Test Module 02: Start-up

(Version 1.16, 14 March 2017)

Objective and Scope

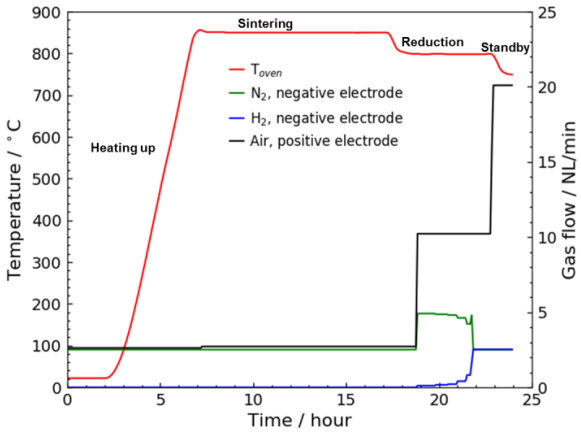
This test module deals with the start-up procedure of solid oxide cells/stacks needed to achieve operating conditions. Start-up includes the heating step and if needed, the gas tightness and electrical contact optimization, the reduction and the conditioning of the SOC stack or cell. The start-up procedure should be given by the manufacturer. However, if there is no start-up procedure available, a recommendation is given in this test module.

Main Test Input Parameters (TIPs)

Static TIP	Variable TIP
Rate of oven temperature change ($\Delta T_{oven}/\Delta t$)	Temperature of the oven (T_{oven})
	Temperature of the pre-heater ($T_{PH,in}$)
	Flow rates of inlet gases (f_{in})
	Composition of inlet gases ($x_{i,\,in}$)

Test Procedure

- Set the flow for the negative ($f_{neg,in}$) electrode to N_2 or Ar. Set the flow for the positive electrode ($f_{pos,in}$) to air.
- Increase cell/stack temperature by setting T_{oven} to the required sealing temperature. Increase the gas inlet temperatures (if possible) by adjusting $T_{PH,in}$.
- Hold time at sealing temperature according to setup requirements.
- Change T_{oven} to the reduction temperature required by the SOCs. Initiate the reduction process (e.g. by increasing H_2 flow stepwise).
- Change T_{oven} to the operating temperature; change the reactants to nominal operation flow/composition.



Schematic example of start-up procedure for non-reduced SOC cell/stack

Critical Parameters and Parameter Controls

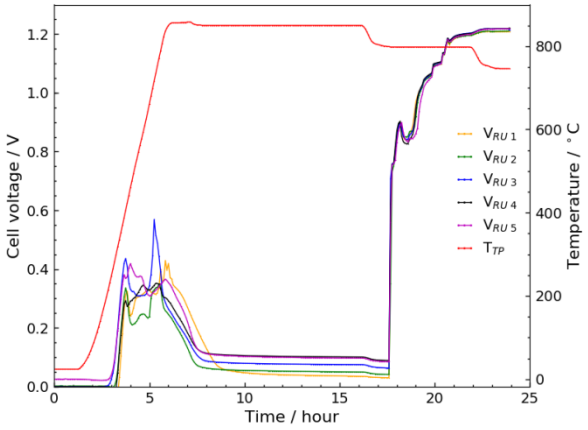
- A large temperature gradient between the gas inlets and the cell/stack should be avoided to reduce the risk of cell/stack damage

Main Test Output Parameters (TOPs) and Derived Quantities

TOP	Derived Quantities
Voltage of cell/stack (V)	Maximum temperature difference during start-up (ΔT_{max})
Temperature of gas streams at cell/stack inlet/outlet, temperature of cell/stack (T)	

Data Post Processing and Representation

Representation examples of start-up:



Schematic example of startup procedure for non-reduced 5-cells SOC stack

SOCTESQA:
Solid Oxide Cell and Stack Testing, Safety and Quality Assurance
Project website: www.soctesqa.eu

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