Polybenzimidazole membranes for zero gap alkaline electrolysis cells

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Publication date: 2016

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

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Citation (APA):
Polybenzimidazole membranes for zero gap alkaline electrolysis cells

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Membranes of m-PBI doped in KOH (aq), 15-35 wt%, show high ionic conductivity in the temperature range 20-80 °C. In electrolysis cells with nickel foam electrodes m-PBI membranes provide low internal resistance. With a 60 µm membrane thickness, 1000 mA/cm² is achieved at 2.25 mS/cm for 20 wt% KOH at room temperature [1].

Cell polarization
For zero gap electrolysis cell measurements, m-PBI membranes were equilibrated in aqueous KOH at a given concentration overnight prior to cell assembly. Electrodes were pressed (thickness ~ 210 µm) nickel foam. Figure 3. Current-voltage-curves are presented in Figure 4. Data were recorded by scanning the potential from 1.2 to 2.5 V at 2.5 mV/s. The cells were operated at 80 °C. The cell house and external setup is displayed in Figure 5, on the right. Aqueous KOH with concentration identical to the doping solution is circulated on both sides.

Figure 2. SEM micrograph of nickel foam electrode when pressed to 210 µm.

Figure 3. Measured conductivity of m-PBI happens at high pH and the precipitated form of m-PBI is predominant in KOH (aq) solutions of more than 15 wt% KOH.

Figure 4. Cell polarization at 80 °C with m-PBI membranes of different KOH (aq) concentrations. Thickness of pressurized nickel foam. Thickness of m-PBI in the range 20-40 µm. Thickness of ZrP is about 900 µm.

Figure 5. Cell setup. (a) System setup; tubes, fittings and containers from PFA or PTFE. Gear pumps for active electrolyte circulation. (b) Cell assembly. (c) Exploded view of the cell: (1) Linear fluorinated plates (P-Ti) nickel coated steel, cell house Ø70 mm. (2) Nickel foam electrodes 5.5 µm. (3) m-PBI membranes 50-60 µm. (4) PTFE gaskets.

Figure 6. Oxygen evolution polarization curves. Conditions: 20 wt% KOH and room temperature. Scan rate 2 mV/s.

CE: Large nickel mesh surrounding the WE and RE

CE: Linear flowfield plates (P-rich Ni coated steel), cell house Ø70 mm.

Dealcoholized ethanol (~5 wt% KOH in ethanol), and adding nickel powder to binders for alkaline electrolysis in particular.

DE: 3) Linear flowfield plates (P-rich Ni coated steel), cell house Ø70 mm.

DE: 2) Cell assembly.

DE: 1) System setup; tubes, fittings and containers from PFA or PTFE. Gear pumps for active electrolyte circulation.

DE: The cell house and external setup is displayed in Figure 5, on the right. Aqueous KOH with concentration identical to the doping solution is circulated on both sides.

Figure 7. Oxygen evolution polarization curves. Conditions: 20 wt% KOH and room temperature. Scan rate 2 mV/s.

De: Large nickel mesh surrounding the WE and RE

RE: Non-viable Hydrogen Electrode

Author's contribution: This work is funded by the internal project “PorouZ” at DTU Energy cell center.

References

Zaragoza, 13th-17th June, 2016
Hydrogen Production: Electrolysis / Electrolyzers
Poster code: P-103

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