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## FROM BASIC TO APPLIED RESEARCH TOWARDS DURABLE AND RELIABLE FUEL CELLS

Focus on accelerated stress tests, degradation phenomena, fault modelling, advanced monitoring, diagnostics, prognostics and control of SOC and PEMFC

Workshop jointly organized by H2020 Projects AD ASTRA and RUBY

5 July 2022 – Lucerne (CH)

European Fuel Cell Forum 2022

venue: [www.efcf.com/2022/conference/highlights/venue](http://www.efcf.com/2022/conference/highlights/venue)

registration: [workshop@rubyproject.eu](mailto:workshop@rubyproject.eu)

info: [workshop@rubyproject.eu](mailto:workshop@rubyproject.eu)

schedule: 9:00 to 17:00

registration deadline: 27 May 2022

The workshop will gather scientists and engineers from EU research and industry communities active on the broad area of Fuel Cell lifetime enhancement and advanced management. The speakers will describe the achievements on stress tests analysis and degradation of high temperature Solid Oxide Cells together with the work undergoing in the field of monitoring, diagnostics, prognostics and control of both SOFCs and PEMFCs.

The partners of the projects AD ASTRA and RUBY will share the results of their efforts, connecting degradation phenomena, fault root causes and mathematical framework that serves for improved stack and balance of plant management. The event will address in a holistic framework the main topics that can lead to more performing stacks and competitive Fuel Cell Systems.

A comprehensive overview and the potential of the projects' outcomes are offered to the interested stakeholders and users from academia, industry and research. Emphasis will be given to methodological approaches that can help achieving reliable performance of both stacks and BoP components, providing a comprehensive vision on the improvement of efficiency, performance, reliability, lifetime and maintenance of SOFC and PEMFC. A talk will describe the results of the project REACTT dealing with advanced diagnostics and control towards increased lifetime of solid oxide cells.

AD ASTRA addresses the building of Accelerated Stress Test protocols for quantitative identification and prediction of critical degradation mechanisms, correlating them with overall performance variables in Solid Oxide Fuel Cell/Electrolyser and stack components. The experimental data are being exploited to build models to predict Remaining Useful Life based on operating profile in real-time. Final protocols will address realistic failure modes of critical SOC components (fuel electrode, oxygen electrode and interconnect) in two application profiles, namely: power-to-X and CHP.

RUBY aims at developing, integrating, engineering and testing a comprehensive and generalized Monitoring, Diagnostic, Prognostic and Control (MDPC) tool capable of improving efficiency, reliability and durability of SOFC and PEMFC systems for stationary applications. The tool relies on advanced techniques such as Electrochemical Impedance Spectroscopy and dedicated hardware and will be embedded in backup and  $\mu$ -CHP Fuel Cell Systems for on-line validation in relevant operational environment.

Registration is free of charge; coffee, beverages and lunch will be offered to all guests.



The projects **AD ASTRA** (Accelerated Stress Tests and lifetime prediction for Solid Oxide Cells) and **RUBY** (Robust and reliable general management tool for performance and durability improvement of fuel cell stationary units) have received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreements No 825027 and No 875047, respectively. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation program, Hydrogen Europe and Hydrogen Europe Research.



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venue: University of Lucerne | Frohburgstrasse, Lucerne (CH) | Conference Room n. 5  
[www.efcf.com/2022/conference/highlights/venue](http://www.efcf.com/2022/conference/highlights/venue)  
registration deadline: 17 June 2022  
registration: [www.rubyproject.eu/dissemination/workshop1/#registration](http://www.rubyproject.eu/dissemination/workshop1/#registration)  
info: [workshop@rubyproject.eu](mailto:workshop@rubyproject.eu)

### PROGRAM

Time	Topic	Speaker
9:00-9:05	Welcome	D. Pumiglia (ENEA) C. Pianese (UNISA)
9:05-9:15	Improving FCs performance from basic phenomena to management	S. J. McPhail – C. Pianese (UNISA) – D. Pumiglia (ENEA)
9:15-9:25	Description of project AD ASTRA	D. Pumiglia (ENEA)
9:25-9:35	Description of project RUBY	P. Polverino (UNISA)
9:35-9:55	How cells and metal interconnects respond to operating parameters up to 40000 h	P. Piccardo (UNIGE)
9:55-10:15	Degradation assessment in solid oxide cell operated in electrolysis mode	A. Leon (EIFER)
10:15-10:25	Q&A	
10:25-10:40	Coffee break & networking	
10:40-11:00	Online THDA for rSOC diagnostic: Illustration for reactants depletion	H. Moussaoui (EPFL)
11:00-11:20	AST: The effect of pressure on the interconnect ageing	R. Spotorno (UNIGE)
11:20-11:40	SOFC degradation studies through a multiscale modelling approach	F. Bianchi (UNIGE)
11:40-12:00	Development of mathematical transfer functions for AST design	P. Polverino (UNISA)
12:00-12:20	Modeling the impact of electrode degradations on the SOC response	E. Da Silva (CEA)
12:20-12:30	Q&A	
12:30-13:30	Lunch at the Canteen of the University of Lucerne	
13:30-13:50	Robust diagnosis of PEMFC based on Artificial Intelligence and EIS	D. Chanal (UBFC)
13:50-14:10	Active and passive diagnosis of SOFC cells and stacks	D. Juricic (IJS)
14:10-14:30	Data-driven and model-based diagnosis of PEMFC & SOFC Balance of Plants	A. Pandolfi (UNISA)
14:30-14:50	Validation of performance of RUBY-tool for SOFC $\mu$ -CHP	A. Nieminen (VTT)
14:50-15:00	Q&A	
15:00-15:20	Coffee break & networking	
15:20-15:40	Enforcing optimal operation of FCS despite degradation via real-time optimization	T. De Avila Ferreira (HES-SO)
15:40-16:00	Degradation-aware energy management of fuel cell-based VPPs	M. Sorrentino (UNISA)
16:00-16:20	EU project REACTT-Advanced Field Diagnostics of SOEC & rSOC	D. Juricic (IJS)
16:20-16:40	Hardware for on-field EIS: state of the art, solutions and issues	G. Spagnuolo (UNISA)
16:40-16:50	Q&A	
16:50-17:00	Feedback from Q&A sessions, discussion – Closure	D. Pumiglia (ENEA) C. Pianese (UNISA)

**Affiliation:** CEA, French Alternative Energies and Atomic Energy Commission (F); EIFER, European Institute for Energy Research (D); ENEA, Italian National Agency for New Technologies, Energy and Sustainable Economic Development (I); EPFL, Swiss Federal Institute of Technology (CH); IJS, Jožef Stefan Institute (SI); HES-SO, University of Applied Sciences and Arts Western Switzerland (CH); UBFC, University of Bourgogne Franche-Comté (F); UNIGE, University of Genova (I); UNISA, University of Salerno (I); VTT, technical Research Centre of Finland (FI).



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