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Electrothermal balanced operation - A new operation method for improved SOEC performance

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Abstract

The ongoing green energy transition increases the need for dynamic and efficient Power-to-X (PtX) systems to convert surplus wind and solar power to high-value products. The solid oxide electrolysis cell (SOEC) technology offers the highest energy conversion efficiency. However, operation at part-load, i.e. below thermo-neutral potential, creates thermal variations causing thermomechanical stress. Combined with limited lifetime this impedes commercialization of the technology. Here we present a novel operating method that alleviates temperature variations in the SOECs and decreases degradation.

A flat thermal profile across the SOEC is obtained by switching several times per second between electrolysis mode and brief pulses in fuel cell mode; the thermal mass of the SOEC prevents temperature fluctuations during the short switching period. The operation method is referred to as AC:DC operation.

In this presentation we present experimental results. The observed reduction in the degradation rate is believed to be caused by desorption of impurities that otherwise adsorb on the surface of the electrodes. Finally, we discuss how AC:DC operation can enable dynamic operation of large SOEC systems.