
ALL
ROUND
ER

Battery or fuel cell? In the race to establish tomorrow's dominant vehicle drive technology, hydrogen-powered fuel cells are drawing more and more attention. ElringKlinger's experts give an insight into the potential of this technology and explain why the two concepts are not mutually exclusive. Outside specialists also provide their view of current developments in a series of short statements.

The idea is not a new one. When the chemist Christian Friedrich Schönbein immersed two platinum electrodes into sulfuric acid in 1838 and introduced hydrogen and oxygen as reactants, he made a ground-breaking discovery: there was a flow of electricity. In doing so, he laid the foundation for the first fuel cell that was built later by the British physical chemist Sir William Robert Grove. Grove called it a "gaseous voltaic battery" and went down in history as the father of the fuel cell. Unfortunately, the initial wave of enthusiasm soon ebbed away because inventions such as the dynamo generated much more electricity at the time. It was not until the mid-20th century that the use of fuel cells in submarines and space capsules breathed new life into the emission-free technology. In terms of broader applications, however, the fuel cell remained firmly on the shelf.

Until today, that is. The world has moved on at a frantic pace, and climate change has presented us with the huge challenge of reducing our CO_2 emissions. There is a broad consensus among experts that global climate objectives can only be achieved if all the different energy sectors – electricity, heating, and transport – become more efficient. Hydrogen is a key component in this transformation. The simplest of all elements is a real all-rounder. It can be used not only to produce electricity in a fuel cell but can also be burnt in the same way as a conventional fuel or used as a storage medium for different forms of energy. Almost 180 years after it was first discovered by Schönbein, the term "cold combustion" is now on everyone's lips.

This development involves a major upheaval for the automotive industry, which is pinning its hopes of zero-emissions mobility on alternative drives such as battery and fuel cell systems. While battery-powered electric vehicles primarily make sense if you are only driving short distances, they face various challenges when it comes to longer distances. Their range is limited: under real-world driving conditions, most purely battery-powered electric cars can only manage 400 kilometers and then need to be recharged for several hours. Even fast recharging stations take half an hour to bring the battery back up to a nearly full charge – not to mention the fact that there is currently no widely available recharging infrastructure.

On a roll: fuel cell development is advancing rapidly.

1838

FUEL CELL

The physicist and chemist Christian Friedrich Schönbein discovers the principle of the fuel cell. Schönbein was born in Metzingen, a stone's throw from ElringKlinger AG's headquarters.

1963

SATELLITE

Fuel cells are used on board a satellite for the first time. The technology is later incorporated into space capsules.

1993

BUS

The first bus is equipped with fuel cells for demonstration purposes.

2007

CAR
A Japanese manufacturer unveils the first fuel cell car to enter series production.

2008

FORKLIFT
A forklift powered by fuel cells is tested in the port of Hamburg.

2017

TRUCK
Several manufacturers announce plans for new trucks equipped with fuel cells.

Within the automotive industry, fuel cells are regarded as the only viable complement to battery technology, and for good reason. Batteries merely store energy, whereas fuel cells can actually convert that energy. They convert hydrogen mainly into electrical energy, and the only waste product, water vapor, is perfectly harmless. Fuel cells – or to be more precise, proton-exchange membrane fuel cells (PEM fuel cells for short) – could therefore be the solution that provides us with clean mobility for the future.

DR. JÜRGEN KRAFT, ELRINGKLINGER AG

»Fuel cells offer a high power density and are ideally suited for mobile applications. I am convinced that this technology will play a key role in the future of the automotive industry.«

So, is the fuel cell just hype, or is it a real alternative to the conventional combustion engine? Dr. Jürgen Kraft specializes in fuel cell technology and is convinced that it has a definite place in tomorrow's automotive world. As a physicist, he leads a team developing PEM fuel cell stacks at ElringKlinger, exploring the potential of fuel cells for broader industrialization. He is fully aware of the many benefits associated with fuel cells: "A vehicle equipped with PEM fuel cells can travel more than 500 kilometers, and refueling takes as little as two to five minutes." If the hydrogen is sourced from renewable energy, you have a completely pollution-free form of mobility. Another advantage is that the heat generated when the energy is converted can be used – in winter, for example – to keep the vehicle interior warm, therefore avoiding any reduction in the vehicle's range compared with battery-powered vehicles. There is a huge range of potential applications. Cars, buses, light commercial vehicles, trucks, trains, and warehouse vehicles such as forklifts are all predestined to be equipped with fuel cell drives.

With so many advantages, it is no wonder that car makers and suppliers such as ElringKlinger have been working on this highly promising technology for the last 20 years, overcoming challenges such as the development of robust tanks that can withstand pressures of up to 700 bar as well as those associated with crash safety and evaporation during long parking intervals. Numerous car makers have already developed early demonstration vehicles or prototypes with hydrogen drives. Some Japanese manufacturers are already producing fuel cell cars at series level, although they are very expensive due to the small numbers involved. Over the years, ElringKlinger has developed a great deal of experience in the field of fuel cell technology and now supplies its own stacks, metallic bipolar plates, and plastic media modules. For Jürgen Kraft, ElringKlinger has a major strategic advantage: "Our traditional core competences in metalworking and plastics processing as well as in the field of joining, coating, and tooling technology can all be harnessed in the development of fuel cells."

DR. CHRISTOPHER HEBLING, FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS ISE

»Hydrogen is an important ingredient in the energy revolution. In car fuel cells, for example, it can be used to help achieve the twin goals of energy efficiency and zero-emissions mobility.«

The idea of using fuel cells as range extenders is particularly attractive. Depending on the system configuration, fuel cells could supply an electric engine directly with energy or recharge the battery. "That combines the best of both worlds – both batteries and fuel cells. You could then have a smaller battery, which would of course cost less, while the fuel cell can be operated at maximum efficiency," raves Jürgen Kraft.

Dr. Mohsine Zahid too believes it is no longer a question of "if" but "when" fuel cell drives will take off. He is responsible for developing the fuel cell business at ElringKlinger, a role that involves a great deal of travel all over the world. He is therefore very familiar with markets and customers: "For the moment, fuel cell cars are still a niche product, partly because there is as yet no national network of hydrogen refueling stations." There are currently fewer than 100 in Germany, although the aim is to reach 400 by 2023. Nevertheless, he believes there is a great deal of interest in this revolutionary energy technology, especially in Asia,

PROF. DR. WERNER TILLMETZ, CENTER FOR SOLAR ENERGY AND HYDROGEN RESEARCH (ZSW)

There is every chance that fuel cell technology will soon emerge as an economically viable solution. The experts agree that the future belongs to the fuel cell. Indeed, it is quite possible that Jules Verne's 1875 prediction – "water is the coal of the future" – will prove entirely accurate.

DR. MOHSINE ZAHID, ELRINGKLINGER AG

»Fuel cell cars are the ideal replacement for all those vehicles currently using diesel engines: from touring sedans designed for longer journeys through to local buses.«

»The fuel cell technology has tremendously gained momentum over the last two years. At ElringKlinger, we are currently working on a wide range of development and grant-funded projects in this area.«

where he held a series of discussions last year with numerous potential customers. "Zero-emissions drive technology is really up there on the agenda in China," he explains. "For that reason, tremendous effort is going into putting alternative drive vehicles on the roads." Driven by very substantial government subsidies, many local buses in China's cities are already equipped with fuel cell systems. Dr. Zahid believes that ElringKlinger's up-front investments in the field of fuel cell technology in recent years will soon pay off. "Thanks to our long-established expertise, we are very much in demand as a partner. Our products have already proven their worth at series production level; our global production network is another advantage."

THE CHANCELLOR AT ELRINGKLINGER

The German Chancellor Dr. Angela Merkel has also shown interest in the performance of the latest fuel cell applications. At the recent International Motor Show (IAA) in Frankfurt, one of the automotive industry's most important annual events, she stopped off at ElringKlinger's booth to find out more about the latest developments relating to PEM fuel cell stacks. The stack is integrated as a fuel cell / battery hybrid system or range extender and is already in series production with a reduced number of cells.

Dr. Stefan Wolf, CEO of ElringKlinger AG, shows the German Chancellor a 300-cell PEM fuel cell stack constructed of metallic bipolar plates; it generates an electrical output of 63 kWeL.