SAPPHIRE: System Automation of PEMFCs with Prognostics and Health management for Improved Reliability and Economy

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Coordination:

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Partners:

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EIFER	European Institute for Energy Research, Germany
FCLAB	Fuel Cell Lab, CNRS Research Federation, France
FESB	U. of Split, Fac. of Elec. / Mech. Eng. and Naval Archit., Croatia
SINTEF	Stiftelsen SINTEF, Norway
ZSW	Centre for Solar Energy and Hydrogen Research, Germany

Abstract

The SAPPHIRE project will develop an integrated prognostics and health management system (PHM) including a health-adaptive controller to extend the lifetime and increase the reliability of heat and power-producing systems based on low-temperature proton-exchange membrane fuel cells (LT-PEMFC).

The PHM system can actively track the current health and degradation state of the fuel-cell system, and through the health-adaptive control counteract the degradation of cells and balance of plant, and thereby boost the lifetime of the controlled system beyond the current lifetime expectancy. An important part of project is to develop novel prognostics approaches implemented in the PHM for estimation of the remaining useful life (RUL) of the PEMFC.

An efficient sensor configuration for control will be chosen using controllability analysis methods, also including indirect sensing/estimation techniques to replace expensive measurement principles. Based on sensor inputs and input from the control system, the PHM algorithms identify the probable failure modes trajectories and estimate the remaining useful life. The consortium's competence ranges from first principles estimation, to signal processing, regression and data-driven techniques, such as neural networks. This ensures an efficient choice of methods.

The project covers a full cycle of research activities, from requirement specification and laboratory experiments, through study of degradation phenomena and selection of prognostic methods, to synthesis of the control system and its testing on the target PEMFC system. A technical-economical analysis will be performed in order to assess the impact of the developed tool in terms of lifetime improvement.

The project is expected to produce hardware and software solutions and have a significant scientific output. The implemented solutions resulting from the project will be tested and validated by the research and industrial partners.