ANION EXCHANGE MEMBRANE ELECTROLYSIS

Anion exchange membrane water electrolysers (AEMWE) represent a groundbreaking emerging technology with the promise of supplanting proton exchange membrane electrolysers (PEMWE). Electrolysers use water to produce green hydrogen by consuming electricity. Unlike PEMWE, which relies on precious metals like Pt and Ir, AEMWE utilises more readily available Ni and Fe-based catalysts.

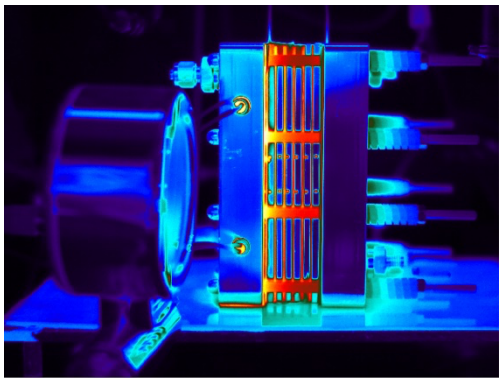

Figure 1:Representative thermographic picture of the developed 1 kWe AEMWE stack (5 cells).

The primary distinction between PEMWE and AEMWE regarding liquid electrolyte lies in using pure water in the PEMWE system, whereas the AEMWE system requires an aqueous KOH solution. Adding KOH salt to the solution is essential for AEMWE to achieve performance comparable to PEMWE's. Furthermore, recent interest has peaked in exploring the potential of direct seawater electrolysis with suitable materials. Sea water essentially contains 0.5M NaCl. The challenge arises in suppressing chlorine evolution while favouring oxygen evolution reactions.

The semester project consists of 2 parallel tasks:

i) Assist in setting up control parameters, monitoring and analysing a long-term degradation test of a 1 kW AEMWE electrolyser stack running at 60 °C, 1 M KOH and near atmospheric pressure, with the following measurement protocol:

Parameter	Conditions	Comments
Time	1000 h	Extendable up to 2000 hours
Temperature and pH	60 °C; 1 M KOH	
EIS testing	Every 50-100 hours	Pseudo-galvanostatic; Bias: 0.1, 0.4, 0.7 A cm^{-2}; Amplitude = 5mV
AEM	X37-50RT	Commercial
HER-Substrate	Raney Ni-Ni Felt	
OER-Substrate	$NiFe_2O_4$-SS316L Felt	
Gas Crossover	Every 100 hours	Using MicroGC

ii) Test and screen MEA materials using a single cell test bench, more challenging lower pH, simulated seawater, in a novel quadruple reference electrode test setup, as shown in Figure 2, under already defined testing protocols.

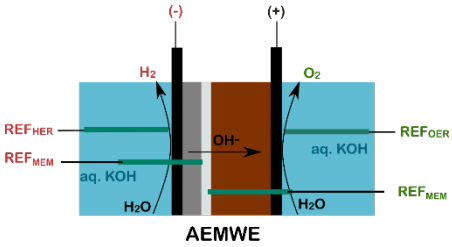

Figure 2: Quadruple reference electrode test setup configuration.

Lastly, it will be interesting to evaluate the relevance of direct seawater electrolysis compared to electrolyzing desalinated water; desalination is widely established and very cheap (1 Fr / m^3).

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