Advancing Anion Exchange Membrane Electrolyser: 3D Porous De-alloyed Catalysts (3D-CAT) Key to a High-Power AEM Electrolyzer

Green hydrogen production via PEM electrolysis faces barriers due to reliance on costly platinum group metals. AEM electrolysis, however, operates with PGM-free catalysts like Ni, Co, and Fe. Scaling AEM systems poses challenges in maintaining catalyst performance. Utilizing 3D de-alloyed porous catalysts addresses stability and efficiency issues. Incorporating 3D-CAT layers offer advantages in surface area, stability, and cost reduction. Collaboration between Cipher Neutron and NRGMATs at the University of Alberta aims to overcome AEM commercialization hurdles, aligning with Alberta's hydrogen roadmap for eco-friendly hydrogen production.

FUNDING DETAILS

RECIPIENT:
UofA / Dr. Shiva Mohajernia

PARTNERS:
Cipher Neutron

TOTAL BUDGET:
$1,090,000

AI FUNDING:
$490,000

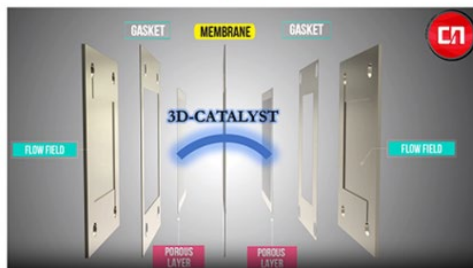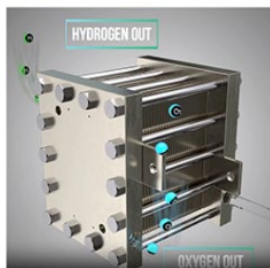**PROJECT DATES:**
FEB 2024 – FEB 2026

PROJECT TRL:
Start: 4
End: 6

APPLICATION

3D-CAT technology will be integrated into AEM electrolyzers for large-scale green hydrogen production. Companies, like Cipher Neutron, can incorporate this innovation into their products. These cost-effective catalysts in AEM electrolyzers will produce green hydrogen efficiently and sustainably, addressing the growing demand for cheaper clean energy, making it more competitive with fossil fuel-based hydrogen sources.

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PROJECT GOALS

- Highly efficient AEM electrolyzers by integrating non-PGM-based catalysts, ensuring sustainable green hydrogen production.
- Target a hydrogen production rate of 5 Nm3/h and 25 kW size with over 82% efficiency, aligning with industry standards.
- Optimize AEM electrolyzer design to streamline cell count, enhancing current density for improved performance and cost-effectiveness.
- Collaborate with industry partner to validate scalability and reliability, ensuring market readiness and widespread adoption of designed catalysts.

BENEFITS TO ALBERTA

- Support job growth, attract investment, and boost economic development across the province, capitalizing on the projected $2.5 trillion global hydrogen market by 2050.
- Facilitate the transition of Alberta's oil and gas sector from grey and blue to green hydrogen, reducing the carbon intensity of hydrogen production processes and enhancing environmental sustainability.
- Enable various industrial processes, including refining, power generation, and chemical processing, to become more efficient and cost-effective through the adoption of green hydrogen produced using AEM electrolyzers.
- Advance Alberta's transition to a low-carbon economy by reducing the cost of green hydrogen production and promoting the use of impure water sources, leading to significant cost savings in both plant infrastructure and materials.

Goal of 6 Publications	Goal of 6 Students Trained	Goal of 1 Patent	Goal of 6 Jobs Created	Goal of 20-30 Future Jobs

Goal of 1 New Product	Goal of 1 Spinoff Company	11 kt/yr Project GHGs Reduced

CURRENT STATUS

MAY 2025

All instruments are purchased, commissioned, and operated by trained HQP. The Fabrication and Benchmarking Lab is fully equipped for project needs. CN visited to train HQP on full-stack assembly, completed and tested successfully. EIS measurements on six commercial membranes were validated by CN through full-scale testing, confirming lab data reliability. Beam time for operando XAS was secured via a successful CLS proposal.