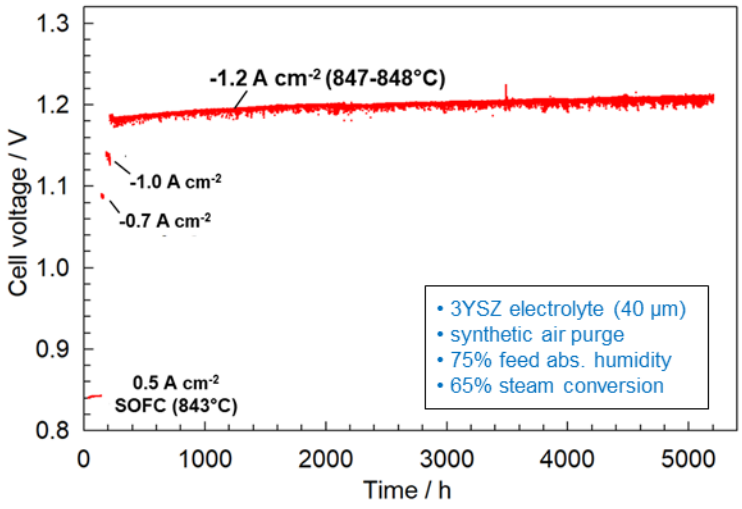
Durability milestone for steam electrolysis: 5,000 hours operation with an electrolyte supported solid oxide cell at high current density (1.2 A·cm^{-2})

Released on the (26.08.2024). Contact Josef SCHEFOLD (EIFER) and Aline Léon (EIFER), josef.schefold@eifer.org; aline.leon@eifer.org;

Launched in March 2021, the H$_2$Giga flagship project consists of 30 independent research projects focused on advancing the industrialisation of low and high temperature water electrolysis. The project is built in three main directions with lead companies to scale up their electrolysers capacities to the gigawatt range, an innovation pool with research institutes to advance interdisciplinary topics like degradation, recycling, material development and next generation scale-up related future technologies like anion exchange membrane electrolyser. The Technology Platform Electrolysis, coordinated by DECHEMA e.V., is tasked with fostering collaboration between H$_2$Giga partners from industry and academia.

Continuous steam electrolysis during 5,000 hours at a high-current density of 1.2 A·cm^{-2} of a solid oxide cell was achieved in June 2024 at the European Institute for Energy Research (EIFER). The test was done with an advanced electrolyte supported cell based on a 40 µm thick 3YSZ electrolyte, supplied by the company Sunfire. It represents the longest incident-free test at such current density reported so far. A found low degradation of 4 mV/1000 h confirms that long-term stable operation with high power is feasible with such type of cells. Josef SCHEFOLD (EIFER) performed the test including the impedance spectroscopic characterization; the cell characterization with classic and advanced techniques will be done by Aline LEON (EIFER).



The time evolution of the cell voltage under constant current was measured after initial fuel cell characterization and ramping up of the current density (see Figure). Average voltage degradation was 4 mV/kh (from 1 to 5 kh). The low degradation together with a low value of the area specific resistance (0.28 Ω·cm^2), feasible with the thin electrolyte, maintained the cell voltage below the thermal neutral voltage (U < 1.3 V). Impedance analysis confirmed an essentially ohmic degradation, attributable at least in part to the decay of the ionic conduction in the electrolyte. No indications exist for major electrode degradation, despite the applied high current density.

The work was presented in more detail in the European Fuel Cell Forum, EFCF (2-5 July 2024, Lucerne, Switzerland).

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