

Accelerating Stress Test (AST) for Solid Oxide Cells (SOCs) interconnects (ICs)

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The degradation of metallic interconnects (ICs) in Solid Oxide Cells (SOCs), usually made from ferritic stainless steel (FSS), is a major issue, especially because of the high operating temperatures and the harsh test condition. This degradation often results in the formation of a chromium oxide layer on the IC surface, which causes ohmic losses and can contaminate the cathode.

The lifetime of SOC is around 40,000 hours. Accelerating the testing process is an effective way to speed up such long-term performance tests. Accelerated Stress Tests (ASTs) are conducted under harsher conditions rather than nominal operating states, and over a shorter time than typical long-term tests, making them a promising tool for simulating long-term aging behaviors. The key to designing such tests is identifying i) the correct stressing parameter and ii) the appropriate value for the increased stress factor. To achieve reliable ASTs, the degradation mechanism must first be well understood, ensuring that the underlying mechanism is not changed.

In our previous studies [1,2], the effects of temperature and humidity as stressing factors were thoroughly studied. In the present study, the goal is to investigate the effect of **electrical current** as a stressing factor for interconnect corrosion. The 500-hour high-temperature corrosion tests will be performed on an ex-situ test bench, simulating real in-situ conditions (a schematic is shown in Figure 1).

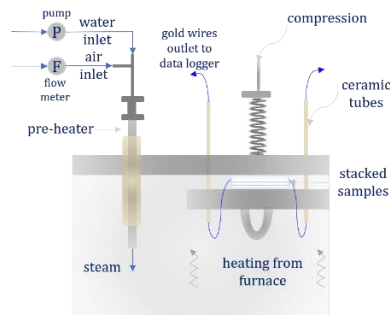


Figure 1. Schematics of ex-situ corrosion ageing test

This project begins with a literature review on the degradation mechanisms of SOC interconnects and their protective coatings. A comprehensive literature review is also required to understand how electrical current may affect the degradation process. The student will receive training in corrosion test mounting and will be responsible for monitoring the test and data analyses. After the 500-hour tests, the samples must be prepared for post-test analysis, primarily using SEM/EDX. The student will also be responsible for analyzing and interpreting the characterization results.

Reference

- [1] S. Daviran, "Spinel Protective Coatings for Solid Oxide Cells (SOCs) Interconnects (ICs)", PhD Thesis, Group of Energy Materials (GEM), EPFL, 2024.
- [2] M. Bianco, "Analysis of High Temperature Degradation of Alloys in Solid Oxide Fuel Cell", PhD Thesis, Group of Energy Materials (GEM), EPFL, 2019.