Pressurized high temperature electrolysis - SOEC

FuelMat Group
Solid Oxide Fuel Cell

Solid Oxide Electrolysis Cell
High temperature co-electrolysis:

\[ \text{H}_2\text{O} \rightarrow \text{H}_2 + \frac{1}{2} \text{O}_2 \]

\[ \text{CO}_2 \rightarrow \text{CO} + \frac{1}{2} \text{O}_2 \]

(F-T process)

Syngas

Hydrocarbon chemicals

Context: power to gas
Advantages:
- Storage of renewable or nuclear power into chemicals
- CO$_2$ converted into synthetic fuel
- Operation at high temperatures confers more favorable thermodynamics and reaction kinetics
- Very high conversion efficiency

Drawbacks:
- Strong degradation phenomena
Pressurized electrolysis

Advantages:
- Lower voltage at high current density (lower electrical power consumption)
- Operation at high pressure advantageous for system integration
Pressurized high temperature testing:

1. low pressure (up to 3 bar) vs. high pressure (up to 15 bar)
   find out differences in conditions for both cases (e.g. at higher pressures, the whole lines have to be kept sufficiently hot to avoid recondensation)

2. maximum differential pressure that a cell can withstand
   find the weakest part (cell or seal), check failures
Pressurized high temperature testing:

3. homogeneous vs. heterogeneous pressure on two sides

- **homogeneous**: design a pressure vessel

- **heterogeneous**: (e.g. steam side with a liquid feed pump before the evaporator - air side with a compressor)
Thank You !