



UNIVERSITÀ
DEGLI STUDI
DI TRIESTE



Dipartimento di
Ingegneria
e Architettura

INTRODUCTION TO THE LABORATORY ACTIVITIES

ON HT-PEMFC AND AEMWE

Prof. Rodolfo Taccani

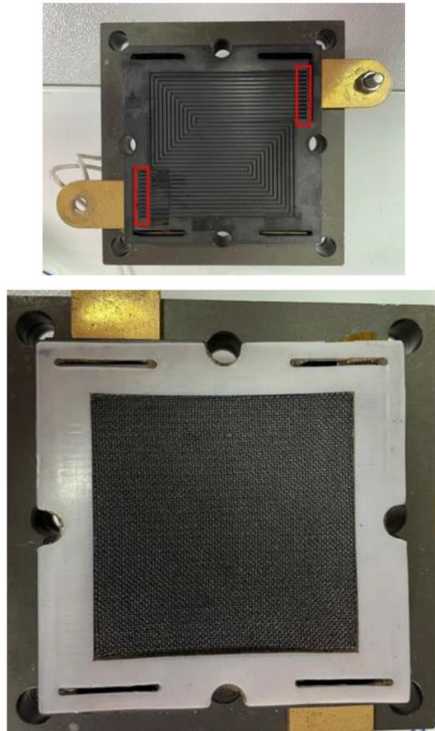
Prof. Marco Bogar

A.A. 2023-2024



1. CHARACTERIZATION OF A HIGH-TEMPERATURE PEMFC

CHARACTERIZATION OF A HT-PEMFC



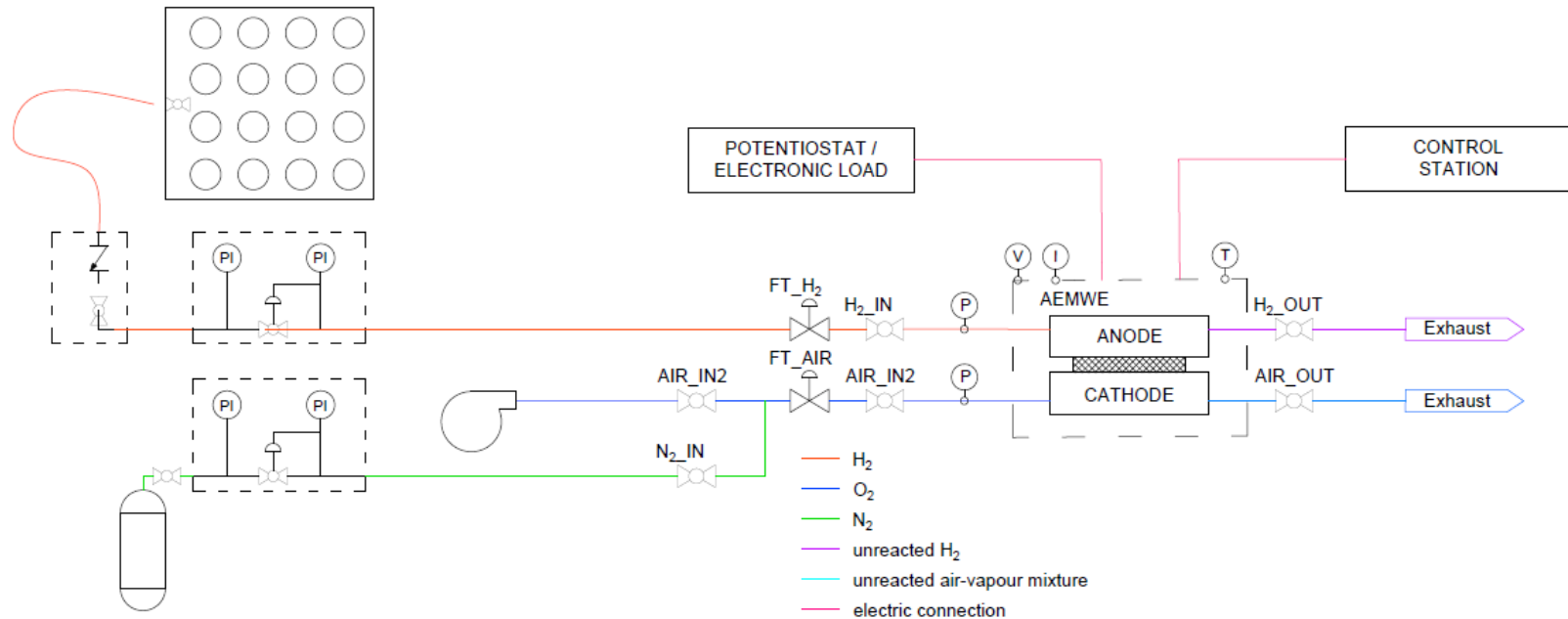
MEA composition

Electrolyte	PEM: <i>TPS® (Pyridine based aromatic polyether electrolyte)</i>	T: 120 – 200 °C t: ≈ 60 μm σ: 0.08 S/cm
Anode ($4OH^- \rightarrow O_2 + 2H_2O + 4e^-$)	Catalyst: <i>Pt/C</i>	
Cathode ($4H_2O + 4e^- \rightarrow 2H_2 + 4OH^-$)	Catalyst: <i>Pt/C (30%wt)</i>	1 mg _{Pt} cm ⁻²
GDL		t _{GDL} : 300 μm
Bipolar plates	<i>Graphite, enclosed in stainless steel BP</i>	Applied torque: 5 Nm

MEA surface area: 50 cm²

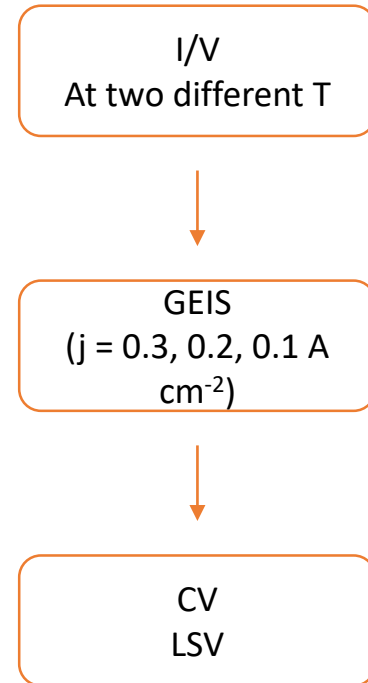
https://advent.energy/docs/tps_mea_product_sheet.pdf
<https://doi.org/10.3390/membranes12010094>
<https://doi.org/10.1002/pi.266>

CHARACTERIZATION OF A HT-PEMFC



CHARACTERIZATION OF A HT-PEMFC

The screenshot shows the Energy.gov website header with navigation links: Newsroom, Leadership, Energy.gov Offices, National Labs, and a search bar. Below the header is the 'Office of ENERGY EFFICIENCY & RENEWABLE ENERGY' logo and a menu with categories: ABOUT EERE, INITIATIVES, RESOURCES, ENERGY EFFICIENCY, RENEWABLE ENERGY, and SUSTAINABLE TRANSPORTATION. A dropdown menu is open for 'HYDROGEN AND FUEL CELL TECHNOLOGIES OFFICE'. The main content area features a green banner with the title 'Fuel Cell Tech Team Accelerated Stress Test and Polarization Curve Protocols for PEM Fuel Cells' and the date 'AUGUST 18, 2015'. Below the banner are social media icons for email, Facebook, Twitter, LinkedIn, and Pinterest. The article text includes: 'Hydrogen and Fuel Cell Technologies Office >>', 'Fuel Cell Tech Team Accelerated Stress Test and Polarization Curve Protocols for PEM Fuel Cells', and 'Accelerated stress test and polarization curve protocols developed by the U.S. DRIVE Fuel Cell Technical Team for polymer electrolyte membrane (PEM) fuel cells, revised January 14, 2013.' A link is provided: 'Fuel Cell Tech Team Accelerated Stress Test and Polarization Curve Protocols for PEM Fuel Cells'.



CHARACTERIZATION OF A HT-PEMFC

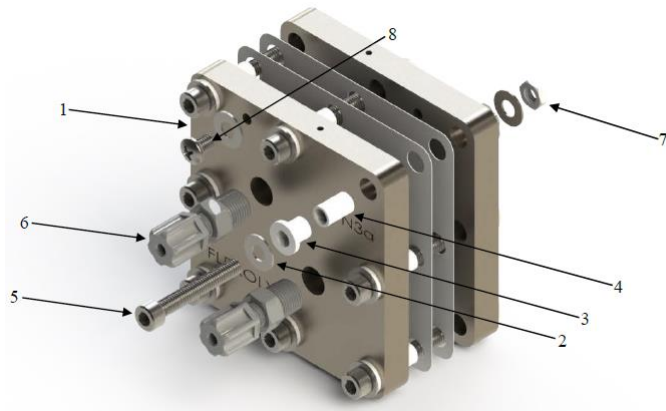
Report:

- Description of the experimental setup
- Description of the experimental activity
- Plot data, compare the I/V curves, discuss the differences in EIS at the different operative points, and discuss the shape of the recorded CV



2. CHARACTERIZATION OF AN AEMWE

CHARACTERIZATION OF AN AEMWE



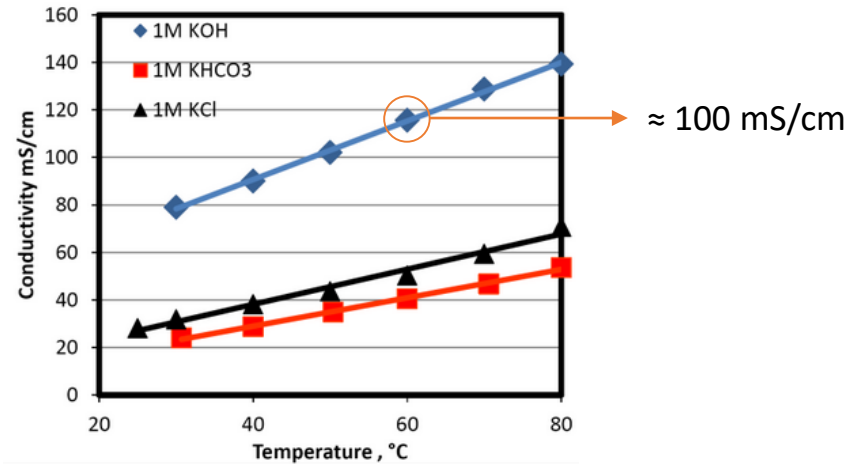
<https://dioxidematerials.com/product/complete-5-cm2-water-electrolyzer/>

MEA composition

Electrolyte

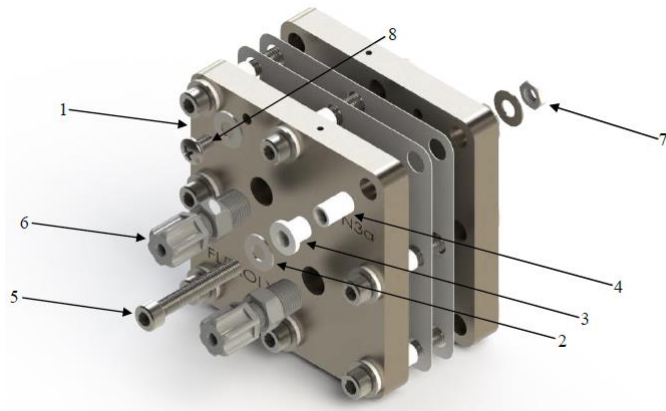
AEM: Sustainion

ρ : $0.045 \Omega \text{ cm}^2$
 t : $50 \mu\text{m}$
 σ : 0.1 S/cm



<https://dioxidematerials.com/technology/sustainion-membranes/>

CHARACTERIZATION OF AN AEMWE



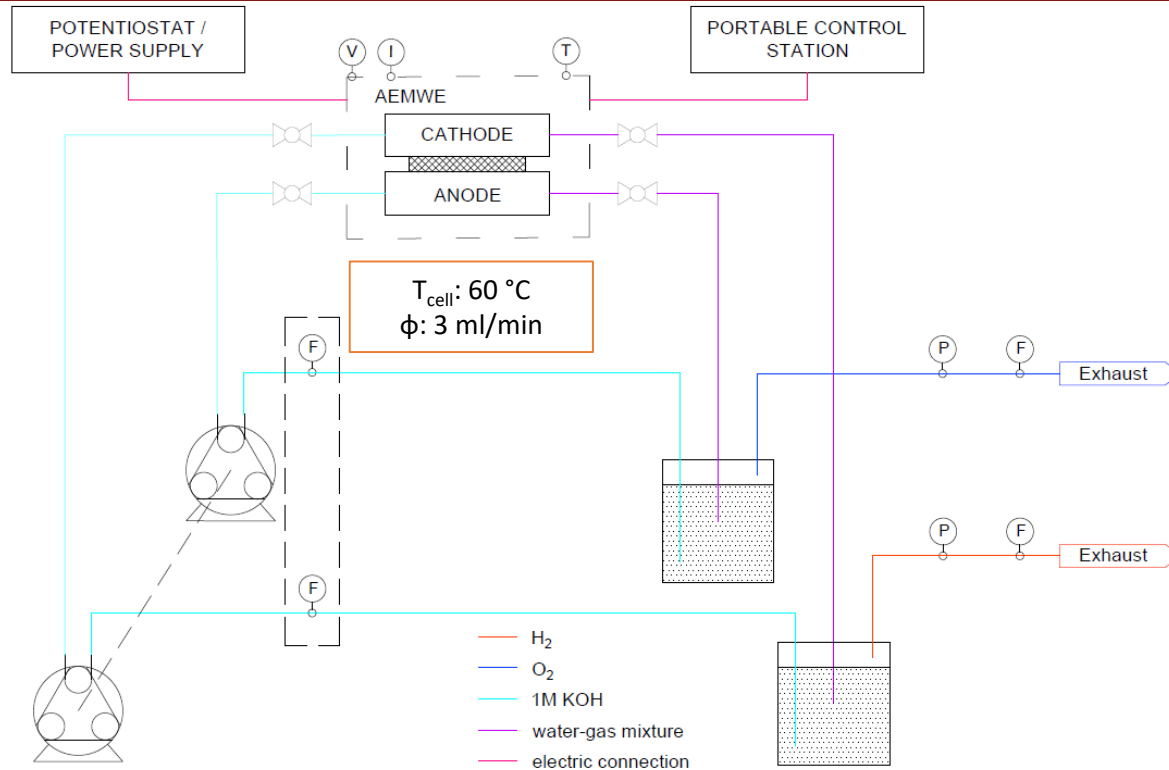
MEA composition

Electrolyte	AEM: Sustainion	ρ : $0.045 \Omega \text{ cm}^2$ t: $50 \mu\text{m}$ σ : 0.1 S/cm
Anode ($4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$)	Catalyst: <i>NiFeOx</i> GDL: <i>stainless steel fiber paper</i>	
Cathode ($4\text{H}_2\text{O} + 4\text{e}^- \rightarrow 2\text{H}_2 + 4\text{OH}^-$)	Catalyst: <i>Ni₅₀Al₅₀ (Raney Ni)</i> GDL: <i>Nickel fiber paper</i>	
Bipolar plates	<i>Ni-made</i>	

MEA surface area: 5 cm^2

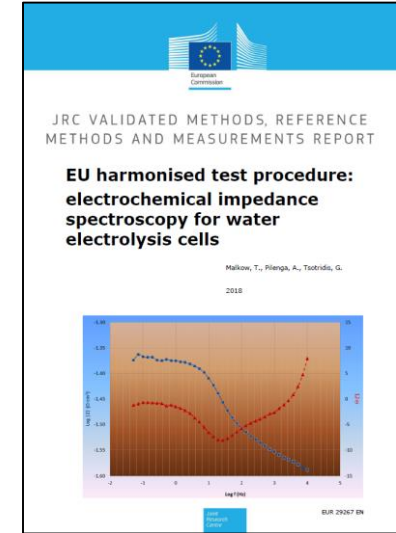
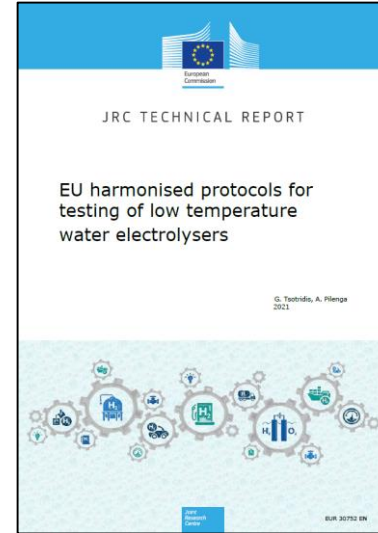
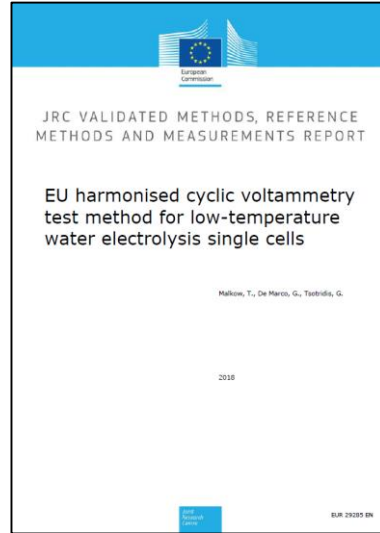
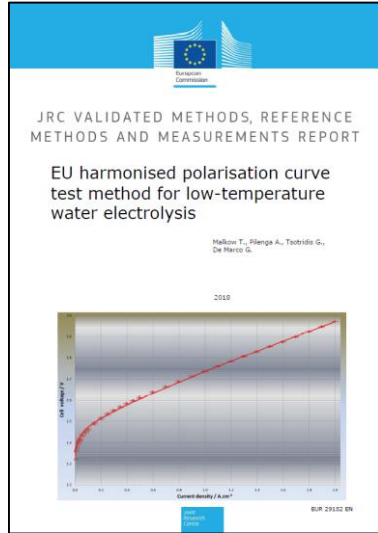
<https://dioxidematerials.com/product/complete-5-cm2-water-electrolyzer/>

CHARACTERIZATION OF AN AEMWE



<https://dioxidematerials.com/product/complete-5-cm2-water-electrolyzer/>

CHARACTERIZATION OF AN AEMWE



I/V
(H₂O vs KOH:H₂O)



CA
V = 1.5, 1.6, 1.7, 1.8 V



PEIS
V = 1.5, 1.6, 1.7, 1.8 V

CHARACTERIZATION OF AN AEMWE

Report:

- Description of the experimental setup
- Description of the experimental activity
- Plot data, compare I/V with the curve provided by the producer, discuss the differences in I/V when different electrolyses are used and discuss qualitatively the EIS recorded



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