Investigation of permanent and reversible degradations in PEMFC and DMFC stationary applications using statistical and modelling tools

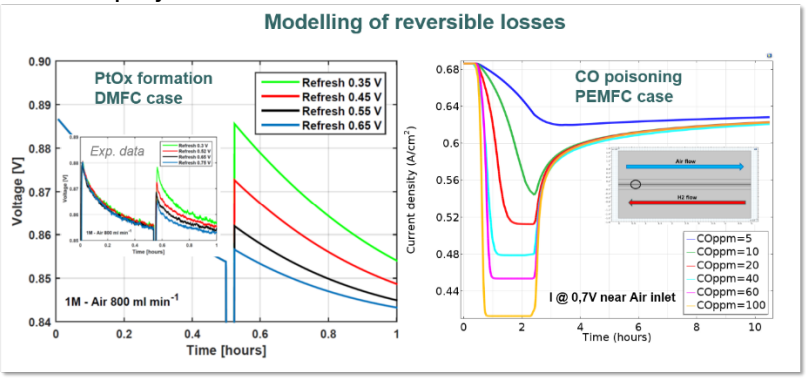
M. Chandesris[1]*, T. Jahnke[2], M. Zago[3], T. A. Aarhaug[4], P. Schott[1], M.-D. Baum[2], A. Casalegno[3]

[1]Univ. Grenoble Alpes, CEA LITEN, F-38054 Grenoble France
[2]German Aerospace Center (DLR), Inst. Eng. Thermodynamics, 70569 Stuttgart, Germany
[3]Politechnico di Milano, Department of Energy, 20156 Milano, Italy
[4]SINTEF, Materials and Chemistry, NO-7465 Trondheim, Norway
* marion.chandesris@cea.fr

Durability of PEMFC and DMFC for stationary fuel cell systems is still one of the main hurdles to overcome for large scale development and systems commercialization, when considering the required target of more than 40000 hours. The Second act project aims at improving understanding of stack degradation in order to propose solutions enabling significant lifetime improvements for µCHP systems using PEMFC or DMFC technology. Ageing investigations and degradation understanding are carried out in this project with joined experimental and modelling analysis. The present work describes the different modelling tools developed to perform these investigations.

Statistical tools have been developed to collect and interpret experimental data from field tests in order to establish statistical distribution and significance level.

Regarding PEMFC and DMFC run in stationary conditions, both reversible and permanent degradations are observed. Furthermore, post-mortem analyses indicate that the permanent degradations at the anode and cathode sides are highly heterogeneous. To analyse these phenomena, the developed degradation models focus on the degradations occurring at the catalyst scale. At the cathode side, platinum dissolution, particle growth as well as platinum oxidation are considered, whereas, at the anode side, CO poisoning, associated to the reformate hydrogen used in stationary conditions, is considered. In parallel, 2D PEMFC and DMFC models have been developed at the cell scale to predict the cell heterogeneities and investigate their impact on the different degradation mechanisms. The different models developments are supported by dedicated experiments to improve the reliability of the simulations, consolidate the degradation mechanism understanding and motivate the improvements that will be tested in the project.



***Keywords**:* PEMFC, DMFC, Stationary applications, degradation, modelling, statistical analysis

Acknowledgements: This work is conducted in the frame of the project Second Act supported by the FCH JU in FP7 program. The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) for the Fuel Cells and Hydrogen Joint Technology Initiative under grant agreement n°621216