Aemion+® Alkaline Membrane shows zero degradation in latest product test
Results Surpass 2024 International Targets for Durability

Vancouver, B.C. |May 5, 2022, |Ionomr Innovations Inc.'s **Aemion+® alkaline membranes** have achieved durability milestones that exceed those set by the **EU's Clean Hydrogen Joint Undertaking Work Programme** **(Clean Hydrogen JU)** for green hydrogen production by AEM electrolysis by 2024.

Durability tests now underway in large-format cells**, including results beyond 7500 hours, show no measurable membrane degradation** (less than 0.05%) **and total system (membrane, catalyst, flow field) degradation rates of less than 0.4% per 1000 hours,** far outpacing **Clean Hydrogen JU's target for measurable system degradation of 0.9% per 1000 hours by 2024.**

Clean Hydrogen JU has set out what's needed for a competitive hydrogen economy, establishing the standards for hydrogen production and fuel cell performance measures and targets for cost reductions.

"Membranes are a central component in the hydrogen materials world. Reducing their cost and improving performance will drive the creation of a more affordable, green hydrogen economy. These Aemion+® test results confirm that we are already producing membranes that outperform the standards being set for 2024," said Benjamin Britton, Chief Strategy Officer, Director and Co-founder of Ionomr Innovations. "At Ionomr we are driving hard to refine these membranes and demonstrate systems that meet 2030 standards well ahead of that target. Aemion+® materials set the stage for the widespread availability of high-performing, ion-exchange membranes developed with modern, green chemistry, and Ionomr is pleased to be leading the path to success."

About Ionomr Innovations
Ionomr Innovations is revolutionizing electrochemistry with newly developed ion-exchange membranes and polymers for clean energy. Ionomr's Pemion® and Aemion® technologies provide cost, performance and sustainability advantages for fuel cells, hydrogen production and carbon capture, use and conversion. Leveraging technology developed at Simon Fraser University, Ionomr was founded in 2018 and employs 43 professionals in Vancouver, Canada and Rochester, New York. For more information about how Ionomr is helping to advance the clean energy economy, visit www.ionomr.com.

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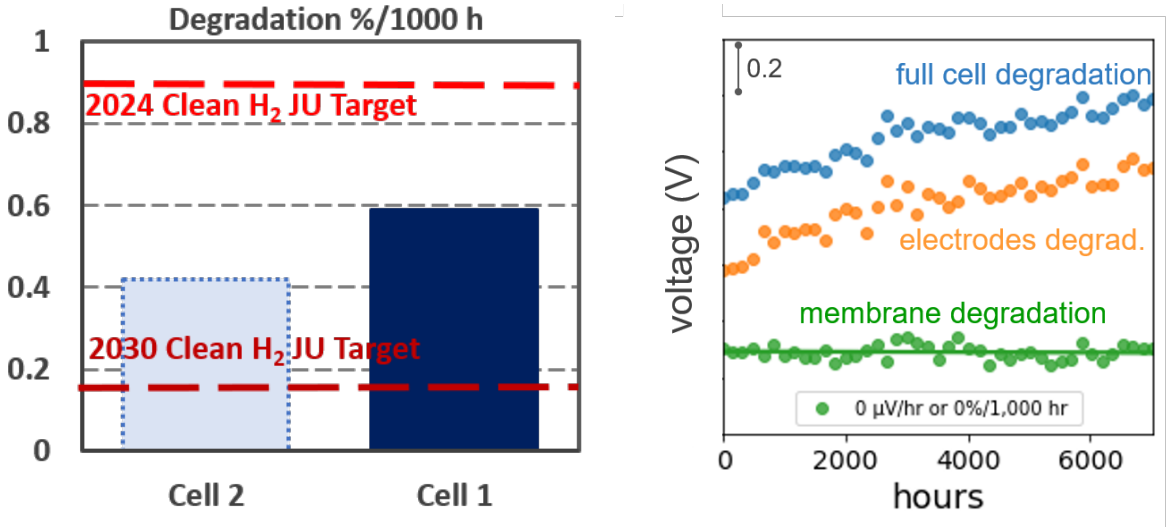
TECHNICAL BACKGROUNDER
AEMION+ DURABILITY TESTING
APRIL 2022

Summary

Durability tests on Aemion+® membranes now underway in large-format, 50 cm² active area cells show no measurable membrane degradation (less than 0.05%) and total system (membrane, catalyst, flow field) degradation rates of less than 0.4% per 1000 hours, far outpacing the EU's Clean Hydrogen Joint Undertaking Work Programme 2022 target for measurable system degradation of 0.9% per 1000 hours by 2024.

Background

The current test has been running for 2500 hours at 2024 EU target current density and follows durability tests conducted on Aemion+® membranes that have now surpassed 7500 hours of operation with less than 0.6% system (electrolyzer stack) degradation per 1000h after the break-in period and 1.2% per 1000h total, also maintaining less than 0.05% per 1000 hours of measurable membrane degradation.



Aemion+® membranes were assembled in Ionomr's nickel-based large-format, 50 cm² active area electrolyzer test hardware equipped with leading commercial alkaline electrodes, known for their long life and stable operation for up to 20 years. This approach allows for the evaluation of the durability of the membrane independent of the catalyst layer, unlike alternative approaches such as a catalyst-coated membrane.

The test showed the electrolyzer operated with record low degradation rates for an anion exchange membrane (AEM) technology. This is the first demonstration of anion exchange membrane water electrolyzers (AEMWE) stability in industry-relevant conditions, a hot, caustic environment required for utility-scale hydrogen production.

Furthermore, analysis of the first test process revealed that most of the degradation in the system resulted from the electrodes or the porous metal components that are integrated to transport gas and liquid. The porous metal element was removed for the current test, resulting in the superior results of the ongoing second test.

Further supporting this work, Ionomr continues its optimization program with National Renewable Energy Laboratory (NREL) as part of the Shell GCxN program. Shaun Alia, staff scientist at NREL, reports that Ionomr membrane electrode assemblies demonstrated greater than 1 A/cm^2 at 2 V in a supporting, hydroxide electrolyte, eliminating iridium use with a non-precious metal anode. Performance losses were not found following greater than 500 hours of operation.

This latest durability data follows Ionomr's earlier success in proving Aemion+® stability in concentrated potassium hydroxide solutions.

About Aemion+®

Ionomr's Aemion+® alkaline membranes are ultra-stable Anion Exchange Membranes (AEMs) designed to eliminate the expensive components conventionally used for water electrolysis. Materials such as Iridium, Platinum, and Titanium have been replaced with less expensive materials while performance is maximized. Ionomr's strategic goal is to eliminate fluorinated materials in hydrogen production and fuel cell processes, enabling the transition to a green economy. Ionomr is advancing the scale-up of electrolyzers for industrial-scale green hydrogen production by water electrolysis working with partners in Europe, North America and Asia.

Production

Aemion+® is produced roll-to-roll in a continuous process with a mechanical reinforcement at thicknesses between 15 and 100 µm. The next-generation materials are based on imidazolium chemistry which is widely used in aerospace and as thin-film coatings due to their exceptional mechanical properties. Mechanical reinforcements are further integrated to reduce unwanted dimensional swelling for suitability in the largest size electrolyzer cells. Ionomr's patented processes enable maximum conductivity, performance, and repeatability, while also providing the greatest alkaline stability of any ion exchange materials available, enabling operation in 1 M KOH at 80 – 100 °C, and up to 3 M KOH at 80 °C.

Environmental and Social Benefits

Membrane materials and polymers commonly in use today are comprised of perfluorinated compounds (perfluorosulfonic acids, PFSAs, a sub-class of PFAS) that are known to be serious, bioaccumulative environmental toxins with impact at concentrations as low as one part per trillion. Disposed of in solid form, they leach into water sources and accumulate biologically in living organisms where they cause numerous negative health effects.

Ionomr develops advanced ion-exchange membranes using modern green chemistry to accelerate the green hydrogen economy. Ionomr synthesizes membranes and polymers from a hydrocarbon base that demonstrates no bio-accumulative tendencies and are non-toxic to the environment through production and disposal. The company's green technologies are fully recyclable and enable full system circularity by environmentally friendly catalyst recovery, the ideal replacements for present membrane and polymer products containing PFAS.

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