InnoMatch

Powered by EIC Innovation Procurement Programme

InnoMatch – EH Group Challenge Definition

11/11/2025

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Innovation Council and SMEs Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

Grant Agreement No.: 101165966
Call topic: HORIZON-EIC-2023-INNOVPRO-01
Type of action: Coordination and support action (CSA)

DISCLAIMER

COPYRIGHT NOTICE

Table of Contents

INDEX

1 Challenge Description

1.1 Name

CHEF– Low platinum Catalyst coated membranefor cost-effective, High-pErformance Fuel cells

1.2 Pitch

Help us scale zero-emission fuel cells by cutting platinum usage — without sacrificing durability or performance

1.3 Organisation Description

EH Group is a leader in hydrogen fuel cell solutions, aiming to replace the use of fossil fuels in maritime, aviation and stationary applications. EH Group was founded in Switzerland in 2017 and specialises in LT-PEM Fuel cell stacks and systems. In 2022, we established EH Group Systems Pvt Ltd at IITM Research Park in Chennai, India, to support our fuel cell systems control development and service our growing Asian client base. We are a growing start-up with a team of 25 engineers, mechanical operators and scientists. We deliver engineering for alternative energy solutions worldwide, thereby contributing to solving the global carbon emission problem. Our products enable end users, including data centres, shipping companies, and aviation companies, to rely on green data, deliver green goods, and operate green flights. EH Group technology utilises a unique microstructure in our stacks that allows us to optimise power density. Thanks to this innovative approach, EH Group outperforms competitors in both volumetric and gravimetric power density, a key selling point in our targeted markets.

1.4 Challenge Description

As a stack and system manufacturer, we rely on suppliers for delivering state-of-the-art, high-performing, and price-competitive components to be used in our stacks and systems. The most crucial component is called the catalyst-coated membrane (CCM). CCMs are the heart of the fuel cell, enabling the electrochemical reactions to happen. Thanks to these electrochemical reactions, the chemical energy or hydrogen and air can be transformed into electrical energy. This electricity can then be used for the propulsion of boats or aeroplanes, or as a source of back-up power for data centres. The only emissions produced by hydrogen fuel cells are water and heat; no carbon dioxide or other greenhouse gases are emitted. Therefore, the hydrogen fuel cell is a prime candidate for the decarbonisation of the mentioned sectors.

In order to transform the chemical energy of hydrogen and air to electricity, the CCM relies on noble metals as a catalyst; the most prominent is platinum. Platinum is pointed out as responsible for about 40–55% of the total cost of the stack fuel cell, which makes its reduction highly necessary for the breakthrough of cost-effective fuel cells.[1] Despite a decade of research, no economically viable alternative to platinum has been found. Platinum is a key cost driver of the overall stack costs, and, moreover, unlike other components, platinum does not have economies of scale. Therefore, the cost contribution of platinum increases with increasing production (compared to the cost of the other components, which lowers as production increases). Therefore, in order to increase the economic competitiveness of our stacks and systems, less platinum has to be used in the CCM.

Mass production of CCMs relies on techniques such as electro-spraying or decal transfers, both of which were developed in the 20th century. However, in recent years, novel approaches in CCM manufacturing have been discovered and developed, such as high-speed magnetron sputtering [2].

1.5 Challenge Main Objectives

The main objective is to lower the CCM platinum in utilising recently developed CCM manufacturing methods, which allow for large-scale production. Magnetron sputtering deposition (MSD) is a mature technology in terms of equipment and thin-film deposition (TRL 8–9), but its specific application in PEMFC manufacturing-especially for platinum is still under development and optimization (TRL 5) We believe, these technological advances will be the key to increasing the utilisation of platinum in the CCM and therefore allowing us to significantly lower the amount of platinum needed in our fuel cell stacks.

The platinum catalyst in a PEM fuel-cell stack typically adds on the order of US$10-30 per kW (depending on loading and platinum price), though this share can drop to single digits under high-volume, low-loading conditions. At large scale volume, costs have to be significantly lower than state-of-the-art products, and the resulting CCM needs to maintain the performance and durability of existing products.

1.6 Solution Functional Requirements

1.6.1 Compulsory Functional Requirements (MUST HAVE)

The proposed solution must meet the following essential functional requirements to ensure its technical feasibility, scalability, and alignment with the objectives of the challenge:

- **Low Platinum Loading:**
  The solution shall achieve an overall platinum loading of 0.25 mg/cm² or less for the complete catalyst-coated membrane (CCM). Great research efforts in the last three decades reduced the platinum (Pt) content by over one order of magnitude in a PEMFC stack for automotive application, from ~4 mg/cm² to < 0.1 mg/cm², but performance is sometimes compromised. The low catalyst loading will [4] minimise material costs while maintaining high electrochemical performance.
- **High Beginning-of-Life (BoL) Performance:**
  The CCM shall demonstrate a current density of at least 1.5 A/cm² at 0.7 V under standard testing conditions at the beginning of life. This ensures competitive performance levels comparable to or exceeding current state-of-the-art technologies.
- **Durability Under Accelerated Stress Testing (AST):**
  When tested according to the U.S. Department of Energy (DoE) voltage cycling protocol (cycling between 0.6 V and 0.95 V for 30,000 cycles), the CCM shall exhibit a performance degradation of less than 40 mV at 1 A/cm² [5]. This requirement ensures long-term stability and robustness under real-world operating conditions.
- **Scalable and Cost-Effective Manufacturing:**
  The production method for the CCM must be economical, scalable, and adaptable to various CCM sizes. This requirement guarantees the technology's potential for industrial-scale manufacturing and broad commercial applicability.
- **Compatibility with Multiple Membranes:**
  The solution must apply to different membrane materials and thicknesses used in low-temperature proton exchange membrane fuel cells (LT-PEMFCs). This flexibility is essential to ensure integration across diverse system configurations and operational environments.

1.6.2 Desirable Functional Requirements (NICE TO HAVE)

In addition to the compulsory requirements, the following functional capabilities would provide added value to the proposed solution by enhancing its performance, versatility, and manufacturing efficiency:

- **High Production Throughput:**

The manufacturing process should enable high production speed, supporting rapid and efficient fabrication of catalyst-coated membranes (CCMs). This would improve overall process productivity and reduce manufacturing costs, facilitating large-scale deployment.

- **Cross-Platform Applicability:**

The coating methods used for CCM production should be adaptable for other electrochemical technologies, including low-temperature proton exchange membrane (LT-PEM) electrolysers and/or high-temperature proton exchange membrane fuel cells (HT-PEMFCs). Such versatility would expand the technology's potential applications and market reach.

- **Consistent Product Quality:**

The production process should ensure high uniformity and reproducibility across individual CCMs and manufacturing batches. Minimal variation in platinum loading, electrochemical performance, and durability would contribute to reliable operation and predictable system performance over time.

1.7 Pilot Scope

The selected provider is expected to cover sample production and delivery, with EH Group providing testing infrastructure, analysis, and technical coordination.

Upon delivery of the developed CCM, both durability and performance will be tested at EH Group on a lab scale. Durability will be assessed with accelerated stress tests and commonly used characterisation methods. Performance will be analysed through polarisation curves at a range of operational conditions, varying pressures, humidities and stoichiometries.

1.7.1 Language

Since the CCMs are used in our products, end-users should not notice any language changes, as they are purchasing entire fuel cell stacks and/or systems, not individual CCMs. English is the preferred language of communication, as we serve a global customer base.

1.8 Pilot Set-Up Conditions

1.8.1 Ethical, Legal or Regulatory

All solutions must fully comply with GDPR. No ethical conflicts are anticipated. The final product will have to comply with RoHS (Restriction of Hazardous Substances), as part of CE marking.

1.8.2 Technological

All tests will be conducted at EH Group facilities or in collaboration with our partners.

1.8.3 Data Access

All direct results of the durability and performance testing will be made available to the solution providers. Comparison with currently used CCMs will be anonymised.

1.9 Expected Impacts and KPIs

The success of the proposed solution will be assessed through a set of quantitative and qualitative Key Performance Indicators (KPIs) directly aligned with the compulsory functional requirements.

- Achieving an overall platinum loading of 0.25 mg/cm^2 or less across the catalyst-coated membrane (CCM).
- Performance will be evaluated by measuring a current density of at least 1.5 A/cm^2 at 0.7 V under standard beginning-of-life (BoL) fuel cell testing conditions.
- Durability will be monitored through accelerated stress testing (AST) following the U.S. Department of Energy protocol, targeting a voltage degradation below 40 mV at 1 A/cm^2 after 30,000 cycles between 0.6 and 0.95 V.
- Manufacturing performance will be measured through the demonstration of a scalable, cost-effective (e.g below market price which is currently around 140-150$), and flexible production process capable of fabricating CCMs of various sizes.

- Compatibility across multiple membrane materials and thicknesses used in LT-PEMFCs will serve as a KPI for the solution's adaptability and practical applicability.

These KPIs collectively ensure that the solution meets essential performance, durability, and manufacturability standards.

1.10 Business Opportunity

1.10.1 Market Size

Our need has applications in aviation, mining, marine, and stationary applications, such as data centres. In the aviation sector, our partnerships with major players are crucial for integrating our fuel cell technology into next-generation aircraft. In the mining sector, we aim to address the critical need for reliable and sustainable power sources in remote, harsh and challenging environments. The marine sector presents unique challenges and opportunities. Our collaboration with DNV and our participation in H2 Marine (EU-funded project) ensure that our fuel cell systems meet stringent maritime regulations and performance standards. For the stationary power market, our focus is on providing resilient and efficient power solutions for commercial and industrial applications. We have just sold a 250 kW system to a Spanish company to be used as a stationary power source.

The to be developed CCMs could be used in other mobile applications, such as trucks or buses; however, this is beyond the scope of EH Group. Further details should be investigated by the CCM manufacturer. A successful outcome may open the door for the selected provider to become a long-term partner, gaining consistent business or future licensing opportunities.

1.10.2 Sustainability Plan

The developed CCMs in this project will allow us to lower the prices of our fuel cell stacks and systems. These savings can be passed on to our customers thereby increasing our competitiveness and allowing us to sell more fuel cells.

If the InnoMatch pilot proves to be successful, EH Group definitely plan to continue collaborating with the supplier. Establishing a long-term partnership would allow us to build on the positive results of the pilot and further optimize both performance and efficiency.

EH Group would also be interested in purchasing their CCMs, provided that they meet our technical, quality, and economic expectations during the pilot phase. We see this as an opportunity to strengthen our supply chain and integrate innovative solutions that align with our strategic goals. The level of commitment would depend on various factors, including the demonstrated value, scalability, and commercial terms of the proposed solution.

Replacing diesel engines with hydrogen fuel cells allows for saving about 1 ton of CO_2 per MWh. With our projects in aviation, marine and stationary being in a MW range, over a year, hundreds to thousands of tons of CO2 can be avoided.