Scale-up studies on the optimization of catalyst loading and the porous transport layer for regenerative electrolyser applications

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MEAs composed of IrO2 mixed with Pt Black in different ratio were prepared and characterized as OER/ORR for PEM-URFC application. The catalysts were characterized by XRD analysis and tested in a single cell with an active area of 8 cm2. A study on the PTL influence on electrochemical performance was also carried out to understand the influence of the structure on MEAs performance. Constant Gas (CG)configuration was adopted to characterize the MEAs prepared. MEA composed with IrO2 /Pt Black in a ratio of 0.69:1 showed the better performance for PEM URFC application. The best PTL was the titanium felt which permitted to obtain a current density of 2.4 A cm2 at 1.86 V in electrolysis mode and 1 A cm2 at 0.39 V in fuel cell mode. The results showed that both ratio and loading catalysts should be considered for an optimization study. Impedance spectroscopy analysis evidenced as an excessive catalyst loading increase the series resistance and influence negatively the MEA performance. The catalysts that demonstrated the best overall performance in both fuel cell and electrolyzer modes was prepared for deposition on an active area of 25 cm². The fabricated MEAs was subsequently tested in a cell made by Baltic, equipped with specially designed titanium plates of 25 cm². Following this, the focus will shift to the detailed design and manufacturing of manifolds, flow-fields, end plates, gaskets, and the H2O supply system. The cell stack, which will be the core of the regenerative electrolyzer, will be designed to minimize the use of expensive materials. Consequently, thin bipolar plates and internal diffusers made from metal foams (eliminating flow-fields) will be employed. Component selection and design will be guided by mechanical modeling with advanced software (e.g., Solid Edge). The stack will comprise 3 cells, each with an active area of at least 25 cm², connected in series by bipolar plates, while the gas diffusers will be in parallel (gas manifolds). Constructing a short stack will provide insights into how a multicell device impacts prototype performance. Consistent with the Mission Innovation project's objectives, these findings will aid in the future automated development of the regenerative electrolyzer design process.