

Objective and Scope

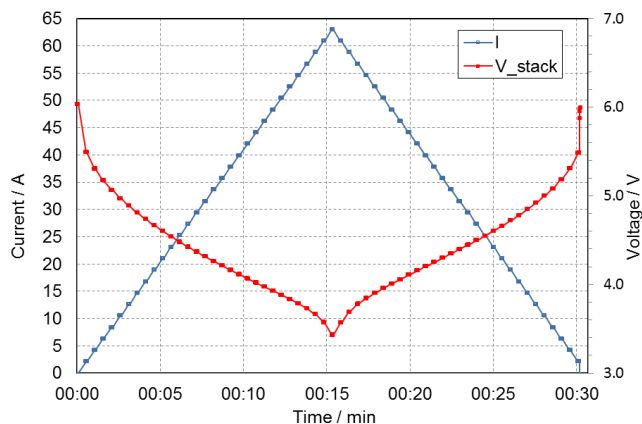
This test module deals with solid oxide cell (SOC) operation at different current densities either as a fuel cell (SOFC) or as an electrolyser (SOEC) to determine the current-voltage characteristics (j - V , polarization curve measurement) of an SOC cell/stack. It is a general characterization method that can be used in SOC R&D and for quality assurance.

Main Test Input Parameters (TIPs)

Static TIP	Variable TIP
Rate of change of current ($\Delta I/\Delta t$)	Current (I)
Flow rates of inlet gases (f_{in})	
Temperature of the oven (T_{oven})	
Pressure of outlet gases (p_{out})	
Composition of inlet gases ($X_{i, in}$)	

Test Procedure

- Stepwise increase current from zero (open circuit voltage) to current at the specified cut-off voltage (ascending j - V curve) followed by current decrease to zero (descending j - V curve) using the specified rate of current change, e.g. $1 \text{ mA cm}^{-2} \text{ sec}^{-1}$.
- Continuously record all TIPs & TOPs at their specified sampling rates, e.g. 1 Hz.
- For step duration of longer than 1 second, the values of SOC voltage last measured during each step versus the current density constitute the data points of the j - V curve.



Evolution of SOFC stack current and voltage during test (ascending and descending)

Critical Parameters and Parameter Controls

- Stability of T_{cell} , T_{stack} , $T_{neg,inv}$, $T_{pos,inv}$, $T_{neg,out}$ and $T_{pos,out}$ under OCV conditions (zero current) prior to the actual polarization (j - V) curve measurement (current-voltage characteristics).

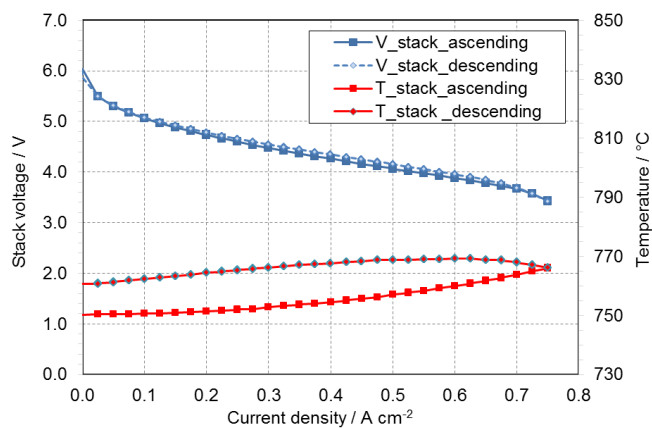
- In SOEC mode, special attention is to be paid to a stable supply of steam to limit SOC voltage fluctuations to within a specified value at OCV, e.g., $\pm 10 \text{ mV}$ per cell.

Main Test Output Parameters (TOPs) and Derived Quantities

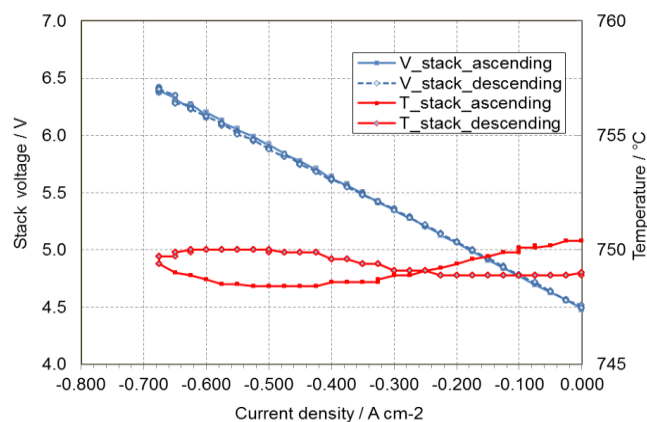
TOP	Derived Quantity
Voltage of cell/RU/stack (V)	Current density (j)
Temperature of gas streams at cell/stack inlet/outlet, temperature of cell/stack (T)	Electrical power density ($P_{d,el}$)
	Reactant gas utilization (U_{gas})
	Area specific resistance (ASR)

Data Post Processing and Representation

Representation examples of j - V curves:



SOFC stack j - V curve (ascending and descending)



SOEC stack j - V curve (ascending and descending)

SOCTESQA:

Solid Oxide Cell and Stack Testing, Safety and Quality Assurance

Project website: www.soctesqa.eu

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