Construction of Improved HT-PEM MEAs and Stacks for Long Term Stable Modular CHP Units - First Year

Partners of CISTEM Consortium

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Objectives

The objective of the CISTEM project is to develop a new fuel cell (FC) based CHP technology, which is suitable for fitting into large scale peak shaving systems in relation to wind mills, natural gas and SMART grid applications. The technology should be integrated with localized power/heat production in order to utilize the heat from the FC via district heating and should deliver an electrical output of up to 100 kW. Additionally the CHP system should be fuel flexible by use of natural gas or use of hydrogen and oxygen which can be provided by electrolysis. This gives the additional opportunity to store electrical energy in case of net overproduction by production of hydrogen and oxygen for use in the CHP system and gives an additional performance boost for the fuel cell.

The purpose of the CISTEM project is to show a proof of concept of high temperature PEM (HT-PEM) MEA technology for large combined heat and power (CHP) systems. A CHP system of 100 kW, will be set up and demonstrated. This CHP system size is suitable for district heat and power supply. The system will be build up modularly, with FC units of 4 kW, output each. This strategy of numbering up will achieve an optimal adaption of the CHP system size to a very wide area of applications, e.g. different building sizes or demands for peak shaving application.

Materials beyond State of the Art

The goal of this work package is to optimize the performance and durability of the MEAs towards the target of the project by:
- Optimization of fuel/oxidant strategy,
- Optimization of electrodes and membranes,
- Optimized MEA design for the chosen fuel/oxidant strategy.

Results of investigations with oxygen enriched air are presented in the figure. It shows the performance of a Dapozol® MEAs from DPS operating with hydrogen as fuel and different oxygen concentrations in the air as oxidant. The highest voltage improvement has been developed in the first step, when the O₂ concentration has been increased from 21% (air) to 30% at 0.3 A/cm².

Degradation with SoA Materials

The goal of this work package is:
- Agreed test and operating procedures as well as long-term and accelerated stress testing (AST),
- Identify the optimal gas composition for O₂ enriched cathode air with respect to durability and degradation,
- Production of single cells with SoA components and test of MEAs for durability and degradation analysis under various operating conditions,
- Short stacks for lifetime testing,
- Identify relevant degradation mechanisms,
- Post mortem analysis,
- Verify the targeted life time of the system.

Degradation Modeling

The figure shows the results of a 1000 h AST of a Dapozol® MEA. The current density cycling has been interrupted for MEA characterization with H₂ and air once per week. The voltage loss at 0.3 A/cm² is higher than the OCV loss.

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