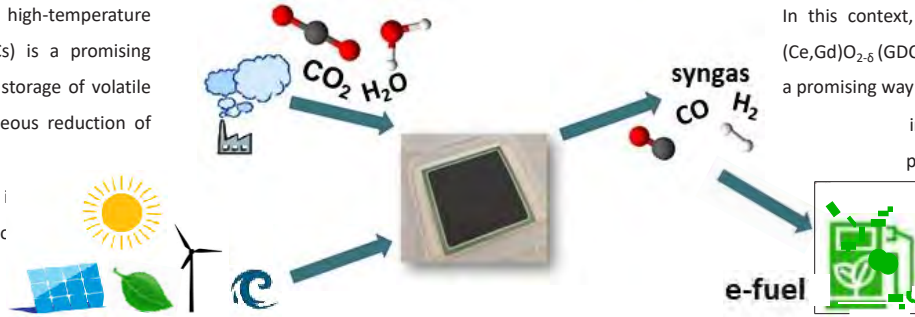


## SOLID OXIDE ELECTROLYSER CELL - SOEC

Co-electrolysis of  $\text{CO}_2$  and  $\text{H}_2\text{O}$  in high-temperature solid oxide electrolyser cells (SOECs) is a promising future technology, as it enables the storage of volatile renewable energy and the simultaneous reduction of  $\text{CO}_2$  emissions.

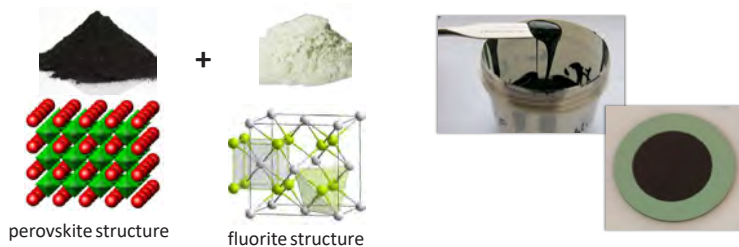
Material development for SOECs is currently aimed at pushing the limits of cell efficiency and lifetime.



In this context,  $(\text{La,Sr})(\text{Co,Fe})\text{O}_{3-5}$  (LSCF) /  $(\text{Ce,Gd})\text{O}_{2-5}$  (GDC) composite electrodes are a promising way to

improve the electrochemical performance, microstructure and stability of the air electrode [1,2].

## SCIENTIFIC APPROACH

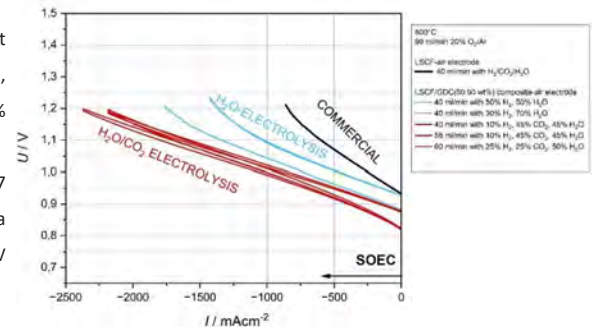


In this study, the composite air electrode was prepared from a mixed ionic electronic conductor  $\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{0.2}\text{Fe}_{0.8}\text{O}_{3-5}$  (LSCF) and an ionic conductor  $\text{Ce}_{0.9}\text{Gd}_{0.1}\text{O}_{1.95}$  (GDC). The screen-printing ink was fabricated with a terpene-based ink vehicle. The air electrode with 1.3 cm diameter was printed onto a commercial NiO/YSZ/GDC button cell substrate and sintered at 1060°C.

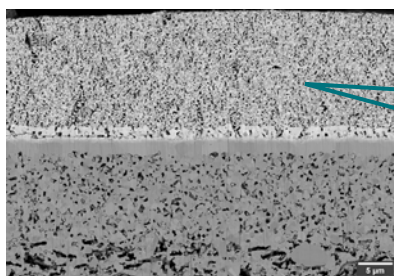
## ELECTROCHEMICAL CHARACTERISATION

The cell was electrochemically characterized at a temperature of 800°C, using a gas with 20%  $\text{O}_2$  (rest Ar) at the air electrode, and either 50%  $\text{H}_2\text{O}$  or 70%  $\text{H}_2\text{O}$  (rest  $\text{H}_2$ ) at the fuel electrode. In co-electrolysis mode, gases at the fuel electrode are switched between two modes 25%  $\text{H}_2$ , 25%  $\text{CO}_2$ , 50%  $\text{H}_2\text{O}$ , and 10%  $\text{H}_2$ , 45%  $\text{CO}_2$ , 45%  $\text{H}_2\text{O}$ , respectively.

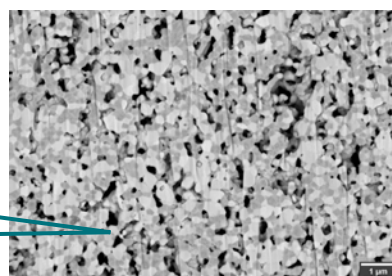
I-U-curves of the cell with 50:50 wt% LSCF:GDC composite electrode show high current densities of  $-1.37 \text{ A/cm}^2$  for  $\text{H}_2\text{O}$  electrolysis and  $-2.37 \text{ A/cm}^2$  for co-electrolysis at 1.2 V electrolysis voltage. In comparison, a commercial cell with single phase LSCF air electrode shows a lower current density of  $-0.84 \text{ A/cm}^2$  at 1.2 V for  $\text{H}_2\text{O}$  electrolysis.



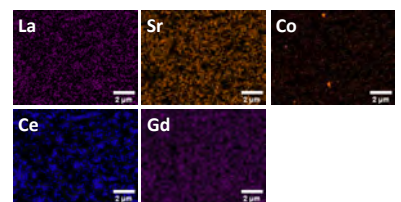
## POST TEST ANALYSIS & CELL MICROSTRUCTURE



- homogeneous thickness
- good adhesion between all layers



- excellent microstructure
- porosity of 20 %



FESEM-EDX images of the elemental distribution in the air electrode

## REFERENCES

- [1] Jiang, S.P., Development of lanthanum strontium cobalt ferrite perovskite electrodes of solid oxide fuel cells – A review. International Journal of Hydrogen Energy, 2019. 44(14): p. 7448-7493.
- [2] Perry Murray, E., M.J. Sever, and S.A. Barnett, Electrochemical performance of  $(\text{La,Sr})(\text{Co,Fe})\text{O}_{3-5}/(\text{Ce,Gd})\text{O}_{2-5}$  composite cathodes. Solid State Ionics, 2002. 148(1): p. 27-34.