

Deliverable D4.1

State-of-the-art survey on the 5 failure modes

Proton Exchange Membrane fuel cells (PEMFC) are promising devices to face energy transition challenges. Nevertheless their durability is mainly influenced by system operating conditions. Indeed, several degradation mechanisms could take place inside the cell in case of abnormal operations. Among other, improper water, thermal and gas managements can induce the system performance reduction, usually resulting in sensible cell voltage degradations. A long-term exposure to these phenomena causes irreversible losses accelerating the PEMFC ageing and, consequently affecting its durability.

In this framework, both system monitoring and control actions are the primary targets to ensure suitable operating conditions. Furthermore, dedicated fault detection and isolation (FDI) algorithms are required to detect abnormal / faulty operating conditions. This deliverable aims at presenting the state of the art of the most relevant PEMFC stack and system faults as well as the related diagnostic strategies. For the needs of the Health-Code project the effects induced by air and fuel starvations, major change in fuel composition, sulphur poisoning and improper water management are analysed. Moreover a focus on model-based, data-based and signal-based diagnosis approaches is given for on-line applications. The different strategies are presented focusing on Electrochemical Impedance Spectroscopy (EIS) measurements and by analysing the output voltage signals deformation induced by the fault generation with respect to the imposed operating conditions.

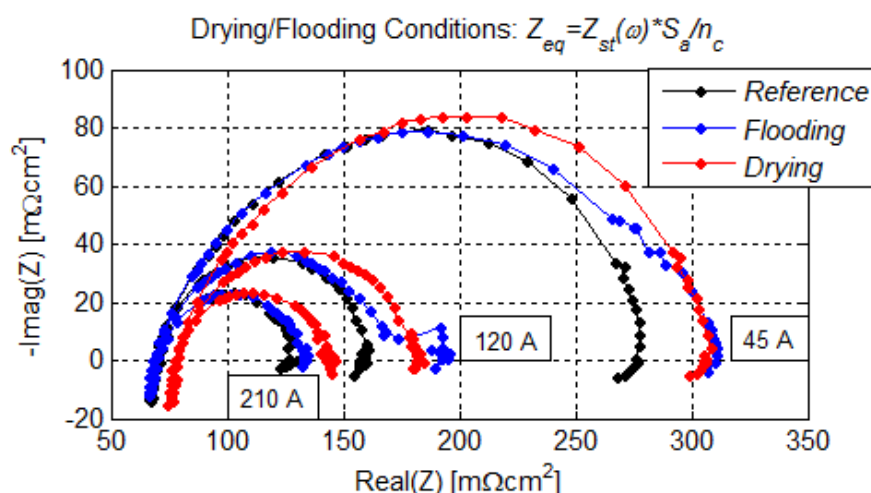


Figure 1: Impact of improper water management on EIS spectra deformations at low, middle and high current values

