DASSAULT SYSTEMES

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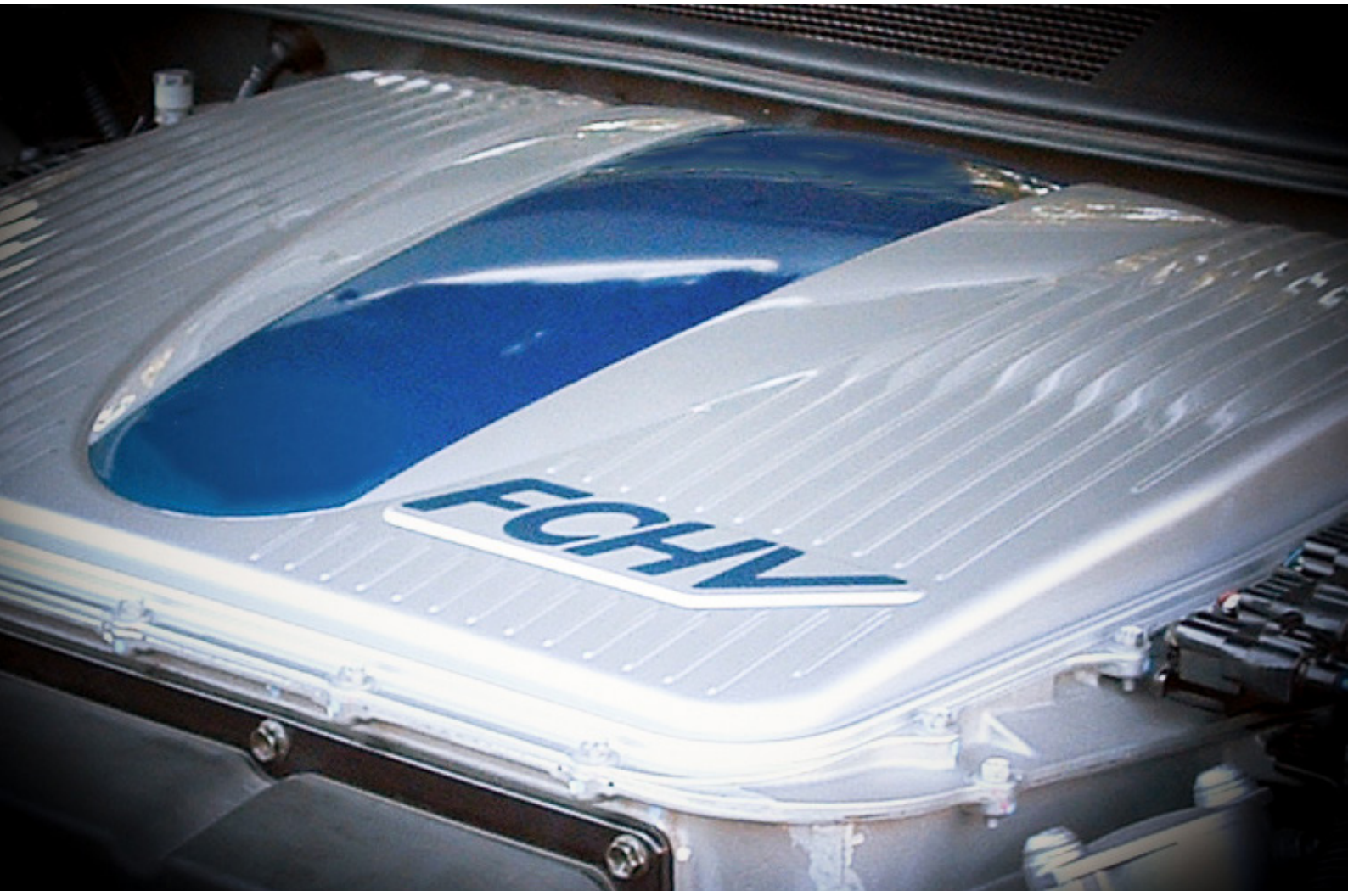
# CATIA SYSTEMS ENGINEERING FUEL CELL LIBRARY

*MODELING AND SIMULATION OF FUEL CELL SYSTEMS WITH CATIA OR DYMOLA*




## RAPIDLY SIMULATE THE DYNAMIC BEHAVIOR OF FUEL CELL SYSTEMS

The Modelica based Fuel Cell Library is ideal for the design, analysis and optimization of fuel cells and fuel cell systems of various types for a wide range of industrial applications. The flexibility provided through the models, extended sample code and implemented examples in the library makes it quick and easy to get started.

The Fuel Cell Library is used for modeling, simulation, analysis and control systems design of fuel cells, especially for Polymer Exchange Membrane (PEMFC) and Solid Oxide (SOFC) based fuel cell systems. The Fuel Cell Library contains what is typically needed to research, design, and configure fuel cell systems, including components, subsystems, templates, and media. The library contains a large number of generic components for modeling predefined configurations for easy simulation of SOFC and PEMFC fuel cells.

## KEY FEATURES

- Well suited for system and component design
- May be used in any fuel cell application domain
- Easy to adapt stack and reactor templates to new structures
- Support for SOFC and PEMFC in the same simulation tool
- Predefined reactors for fuel pre-processing and internal stack reforming
- Reactions calculated by various approaches
- Handles reformate and other ideal gas mixtures
- Support for condensation analysis

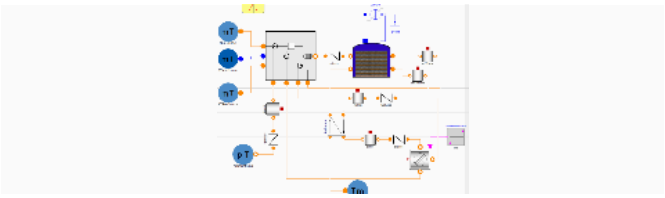
## TYPICAL EXAMPLE

### Full SOFC system

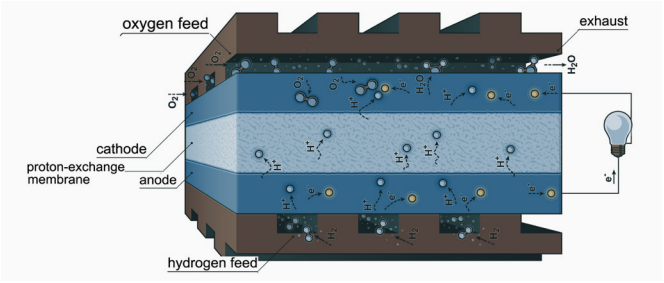
Natural gas, water and air is fed to a fuel preprocessor where the components are mixed, pre-heated and reformed into synthetic gas (syngas) suitable as a fuel for a SOFC stack. The reformed gas is fed to the anode side of a 5 kW SOFC stack with hot air fed to the cathode side.

The stack shown in the figure below contains three sub-stacks with a total of 50 cells. Reforming reactions take place in the anode channel of each sub-stack so that more hydrogen gas is generated.

The hydrogen reacts with oxygen in the cell membrane, which gives rise to an electrical current through the stack. Hot exhaust gasses from the stack is used for pre-heating of the air in the preprocessor and the air that is fed to the cathode before it is fed to a catalytic after burner where it is burned. Finally, the exhaust gas from the burner are used for steam generation and pre-heating of natural gas in the preprocessor.



SOFC example system with heat recirculation




Typical Proton Exchange Fuel Cell

## LIBRARY CONTENTS

### Reactors and Burners

Predefined models of reactor volumes are included. A model of a dynamic combustor with constant volume and metal mass as well as simplistic ignition models to capture ignition from cold and warm states are included.

### Heat Exchangers and Heat Transfer Models

Heat exchanger models including gas-gas, gas-water and water-water heat exchangers which can be used for several different types of heat exchangers as the parameterization is generic.

A simple heat transfer model with constant heat transfer coefficient enables the modeling of heat transfer in physical systems.

### Pipes, Walls and Reactions

Interfaces for reaction objects and models of pipes and channels are included along with a dynamic wall with conduction heat resistance.

### Sources

A range of boundary components are provided that can be used as sinks and sources for homogenous reaction gases and two-phase media.

### Flow Resistance

Flow resistance components like gas and water resistance are available which can be extended and modified.

## BENEFITS

- Significantly reduced development costs due to the seamless simulation of scenarios that are expensive and difficult to physically model and test
- Wide range of library components that can be efficiently used in any fuel cell application domain
- The flexible and powerful library models makes it quick and easy to get startedt

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