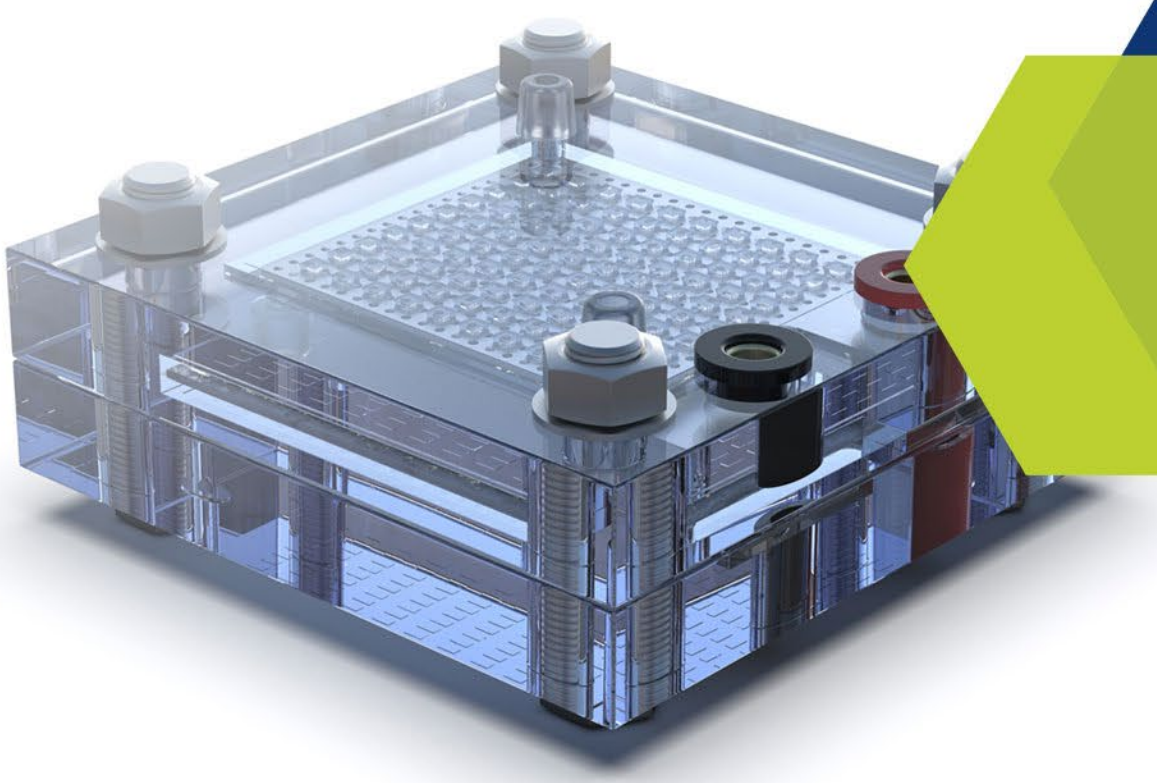
Case Study – Fuel Cells

Effective gasket materials for operating fuel cells



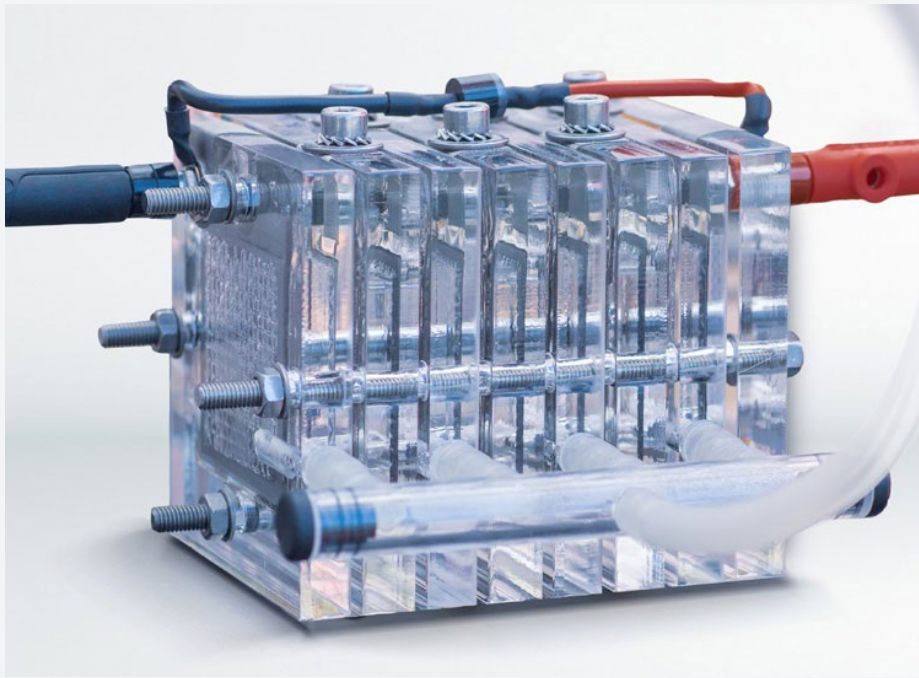
How fuel cells work

The tighter the seal, the more efficient the operation

Basic functionality of fuel cells: **Chemical energy is converted into electrical energy.** In a fuel cell, hydrogen and oxygen are combined to produce water and and electricity. Waste heat is also generated in the process.

A single fuel cell consists of two electrodes, the anode and cathode, and what are known as bipolar plates for conducting the current generated during the reaction and distributing the reaction gases. There is also a specific electrolyte and, finally, the fuels hydrogen and oxygen. However, since a single fuel cell generates only a small amount of electricity, practical applications usually connect a large number of these individual cells in a series – also known as a stack. The number of stacks and thus the size of the fuel cell varies depending on how much electricity must be generated. The stacks are limited by the bipolar plates, which ultimately conduct electrical current from cell to cell.

Ultra-high-performance gasket materials inside the cell are absolutely essential in order for fuel cells to operate. They are sandwiched between the stacks to prevent the escape of fuel gases and the electrolyte, to shield the bipolar plates from one another and thus to prevent short circuits. Moreover, the supply lines in which hydrogen and oxygen gases are transported must be sealed. The same gasket materials are not necessarily used on stacks and supply lines, as the requirements may vary and require specific gasket properties.



Test setup of a fuel cell on a small laboratory scale, as commonly used for research purposes.

Applications for Frenzelit gaskets

High demands on gasket materials

- Ability to insulate bipolar plates from one another
- Conductive gaskets (not in the stack)
  e.g. where the supply lines are located to allow current to flow away and to prevent the component from becoming electrically charged.
- Sealing of the electrolyte (often a challenging medium such as strong alkalis) inside the stacks (usually liquid).
- Sealing of hydrogen and oxygen acting as fuels (highly demanding, combustible and potentially explosive gases → reliable sealing is an important safety aspect).

Sealing is the decisive factor in ensuring fuel cell efficiency: **The tighter the seal, the more efficient the operation!**
The more gases that escape, the lower the level of efficiency.

This figure shows the various potential areas where gasket materials can be used in fuel cells. These include sealing the hydrogen and oxygen supply lines (positions 1 and 4) and sealing the individual stacks at the bipolar plates (positions 2 and 3).

Frenzelit gasket materials

Efficient use in fuel cells

Gasket material requirements:

- High-performance gasket material for highly efficient fuel cells.
- Resistance to high temperatures of more than 500 °C (in some fuel cell variants) → Purely elastomer-based gasket materials are out of the question in these types of applications.
- Long service life of the materials to ensure the fuel cell requires little maintenance and remains operational.

Materials that are particularly suitable for use in fuel cells:

- **novapress®** – products (elastomer-bonded gasket materials based on high-quality aramid fibers and special functional fillers). They can achieve a leakage level that is up to 10,000 times better than that of comparable standard gaskets.
- **novamica®** – products (consisting of phlogopite mica), which are used in high-temperature fuel cells due to their temperature resistance.
- **novaphit®** – products (consisting of graphite materials) transport electricity away due to their conductivity, thereby preventing the fuel cell from becoming electrically charged.

Frenzelit already uses these effective sealing materials in a wide range of fuel cell applications. We are also involved in research projects and are continuously advancing gasket materials based on customer requirements, e.g. with specific coatings or custom designs. If necessary, we also develop new, effective gasket materials in house.

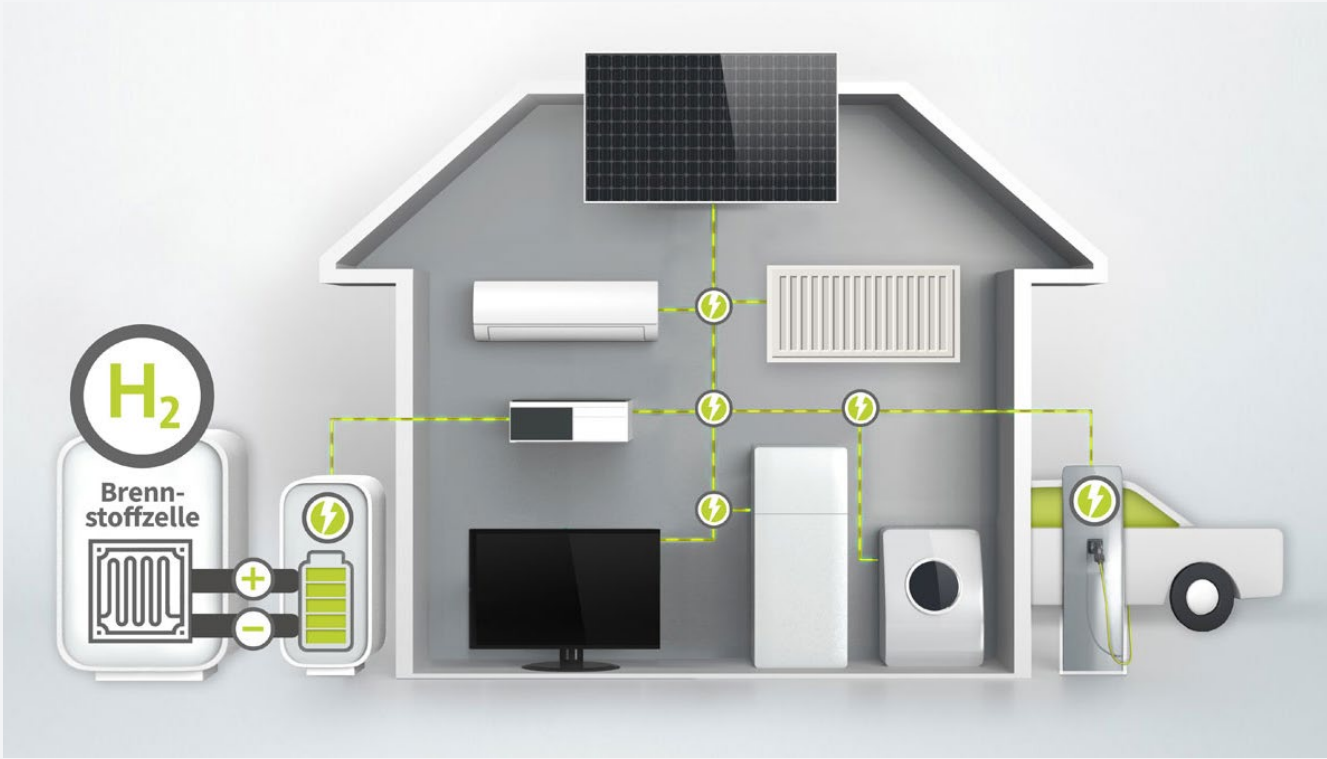
Application example

Fuel cells

The fuel cell is a crucial part of the hydrogen strategy in the context of the energy transition.

Hydrogen production from green electricity via electrolysis: Hydrogen serves as an energy store and can be converted back into electricity as needed with the help of the fuel cell.

Potential applications not only include the mobility sector, from cars to trucks, but also the use in fuel cell heating systems. Waste heat produced by the fuel cell can be used to heat buildings while simultaneously generating electricity.



In private households, the electricity generated can be used to charge electric cars, for instance. At the same time, waste heat from the fuel cell flows into the heating circuit.

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