Towards robust and reliable SOEC cells and stacks: Understanding degradation phenomena occurring under high current densities

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The amount of electricity generated from renewable energy sources is growing and it is expected that already in 2025 up to 50% of the annual production of electricity in Denmark could take place at times when production exceeds demand.
To integrate such high amount of fluctuating energy into the existing energy grid, efficient and cost competitive conversion of electricity into other kinds of energy carriers is needed.
Technologies based on high temperature solid oxide electrolysis cells (SOECs) have the potential to contribute substantially: When electricity production exceeds demand, this technology can be used to convert renewable electric power, H_2O and/or CO_2 to hydrogen or synthetic fuel with very high efficiency.
In this presentation recent highlights from the Danish ForskEL project “Development of SOEC cells and stacks” will be discussed.
Results from SOEC cell and stack testing will be shown and the electrochemical performance and post-mortem analysis of the cells will be presented.
Based on these results the advantages and disadvantages of different electrode materials and the influence of the operation conditions will be evaluated.
Another main part of this presentation will be the evaluation of different degradation mechanisms occurring under high currents: Phenomena like loss of percolation in electrode material, crack formation in the electrolyte and electrode poising by impurities will be presented and possible counter-strategies discussed.