



HAL
open science

Modelling of the anion exchange membrane based water electrolysis

Ronit-Kumar Panda, Guillaume Serre, Pascal Schott, Yann Bultel

► **To cite this version:**

Ronit-Kumar Panda, Guillaume Serre, Pascal Schott, Yann Bultel. Modelling of the anion exchange membrane based water electrolysis. ModVal 2022 - 18th Symposium on Modeling and Experimental Validation of Electrochemical Energy Technologies, Mar 2022, Hohenkammer, Germany. cea-03943484

HAL Id: cea-03943484

<https://cea.hal.science/cea-03943484v1>

Submitted on 20 Feb 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Modelling of the Anion exchange membrane based water electrolysis

R.K. Panda¹, G. Serre¹, P. Schott¹, Y. Bultel²

¹CEA Liten, 17 Avenue des Martyrs, 38000 Grenoble, France

²Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, Grenoble INP, LEPMI-UMR CNRS, 38000 Grenoble, France

Anion exchange membrane (AEM) electrolysis is the method of hydrogen generation with an Anion Exchange Membrane, using electricity. One of the major advantages of AEM water electrolysis is the replacement of conventional noble metal electrocatalysts with low-cost transition metal catalysts. This device has been modelled in the code MePHYSTO-WE developed by CEA LITEN for the simulation of the electrolyzer performances. The model structure is based on the Bond Graph theory, in which each transport block is represented by a resistive element and each balance block is represented by a capacitive element. The developed multiphysics model for this device also incorporates the transport of liquid water and gaseous products through the porous layers. The equations were solved in MATLAB/SIMULINK. Finally, the sensitivity analysis incorporates an evaluation and optimisation of the model geometry, operating temperature, concentration of the electrolyte fed into the device and internal characteristics such as porosity and tortuosity of the electrodes and membrane thickness. The main advantage of the model is the assessment of the phenomenon resulting in performance loss of the device, investigating the pH gradient and role of electrolyte concentration on operation as well as understanding the Schroeder paradox for its role on membrane water transport and assessing the key parameters to achieve the desired electrolyser performance. In terms of fabrication of components we also assess the role of membrane and catalyst size and the impact of ionomer content in the membrane and catalysts on the performance.

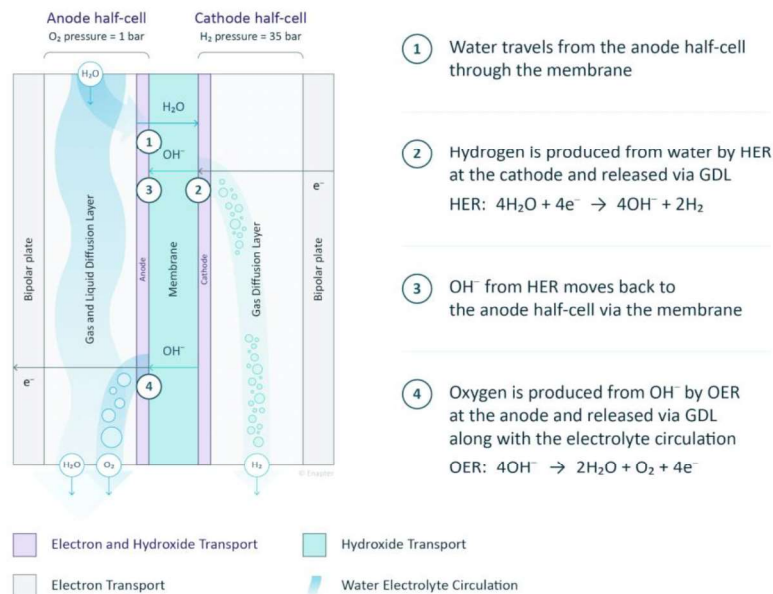


Figure 1: schematic AEM water electrolysis

- Gerhardt, M.R.; Pant, L.M.; Weber, A.Z. *J. Electrochem. Soc.* **2019**, *166* (7), F3180.
- Stanislaw, L.N.; Gerhardt, M.R.; Weber, A.Z. *ECS Transactions*, **2019**, *92* (8), 767.
- Zenyuk, I.V.; Das, P.K.; Weber, A.Z. *J. Electrochem. Soc.* **2016**, *163* (7), F691.
- <https://www.enapter.com/aem-water-electrolysis-how-it-works>
- Fouda-Onana, F. (CEA/Liten) internal communication, NEWELY report.