On the Effect of Clamping Pressure and Methods on the Current Distribution of a Proton Exchange Membrane Water Electrolyzer

Al Shakhshir, Saher; Zhou, Fan; Kær, Søren Knudsen

Publication date: 2018

Document Version
Publisher's PDF, also known as Version of record

Link to publication from Aalborg University

Citation for published version (APA):
On the Effect of Clamping Pressure and Methods on the Current Distribution of a Proton Exchange Membrane Water Electrolyzer
ECS-233 meeting (104-1814)

Saher Al Shakhshir, Fan Zhou & Søren Knudsen Kær
Department of Energy Technology, Aalborg University, Aalborg, Denmark
SAS@ET.AAU.DK

- Producing hydrogen using renewable energy sources:
  - Reduces the CO₂ footprint, and
  - Improves energy security.
- PEMWE is considered a good candidate to produce hydrogen from renewable energy sources.
- Technical challenges such as cost, reliability, and durability slowing down the widespread of PEMWE commercialization.
- Thus, a better understanding of the PEMWE electrochemical reaction degradation is required.
- The local current distribution (LCD) measurements is one of an operando and in-situ experimental characterization technique that can help for a better understanding for electro chemical reaction degradation at the coated catalyst layer of the PEM.
- In this work, LCD is measured at the cathode side of 50 cm² PEMWE cell at different clamping pressures and methods:
  - Bolting the cell with 8 bolts around the active area, and
  - Compressing the overall area of the end plate using pneumatic compression pressure on the whole area of the end plate (drawings are out of scale).
- A single-square PEMWE cell with 50 cm² active area was built in house.
- Similar titanium porous transport layers were used on both sides of the MEA.
- S+® Current Scan Lin was used to measure the LCD at the cathode side.

Measured LCD of PEMWE cell a) bolted with 1.5, 2.5, and 3.5 Nm and b) pneumatically compressed with 50, 100, and 150 psi, at 70 °C, 70 A, and atmospheric pressure.

Measured LCD and calculated standard deviation at 10 A for the bolted cell at 3.5 Nm and for the pneumatically compressed cell at 150 psi.

Measured IV curve with and without the S® gold plated segmented plate at 70 °C, atmospheric pressure, and 3.5 Nm compression torque.

In this work, the effect of the amount of clamping pressure and methods on local current distribution (LCD) of the square single 50 cm² PEMWE cell has been in-situ and operando experimentally demonstrated at different current densities.
- The bolted cell has shown more heterogeneous LCD and the heterogeneity increases with increasing the clamping torque.
- Meanwhile, more homogeneous LCD for the pneumatically compressed cell and the homogeneity of LCD increases with increasing the clamping pressure.
- The bolted cell has shown lower LCD values in the middle and higher values on the perimeter of the cell. Meanwhile, the more homogeneous LCD in the pneumatically compressed cell.
- Despite the fact that, the bolted cell has higher performance at the highest torque. The degradation rate of the electrochemical reaction might be higher due to heterogeneous LCD. On the other hand, the pneumatically compressed cell has shown more homogeneous LCD at the highest applied pressure. Thus, highest performance with the lower electrochemical degradation rate can be obtained.