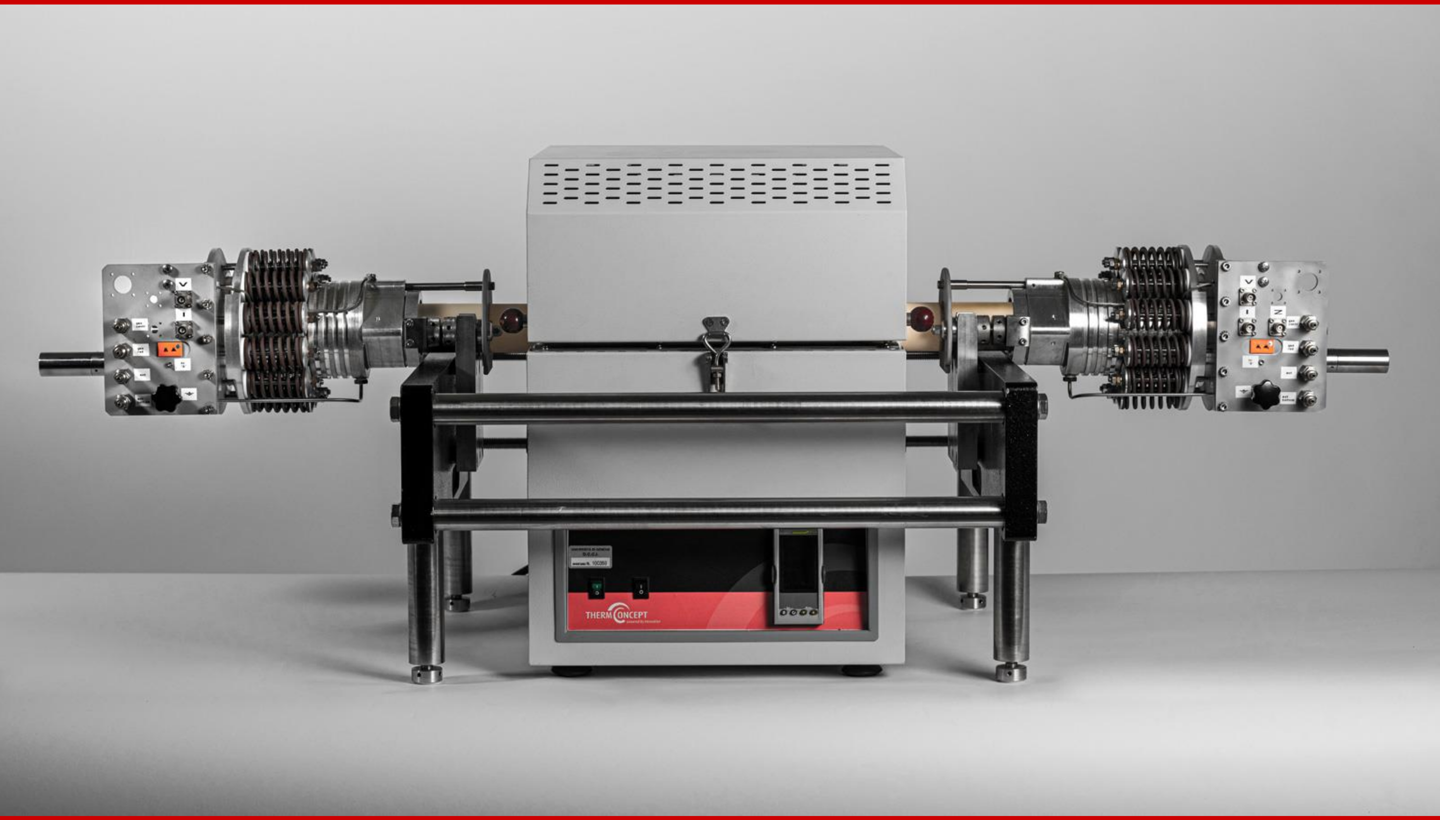
REAL LIFE TESTER



CASE STUDY
FUEL CELLS

STUDY OF INTERCONNECTORS

Analysis of AISI441, AISI444 and AISI430 steels, specific alloys and ceramic layers used in the construction of SOFC fuel cells

REAL LIFE TESTER

REAL LIFE TESTER HAS BEEN DEVELOPED IN COLLABORATION WITH

Consiglio Nazionale delle Ricerche

UNIVERSITÀ DEGLI STUDI DI GENOVA

REAL LIFE TESTER HAS PRODUCED DEMONSTRABLE RESULTS IN THE FOLLOWING EUROPEAN RESEARCH PROJECTS

AD ASTRA

Accelerated Stress Tests and Lifetime Prediction for Solid Oxide Cells

https://www.ad-astra.eu/

Partner Companies: **SOLIDPOWER SPA** (Italy), **SUNFIRE GMBH** (Germany).

Partner Research Institutions : **ENEA** (Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile, Italy), **UNIGE** (Università di Genova, Italy), **EIFER** (European Institute for Energy Research, Germany), **CEA** (Commissariat à l'Énergie Atomique et aux Energies Alternatives,France), **EPFL** (École Politechnique Federale de Lausanne, Switzerland), **DTU** (Danmarks Tekniske Universitet, Denmark), **UNISA** (Università di Salerno, Italy).

ENDURANCE

Enhanced Durability Materials for Advanced Stacks of new Solid Oxide Fuel Cells.

http://http://durablepower.eu/

Partner Companies: **SOFCPOWER SPA** (Italy), **SCHOTT AG** (Germany), **HTCERAMIX SA** (Spain), **MARION TECHNOLOGIE** (France).

Partner Research Institutions: **UNIGE** (Università di Genova, Italy), **DLR** (Deutsches Zentrum für Luft- und Raumfahrt, Germany), **IREC** (Institut de Recerca en Energia de Catalunya, Spain), **CNRS-BX** (Centre National de la Recherche Scientifique, France), **EPFL** (Ecole Polytechnique Fédérale de Lausanne, Switzerland), **IEES** (Institute of Electrochemistry and Energy Systems, Bulgary), **CEA** (De la recherche à l'industrie, France), UNIPI (Università di Pisa, Italy).

REAL LIFE TESTER

FUEL CELLS

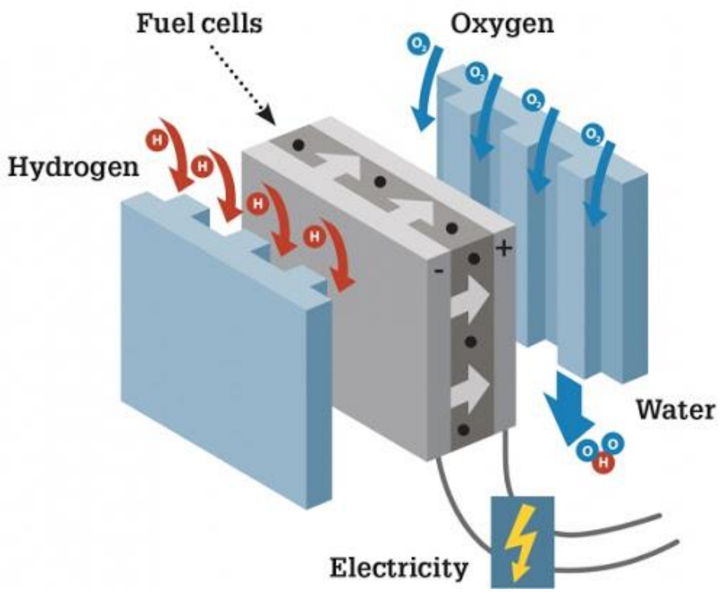
PROBLEM: Analyze the phenomena that cause the deterioration of the interconnectors and the consequent degradation of the performance of a SOFC fuel cell.

SOLUTION: Analyze with Real Life Tester the corrosion and oxidation phenomena of the steels used in the interconnectors, recreating in the laboratory the operating conditions to test the phenomena on different types of alloys and choose the one that guarantees the best performance.

A SOFC solid oxide fuel cell operates in a temperature range between 600 and 900°C.

The exposure of steels to operating conditions of pressure and temperature leads to an alteration of the steel with formation of oxides and volatile chromium-rich compounds.

This process affects the performance of the fuel cell over time and accelerates its degradation.



With Real Life Tester it is possible to reproduce the operating conditions to which the steels used as interconnectors or as structural part of the stack are subjected.

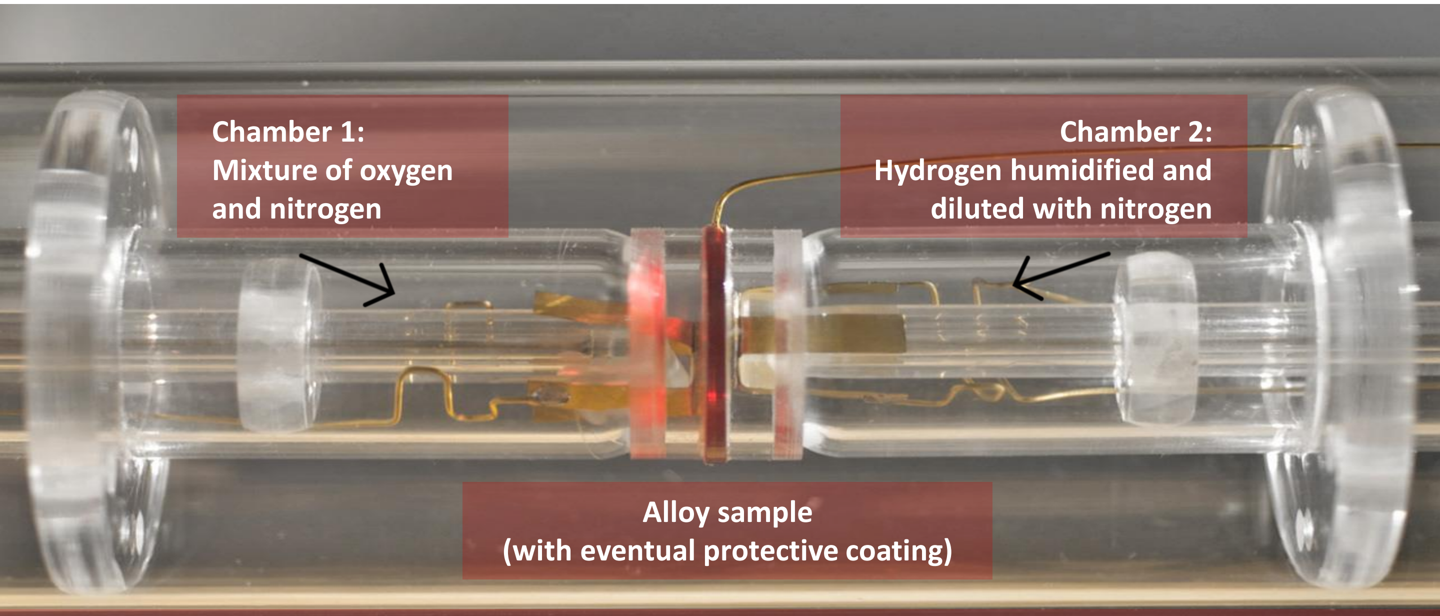
Real Life Tester allows to verify the behaviour of the steel with or without protective coating, the interaction with the other elements of the stack (e.g. the cells) and the reactivity with the glass-ceramic materials used to seal the cells.

REAL LIFE TESTER

FUEL CELLS

PROCEDURE

Insert the steel sample, eventually covered with the protective coating, inside the Real Life Tester, bring the environment to the working temperature of 600-900°C and let hydrogen humidified and diluted with nitrogen flow in one chamber and air or mixture of oxygen and nitrogen in the other (each chamber is in contact with only one side of the sample). An appropriate and further increase in temperature and pressure will speed up the processes that are the subject of the study.



Detail of the material sample inside the Real Life Tester.

RESULTS

By polarizing the sample it is possible to verify various characteristics including the increase in oxide thickness, the formation of new phases as reaction products and the evolution of the protective coatings. If the steel-sealing interface is being studied, it is possible to verify both the evolution of this interface and possible alterations of the sealing material.

MEASUREMENTS

The 4-pole measurement of material resistance is considered a very effective method. The degree of oxidation of the steel used increases in fact the resistance to the passage of current. The addition of a fifth pole gives the possibility to separate the contributions and monitor the behaviour of the sample on each face. The circuit made in platinum avoids any possible alteration and allows to collect data even in extreme operating conditions.

REAL LIFE TESTER

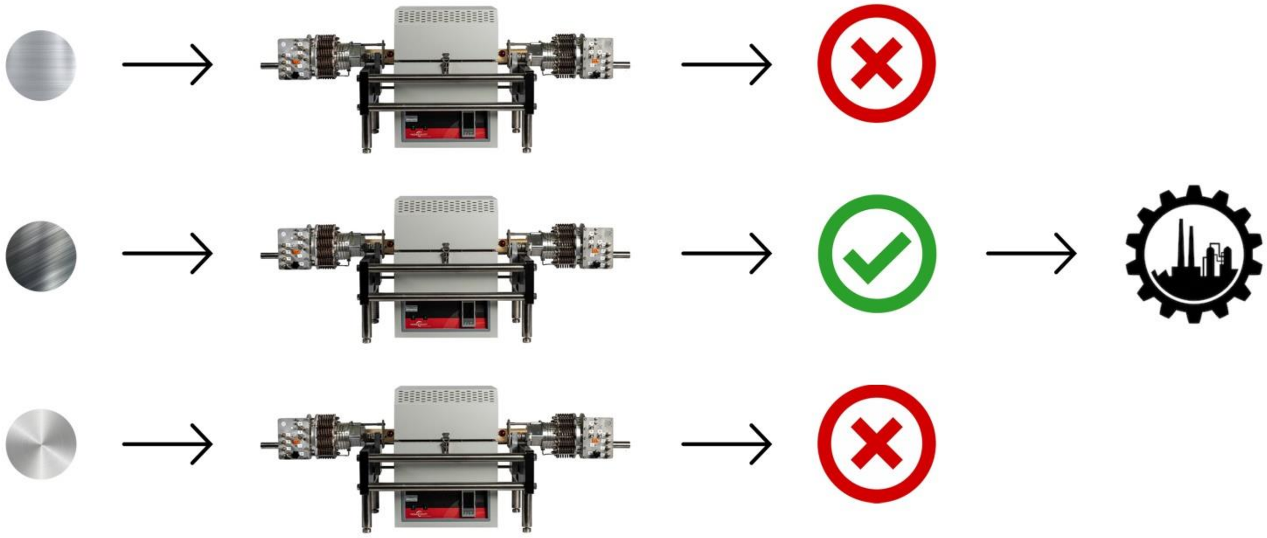
FUEL CELLS

ENHANCE THE PRODUCT PERFORMANCE

Thanks to test cycles that can last from a few hundred to several thousand hours, it is possible to calculate the material's behaviour and thus its life cycle. In this way it is possible to compare several candidate materials for the same function (e.g. different steels, different coatings, different steel-coating pairs) in order to choose the one that guarantees the best yield in the long term.

REDUCE TIME-TO-MARKET BY UP TO 5 TIMES

By placing more Real Life Testers to work in parallel on different samples, at the end of a single test cycle it is possible to immediately compare the data collected on the various types of steel and choose the most performing one.



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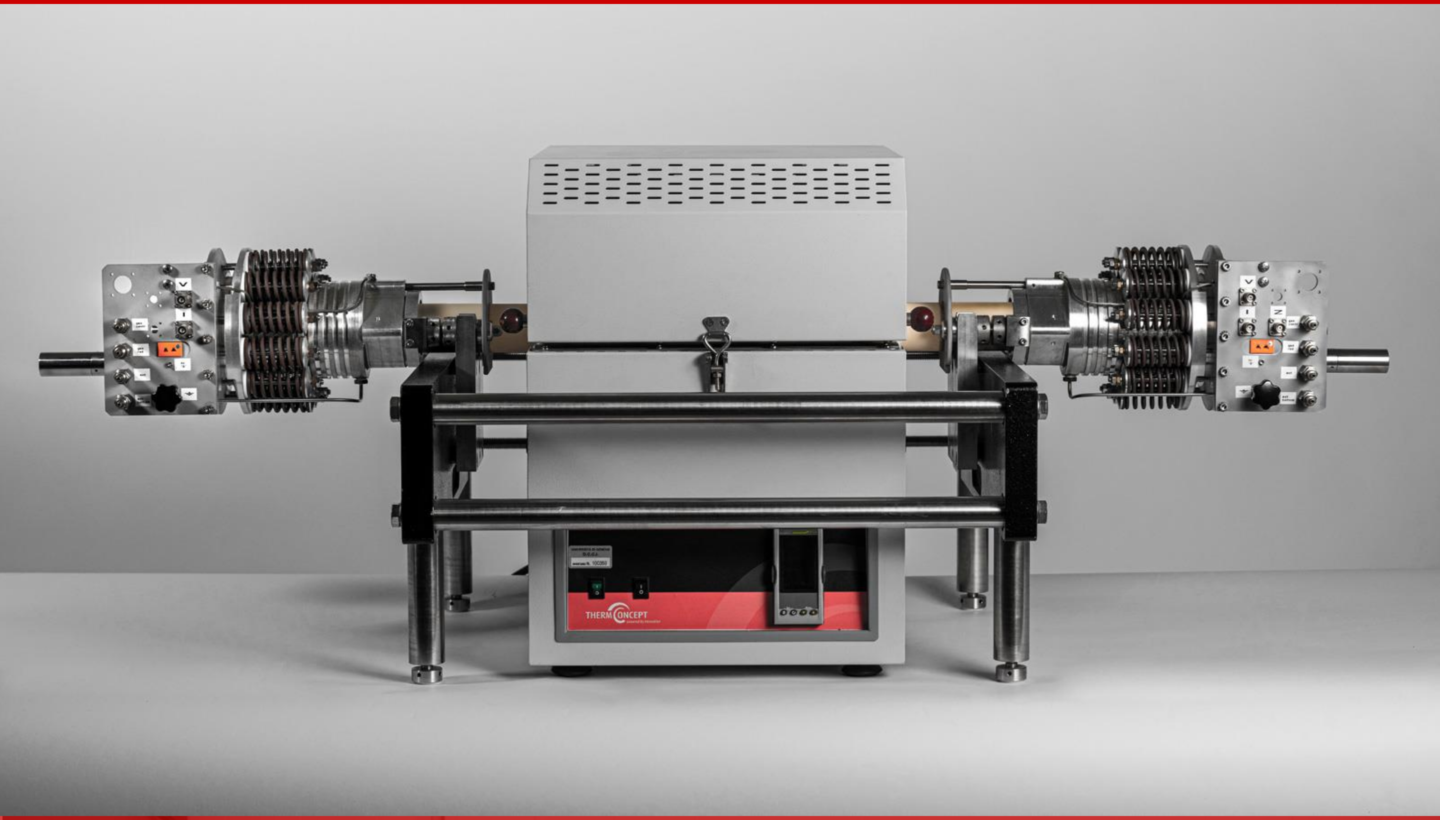

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Real Life Tester

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