Green hydrogen is a promising fossil fuel replacement for reaching the net-zero emissions goal by 2050. Water electrolysis, powered by renewable sources produces green hydrogen. Three types of water electrolyzers exist at low temperature: alkaline (AWE), proton-exchange membrane (PEMWE) and anion exchange-membrane (AEMWE) water electrolyzers as shown in figure 1.

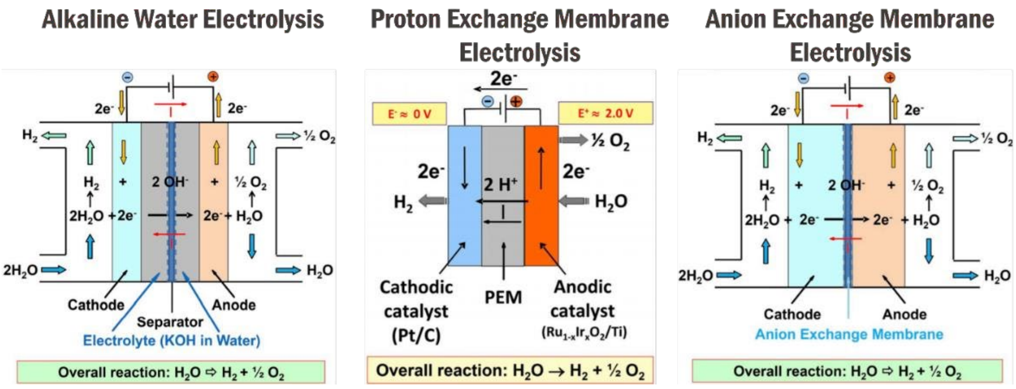

Figure 1: Three types of low temperature electrolyzers: AWE, PEMWE and AEMWE, shown from left to right

AEMWE are a promising technology for relatively cheap hydrogen production with high gas purity and high efficiency. AEMWE technology improved significantly in recent years and reached stack level, however, AEMWE durability is still problematic. Furthermore, multi-physics simulations for AEMWE are still in early development stages and need to be developed. Therefore, stack simulation is required to help improve AEMWE scaling up progress, and developing a stack digital twin is essential for monitoring, diagnosis, prognostics and optimization to improve AEMWE durability. Hence, a surrogate model for the stack must be developed first.

During this master thesis, your tasks will be to:

- Simulate a stack of 5-6 AEMWE cells using an existing single-cell AEMWE model. Simulations will include electrochemistry (polarization curves) and two-phase flow through porous media (gas bubbles in liquid electrolyte through porous transport layers).
- Perform a design of experiments to determine the most influential operating conditions and to optimize the single-cell and stack models.
- Develop a surrogate model for the single cell and stack models.

Software (no previous skill required):

- MATLAB
- COMSOL

Completing this project successfully can result in a journal paper publication and/or production of a simulation app to share the model with the scientific community.

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