MCFC catalyst and stack component degradation and lifetime: Fuel gas CONTaminant effects and EXtraction strategies

Project website: www.enea.it/mcfc

Introduction and objectives

The Molten Carbonate Fuel Cell is unique in being able to reduce carbon footprint in a twofold way:
- Separation of CO₂ from combustion-based flue gas while generating heat and power
- Replacement of fossil fuel dependency by high-efficiency heat and power generation with renewable fuels

For both applications, MCFC-CONTEX aims to tackle the problem of degradation by trace contaminants from two sides:
- Investigation of poisoning caused by alternative fuels and applications and determination of MCFC tolerance limits for long-term endurance;
- Optimization of fuel and gas cleaning to achieve tailored degrees of purification according to MCFC operating conditions and tolerance.

Work Package 4: Cleaning strategies

Scope of WP4 is to identify fuel cleaning requirements for the catalysts/reforming systems and to define the specification of the according biogas cleaning processes. Characterization of selected processes, and prototype development of gas cleaning technology for optimised utilisation with MCFC. The defined steps are:
1. Literature research and preliminary definition of fuel gas purity requirements (limits) done
2. Definition of gas cleaning technology requirements… in process
3 Cleaning Strategies: Reactive clean-up… in process
3.1 Material, process selection and qualification of test facilities
4.1 Cleaning Strategies: Adsorptive clean-up… in process
5 Development and operation of lab-scale gas cleaning unit and evaluation of scaling possibilities

Partners involved: MTU, AFC, ENEA, MAM, OVM

Work Package 2: Contaminant effects on MCFC

The effects on cell performance are studied by specific tests in button cell, single cell and lab-scale stack.

Scope of WP2 is to determine the maximum threshold of contaminants for durable cell performance. Relevant accelerated tests with specific contaminants are performed and a model to study the damage mechanism and to predict the decay rate and lifetime is developed

Partners involved: MTU, AFC, ENEA, JRC, KTH, UNIGE

Work Package 3: Analysis methods

Scope of WP3 is to detect and quantify the elemental and molecular components identified in WP2. This will be achieved through development of a laser spectroscopic instrument based on Laser Induced Breakdown Spectroscopy (elements) and Raman Spectroscopy (molecules)

Reference analysis will be carried out by Gas Chromatography (GC/ECD and GC/FID)

Establishment of suitable sampling and transport methods for off-line analysis from different sites to different laboratories.

Partners involved: TUM, MTU, AFC, OVM

Status, results and prospects

- Literature study carried out (gas cleaning and MCFC tolerance & degradation)
- Field test data gathered (contaminant concentrations and classification)
- Definition of test conditions, material supply, experimental campaign ongoing
- MCFC-CONTEX website set up and running
- 7 out of 10 Deliverables due delivered

As the system outline and investigated conditions are emerging more clearly, activity and collaboration is intensifying.

First experimental results due by end of the first year.