3D Multi-Physical Modeling (with CFD and Heat transfer) of a Proton-Conducting Electrolyzer

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

Administrative:

Supervision: Dante Fronterotta, Prof. J. Van Herle
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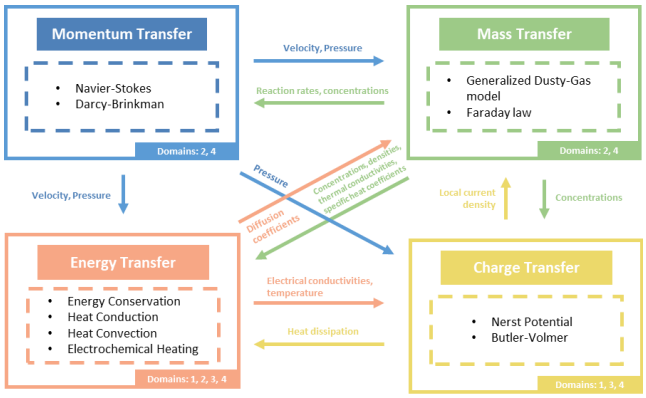
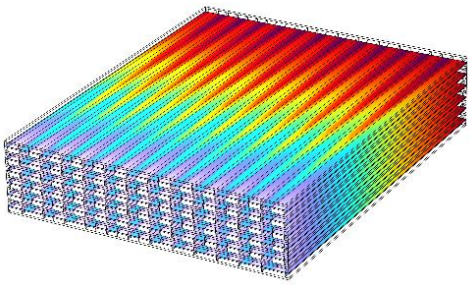
Location: Sion or remotely (travel allowance offered)
Remarks: If interested, please send your CV, with a short motivation letter, to Dante.

Project description:

This project is about building and testing a COMSOL model of a proton-conducting electrolyzer (PCE), a new device that makes hydrogen efficiently at high temperature. It's part of the targets of *HySPIRE European Project*. Compared to the usual solid oxide electrolyzers (SOEs), PCEs can run at lower temperatures and are easier on the materials, which makes them very interesting for future hydrogen and energy systems. Prior COMSOL experience is not required.





Hydrogen production from inlet to outlet

Your tasks:

1. Conduct a literature review to see how PCE cells are usually modeled and note which material/transport parameters are still missing.

2. Build a 3D steady-state COMSOL model of a PCE (starting from a lab's existing SOE model).

3. Validate the model by comparing your simulations with data from the literature to check that trends and magnitudes match.

4. (Exclusive to Master's Project) Use experimental single-cell data from the lab to tune model parameters and show that the model can reproduce real operation.

5. (Exclusive to Master's Project) Run CFD/thermal/design studies to see how off-design conditions and geometry changes affect flow, temperature, and overall performance.

References

[1] Laguna-Bercero, M. A. (Ed.). (2023). High temperature electrolysis (Vol. 95, **pp. 207–276**). Springer International Publishing. https://doi.org/10.1007/978-3-031-22508-6