SC9: ANION-CONDUCTING MEMBRANES FOR ENERGY APPLICATIONS

PILOT LINE 7

Anion-conducting membrane to be used in alkaline water electrolysis to produce H2

PL OWNER

- Scale-up of polymer-based membranes with optimal ion conductivity and selectivity as well as mechanical and chemical stability

IP OWNER

- Evonik is the sole IP owner of the DURAION® membrane

THE CONTEXT

H2 offers a versatile, clean and flexible energy vector making large-scale integration of renewable energy possible. Within the low temperature water electrolysis, PEM and alkaline electrolysers are considered the most promising. PEM has attracted considerable attention even if, being associated to high CAPEX, megawatt size PEM electrolysers are being deployed for energy storage and decarbonization of industry segments. The main advantages: i) high current densities, ii) rapid power-up/power-down rates and iii) high-pressure, making them very suitable for H2 production from renewables. On the other hand, alkaline electrolysers employ porous diaphragms in combination with highly concentrated KOH solutions. The technology has lower CAPEX due to the use of low-cost materials. However, it is also associated with lower H2 purity and pressure, slower power-up/power-down rates, and larger parasitic energy losses. Recent developments in membranes have led to the possibility of using anion-exchange membranes (AEM). AEM has the potential of combining the advantages of alkaline water electrolysis (low CAPEX and use of non-precious catalysts), with the advantages of PEM. However, AEM electrolysis is limited by membranes exhibiting insufficient ionic conductivity as well as a poor chemical-mechanical stability.

THE CHALLENGE

In the past years Evonik has developed a variety of novel cationic moieties and backbone chemistries for hydroxide conducting polymers for versatile use in AEM membranes. The chemistry makes use of different cyclic quarternized ammonium cationic moieties (cQA) like imidazolium, benzimidazolium and more advanced cyclic derivatives, along with polymer backbones based on polyaryletherketones (PAEK). Membranes derived from cQA-PAEK chemistry already meet major KPIs, however, this new chemistry has to be translated into a continuous coating process. The key challenge is to identify and validate optimal parameters with regard to polymer solution, coating techniques and thermal post-treatment. This is necessary in order to optimize the channel-in-matrix morphology which is obtained by nanoscale phase segregation of the amphiphilic polymer.

KEY DRIVERS OF THE SERVICE: THE VALUE PROPOSITION

Through the workshop with Evonik, the following points were highlighted as the key differentiators of the membranes being produced in this showcase.

Unmatched quality excellence

- Distinguished mechanical integrity
- Excellent chemical stability in aggressive media
- Very high ionic conductivity

Continuous roll-to-roll process

- successfully transfered from batch-to-batch lab-scale manufacturing process tocontinuous roll-to-roll process

Low CAPEX

- Same performance as a PAM electrolizer but with a low CAPEX