

# Solid Oxide Fuel Cells – Integrating Degradation Effects into Lifetime Prediction Models

(Project **SOFC-Life**, Forschungszentrum Jülich GmbH, Germany)

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## Consortium:

Partner	Beneficiary Name	Country	Role
1	Forschungszentrum Jülich GmbH	Germany	Research
2	Hexis AG,	Switzerland	Industry (SME)
3	HTceramix,	Switzerland	Industry (SME)
4	Topsøe Fuel Cell A/S	Denmark	Industry (SME)
5	Commissariat à l'Energie Atomique	France	Research
6	DTU-EC	Denmark	Research / University
7	Eidgenössische Materialprüfungs- und Forschungsanstalt	Switzerland	Research
8	Institute of High Temperature Electrochemistry	Russia	Research
9	Valtion Teknologian tutkimuskeskus VTT,	Finland	Research
10	Ecole Polytechnique Fédérale Lausanne	Switzerland	University
11	Imperial College	United Kingdom	University
12	Electricité de France	France	Research
13	Zürcher Hochschule für Angewandte Wissenschaften	Switzerland	University

**Title :** Solid Oxide Fuel Cells – Integrating Degradation Effects into Lifetime Prediction Models **SOFC-Life**

**Objectives :** The project addresses the quantification and understanding of the details of major Solid Oxide Fuel Cells (SOFC) continuous degradation effects. The goal is to isolate effects occurring on the anode and cathode side of SOFC and developing descriptions of the degradation mechanisms as functions of distinctive operating parameters (mainly temperature, atmosphere and current density). These functional descriptions are to represent the physical and chemical changes of basic materials and layer properties over time. This information will be integrated into higher level models that are then capable of predicting single degradation phenomena and their combined effect on SOFC cells and single repeating units.

Long-term stable operation of Solid Oxide Fuel Cells (SOFC) is a basic requirement for introducing this technology to the stationary power market. Electricity generating equipment usually is designed for lifetimes of 10 years and well above, corresponding to 40,000 to over 100,000 hours of operation. The continuous degradation of fuel cell voltage commonly observed has to be reduced such that the loss of power remains within acceptable limits during the lifetime. The project aims at a better understanding of the degradation phenomena as a tool for mitigating these effects and as a first step towards developing accelerated testing methods.

The project follows a systematic approach to analysis of some of the most important degradation mechanisms. It concentrates on the 'continuous' (baseline) degradation phenomena determining stack behaviour in the long term. By deconstructing the SOFC stack into isolated elements and interfaces, these are exposed to the physical conditions found in typical SOFC system operation (and beyond). At regular intervals specimen are taken from the experiments and thus a time series of the gradual development of degradation effects is recorded. This time-lapse photography type approach is designed specifically to allow the modelling of physical change over time.

## Expected results :

- Anode sub-model
- Cathode sub-model
- Integrated model(s) for predicting cell and SRU level degradation
- Identification, Assessment and Simulation of Major Degradation Parameters - Concluding report (M36)

The project aims at improving the longevity of SOFC and such contributes towards market introduction and economic development of the stationary fuel cell sector.