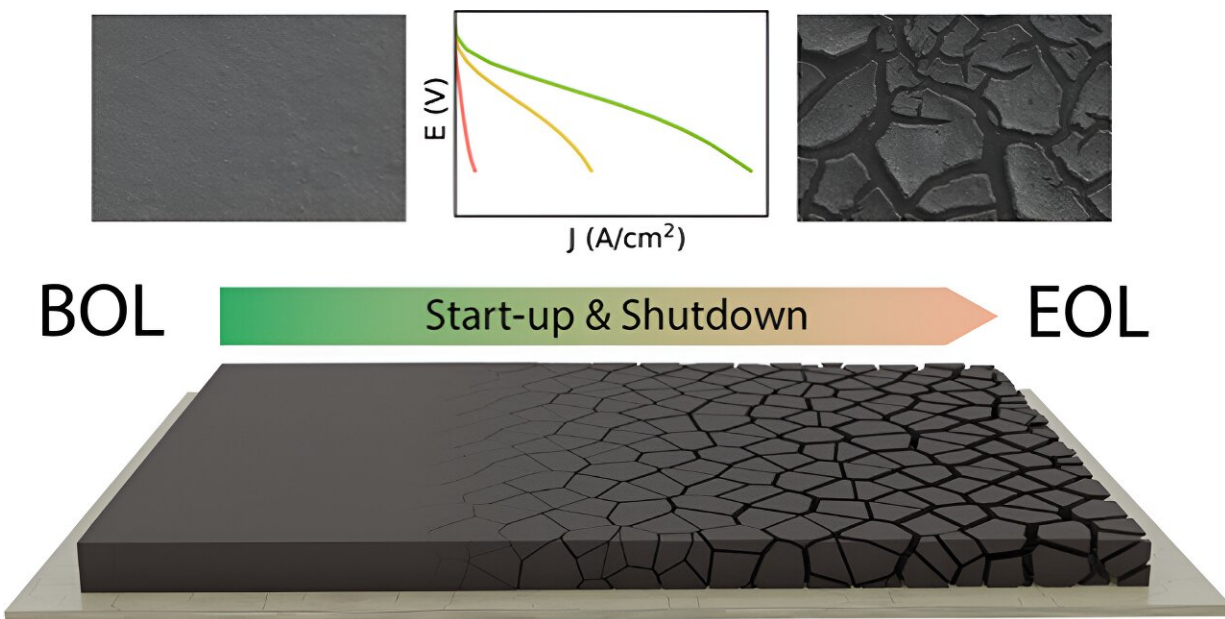


Method paves the way for improved fuel cell vehicles

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Credit: *ACS Catalysis* (2024). DOI: 10.1021/acscatal.4c00417

Hydrogen is a fuel alternative that is becoming increasingly interesting for heavy-duty vehicles. Hydrogen-powered vehicles only emit water vapor as exhaust, and if the hydrogen is produced using renewable energy, it is completely free of carbon dioxide emissions.

Unlike battery-powered electric vehicles, hydrogen-powered vehicles do not need to burden the [electricity grid](#), as hydrogen can be produced and

stored when electricity is cheap.

For some hydrogen-powered vehicles, the propulsion comes from a so-called [fuel cell](#). However, hydrogen-fuel-cell-powered vehicles are limited by a relatively short lifespan, because fuel cell components, such as electrodes and membranes, degrade over time. It is this problem that a recent study addresses.

Researchers at Chalmers University of Technology have developed a new method for studying what affects the aging of fuel cells by tracking a specific particle in the fuel cell during use.

The team of researchers studied an entire fuel cell by taking it apart at regular intervals. Using advanced electron microscopes, they then followed how the cathode electrode degrades in specific areas during the cycles of use. The most recent findings are [published](#) in the journal *ACS Catalysis*.

Previous studies have been done on so-called half-cells, which are similar (but not the same as) half of a fuel-cell and are carried out under conditions that differ significantly from the real fuel cell.

Better understanding with new experimental method

"It has previously been assumed that the performance would be affected by the fuel cell being disassembled and studied in the way we have done, but it turned out that this assumption is not correct, which is surprising," says research leader Björn Wickman, Associate Professor at the Department of Physics at Chalmers.

The researchers at Chalmers have been able to explore how the material in the fuel cell degrades at both the nano and micro level, and pinpoint exactly when and where the degradation occurs. This provides valuable

information for the development of new and improved fuel cells with a longer lifespan.

"From previously only looking at how the fuel cell has aged after use, we have now been able to look into the middle stage," says doctoral student Linnéa Strandberg at Chalmers. "Being able to follow a single, chosen particle within a specific area provided a much better understanding of the degradation processes. Greater knowledge of these is an important step on the way to designing new materials for fuel cells or to adjust the control of the fuel cell."

New method paves way for longer lasting fuel cells

The U.S. Department of Energy (DOE) has pointed out that an improved lifetime of fuel cells is one of the most important goals to reach before fuel cell-powered hydrogen vehicles can become commercially successful. According to the industry, a truck needs to be able to withstand 20,000—30,000 hours of driving over its lifetime, which a fuel cell-powered hydrogen truck cannot achieve today.

"We have now laid a foundation on which to build for the development of better fuel cells. Now we know more about the processes that take place in the fuel cell and at what point over the lifetime of the fuel cell they occur. In the future, the method will be used to develop and study new materials that can give the fuel cell a longer lifespan," says Björn Wickman.

More information: Linnéa Strandberg et al, Carbon Support Corrosion in PEMFCs Followed by Identical Location Electron Microscopy, *ACS Catalysis* (2024). [DOI: 10.1021/acscatal.4c00417](https://doi.org/10.1021/acscatal.4c00417)

Provided by Chalmers University of Technology

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