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Modelling of the Anion exchange membrane based water electrolysis

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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.

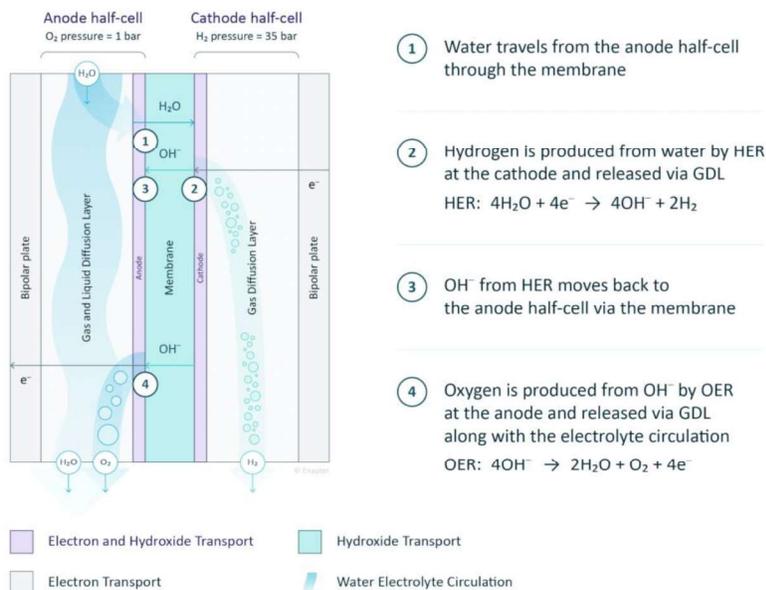


Figure 1: schematic AEM water electrolysis

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