

Accelerated Stress Tests for Anion Exchange Membrane Water Electrolyzers

Master Project (30 ECTS)/Semester Project (10 ECTS)

Administrative

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Location: Sion (travel allowance offered)

Project description:

Anion exchange membrane water electrolysis (AEMWE) is considered a novel technology for hydrogen production. It combines the advantages of classical alkaline water electrolysis (AWE) by using cheap catalyst materials such as Nickel and the advantages of proton exchange membrane water electrolysis (PEMWE) by using a membrane which ensures higher hydrogen purity and higher efficiency. However, since AEMWE is still new to the field, it still suffers from short lifetime and low durability.

The student project will be part of the HyPrAEM European project which is one of the Horizon Europe initiative projects [1]. One of the goals of the HyPrAEM project is to increase the lifetime of AEMWE cells and stacks, by conducting accelerated stress tests (ASTs). ASTs are tests that subject the AEMWE to adverse and dynamic operating conditions, to allow for faster degradation and thus for early identification of degradation mechanism. ASTs simulate the intermittent energy profiles of renewable sources by using cyclic loads and hence reduce the costs for long term operation.

Several efforts have been made to produce ASTs, however, these efforts remain in AWE and PEMWE, while AEMWE still lacks in this field.

Your tasks:



Figure 1: a) 3-electrode system for conducting AST b) Real experimental AEMWE cell stack

As a semester project student, your goal will be to conduct ASTs in adverse environments for the anodic porous transport layer (PTL) of the cell (figure 1a). The PTL is responsible for transporting produced gases from the reaction site to the flow channels to be stored later (e.g. hydrogen storage). Typical adverse environments in which the tests will be conducted are high currents, voltages, temperatures,

KOH concentration ($\text{pH} > 14$) and cyclic loading. The tests will also be conducted using different combinations of these conditions for better understanding of PTL degradation. The generated data will then be analyzed to determine the most important degradation factors and to study the effect of their interactions. The results obtained from the ASTs during the project will be used as feedback for the long-term testing of the AEMWE stack (figure 1b).

References

[1] cordis.europa.eu CORDIS, "High-pressure anion exchange membrane electrolyzers for large-scale applications," *CORDIS | European Commission*, Dec. 20, 2024.

<https://cordis.europa.eu/project/id/101192442> (accessed Jun. 20, 2025).

[2] Urbano a b *et al.* (2024) *Accelerated stress testing in proton exchange membrane water electrolysis - critical review*, *Journal of Power Sources*. Available at:

<https://www.sciencedirect.com/science/article/pii/S0378775324014034>.