

Steam Electrolysis vs Co-electrolysis: Mechanistic Studies of Long-Term Solid Oxide Electrolysis Cells

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Supplementary Information

Table S1. Reduction of NiO in the cermet fuel electrode at 900 °C.

| Reduction step | H ₂ / % | N ₂ / % |
|----------------|--------------------|--------------------|
| 1 | 0 | 100.0 |
| 2 | 7.7 | 92.3 |
| 3 | 14.3 | 85.7 |
| 4 | 25.0 | 75.0 |
| 5 | 33.3 | 66.7 |
| 6 | 44.4 | 55.6 |
| 7 | 55.6 | 44.4 |
| 8 | 66.7 | 33.3 |
| 9 | 77.8 | 22.2 |
| 10 | 88.9 | 11.1 |

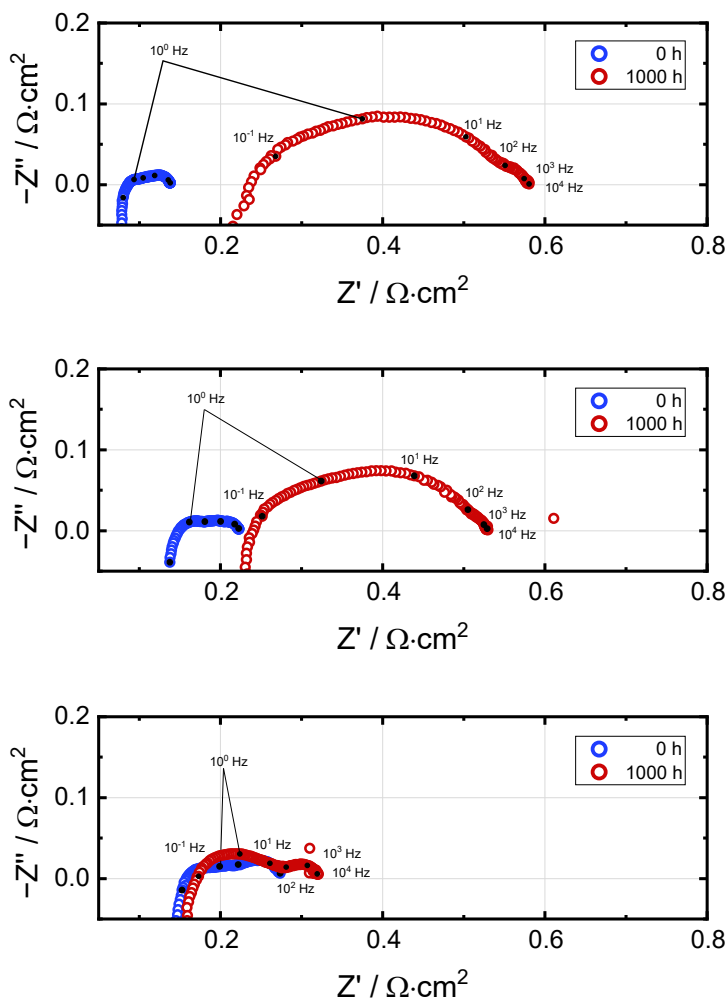


Figure S1. EIS measurements with the single cells at OCV at 0 h and 1000 h with 9 l·h⁻¹ fuel consisting of (a) 50% H₂ + 50% H₂O at 800 °C and (b) 50% H₂ + 50% H₂O at 750 °C and (c) 40% H₂O + 40% CO₂ + 20% H₂ at 800 °C.

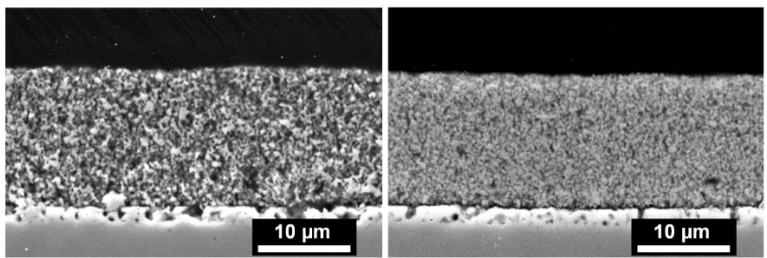


Figure S2. SEM-images at 20 keV of the oxygen electrode of the cell (a) after the durability test at 750 °C and 50% H₂ + 50% H₂O for 1000 h and (b) the durability test at 800 °C with 40% H₂O + 40% CO₂ + 20% H₂ at for 1000 h.

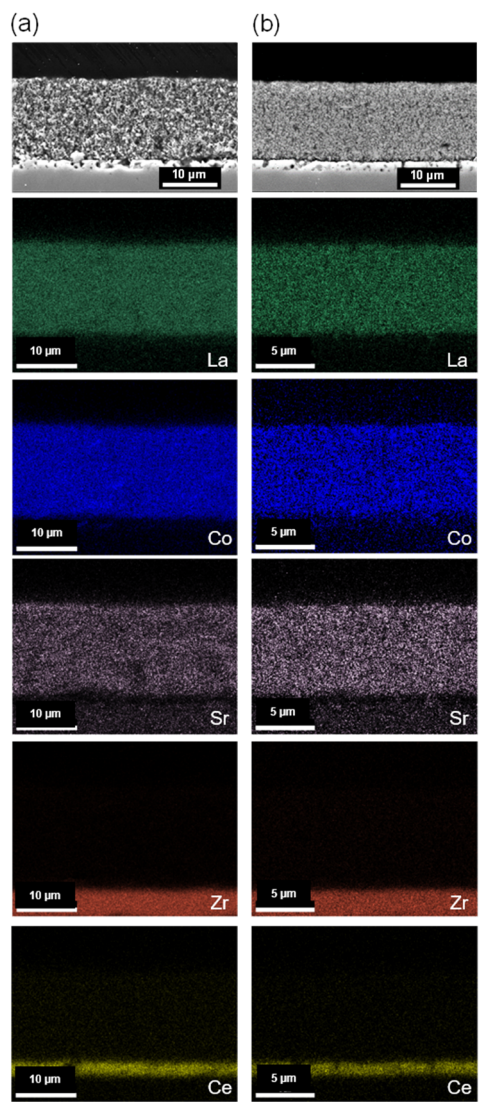


Figure S3. SEM-EDX mapping of single cells towards oxygen electrode side for La (La, 4.65 keV), Co (K α , 6.92 keV), Sr (La, 1.81 keV), Ce (La, 4.84 keV) and Zr (La, 2.04 keV) (a) after the durability test at 750 °C and 50% H₂ + 50% H₂O for 1000 h and (b) the durability test at 800 °C with 40% H₂O + 40% CO₂ + 20% H₂ at for 1000 h.

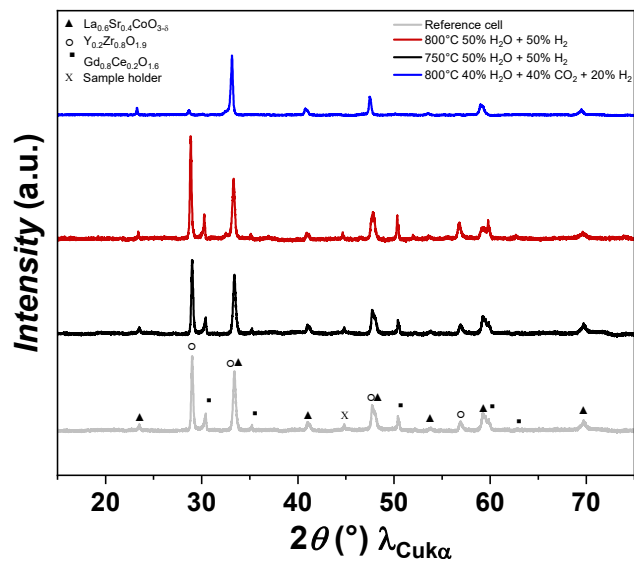


Figure S4. XRD-image of the oxygen electrode of the cell before and after the durability tests for 1000 h.

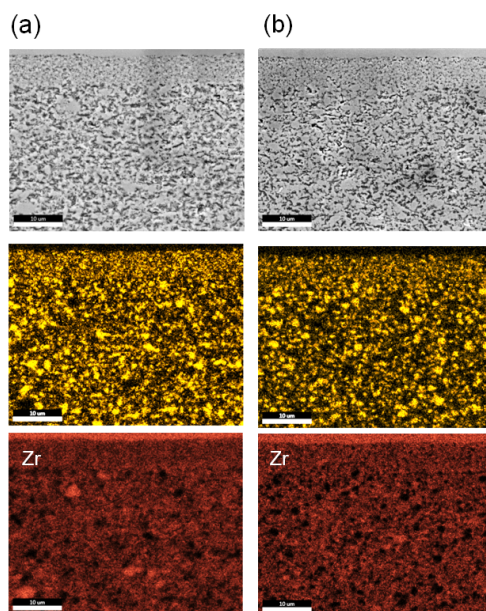


Figure S5. SEM-EDX mapping of single cells towards fuel electrode side for Ni ($K\alpha$, 7.47 keV), Zr ($L\alpha$, 1.81 keV) line (a) after the durability test at 750 °C and 50% H_2 + 50% H_2O for 1000 h and (b) the durability test at 800 °C with 40% H_2O + 40% CO_2 + 20% H_2 at for 1000 h.