



HAL
open science

Voltage Singularity-Based Diagnostic for H₂&CO₂/O₂ PEM Fuel Cell Stack designed for Operation in μ CHP Units

Raffaele Petrone, Rungsima Yeetsorn, Fabien Harel, Daniel Hissel,
Marie-Cécile Pera, Fei Gao, Elena Breaz, Stefan Giurgea

► **To cite this version:**

Raffaele Petrone, Rungsima Yeetsorn, Fabien Harel, Daniel Hissel, Marie-Cécile Pera, et al.. Voltage Singularity-Based Diagnostic for H₂&CO₂/O₂ PEM Fuel Cell Stack designed for Operation in μ CHP Units. FDFC 2017, 7th International Conference on Fundamentals & Development of Fuel Cells,, Jan 2017, STUTTGART, Germany. hal-01831175

HAL Id: hal-01831175

<https://hal.science/hal-01831175>

Submitted on 5 Jul 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Impact of Quasi-Static Load Profile on PEMFC Durability for Automotive Application: Reference and Accelerated Stress Tests

R. PETRONE^{1,2}, R. YEETSORN³, F. HAREL^{2,4}, D. HISSEL^{1,2}, M-C. PERA^{1,2}, F. GAO^{2,5}, E. BREAZ^{2,5}, S. GIURGEA^{2,5}

¹ FEMTO-ST, CNRS, Univ. Bourgogne Franche-Comte, rue Thierry Mieg, F-90010 Belfort Cedex, France

² FCLAB, CNRS, Univ. Bourgogne Franche-Comte, rue Thierry Mieg, F-90010 Belfort Cedex, France

³ Department of Industrial Chemistry, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand

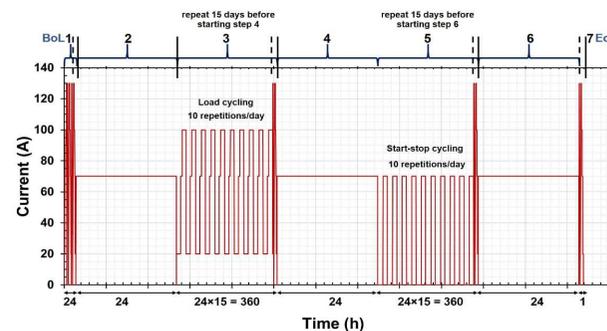
⁴ Université de Lyon, IFSTTAR / AME / LTE, France

⁵ FEMTO-ST, CNRS, Univ. Bourgogne Franche-Comte, UTBM, rue Thierry Mieg, F-90010 Belfort Cedex, France

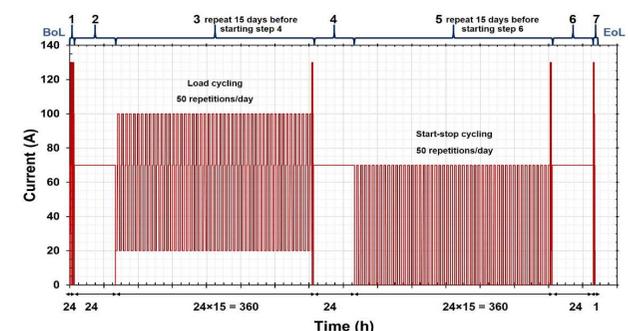
In automotive application, polymer electrolyte membrane fuel cells (PEMFCs) are operated through dynamic working conditions. Dynamic driving cycles are mainly composed by cold starting, sudden load variations, continuous load running, idle running, full power running, overload running, and start-stop repetitions [1-2]. These conditions if operated for long-time can severely impact the PEMFC lifetime. To solve this problem, a power balance strategy related to a PEMFC-battery hybrid structure is usually considered to improve the PEMFC durability [3]. As a result of the power balance strategy based on the battery state of charge optimization, a more beneficial quasi-static load profile is commonly obtained for the PEMFC operations. The aim of this work is to observe the effects of the quasi-static load profile on the PEMFC degradation. To this purpose a quasi-static reference profile was developed to separately investigate the impacts of both stationary conditions and load variations (from 0 h to 408 h) and start-stop conditions (from 408 h to 792 h) on the stack voltage degradation. A stack voltage reduction was observed after 408 h of operation, where the impact of the load variation was tested. Subsequently, the first recovering was found. Test results after 792 h also showed the start-stop impact on the stack voltage degradation. Particularly, considering the voltage variation with respect to the cumulated energy an higher voltage slope can be observed. An accelerated load profile was finally developed to study the influence of the number of repetitions in both load and start-stop cycles on the PEMFC voltage degradation; the results are then compared. Both reference and accelerated load profiles are reported below.

References:

- [1] Lin R, Li B, Hou YP, Ma JM., *Int JHE vol. 34*, pp. 2369-76 (2009).
- [2] Petrone R, Hissel D, Péra M-C, Chamagne D, Gouriveau R., *Int JHE vol. 40*, pp.12489-505 (2015).
- [3] Barelli L, Bidini G, Ottaviano A., *Applied Energy vol. 97*, pp.777-84 (2012).



Reference profile



Accelerated test profile