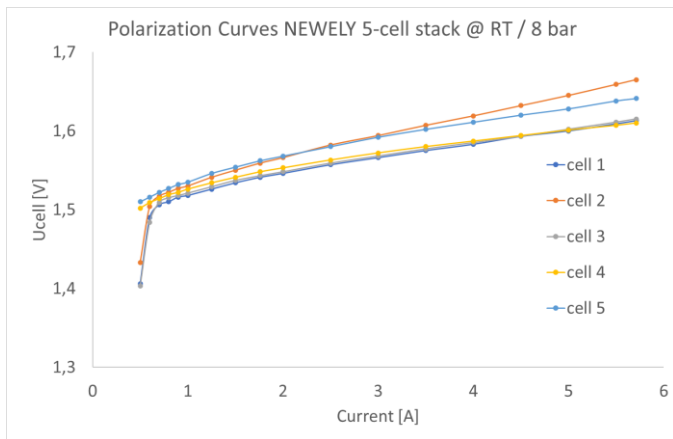


# The NEWELY prototype – a CRM free rainbow configuration



## Pre-tests to ensure operability:

- Cell voltage measurement
- Temperature sensors
- Process media flux
- Stack heating
- Cell compression
- Initial cell test at RT



After successful pre-checks, delivery to ITA



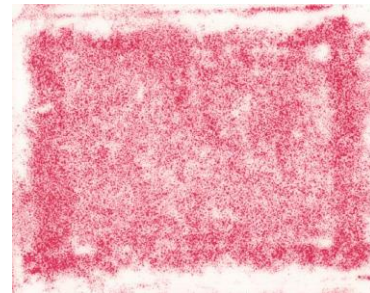
A 2,000-h test has just started and will soon be reported

# Recent R&D activities to discover the power of AEMWE

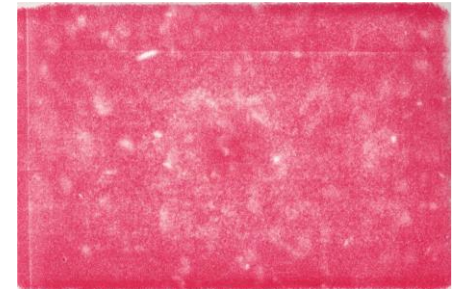
## High-pressure electrolysis



## Hydraulic cell compression for industrial-scale cells

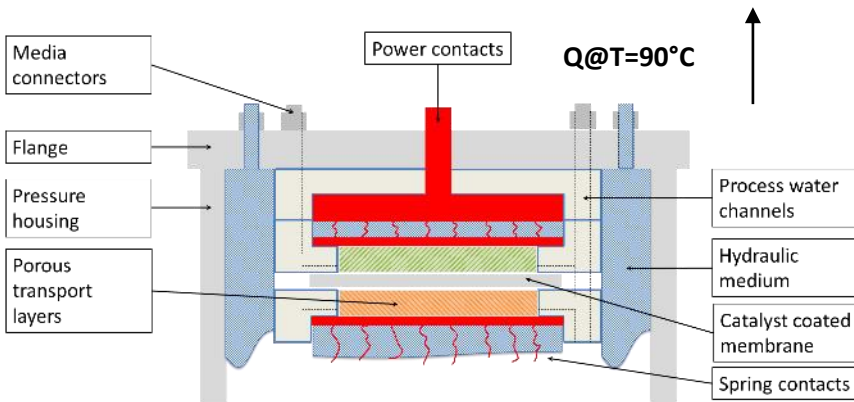


A = 20 cm<sup>2</sup>

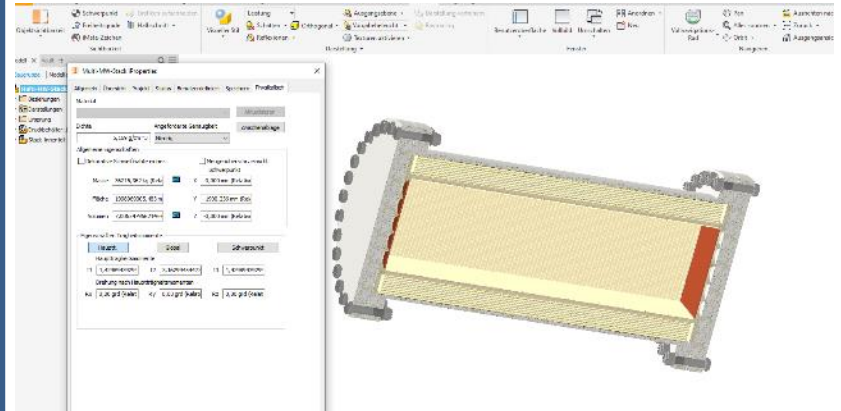


A = 600 cm<sup>2</sup>

## Waste heat recuperation



## Multi-MW-Stacks



# Acknowledgement

The project NEWELY has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 875118. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation program, Hydrogen Europe and Hydrogen



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Thank you very much for your attention

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