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Elisabeth Djurado[1], Nur Istiqomah Khamidy[1,2], Dario Ferreira Sanchez[3], Federico Monaco[2], Jérôme Laurencin[2]

[1]*Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, Grenoble INP, LEPMI, 38000 Grenoble*
[2]*Univ. Grenoble Alpes, CEA/LITEN, 17 rue des Martyrs, 38054, Grenoble, France*
[3]*Paul Scherrer Institut, 5232 Villigen PSI, Switzerland*

Solid oxide cells operating at ~750-850°C are efficient energy conversion systems for electrical power generation and hydrogen production but suffer from long-term durability issues. To increase the lifetime, one strategy consists to lower the temperature down to 600-700°C. However, one of the main challenges with the lower operating temperature is to decrease the oxygen electrode overpotential by enhancing the oxygen reduction/evolution reaction. To tackle this issue, it is important to choose suitable materials with adequate physical-chemical properties and to optimize the microstructure to further increase the performance. The present work, based on an experimental approach, aims (i) at designing lanthanum-praseodymium nickelate ($LaPrNiO_{4+\delta}$, LPNO) using electrostatic spray deposition (ESD), and/or screen printing (SP) techniques to increase electrochemical performances [1], (ii) at investigating the electrode durability by long-term electrochemical measurements using symmetrical and complete cell configurations [2]. To address this question on the stability, a symmetrical cell of LPNO deposited on a $Ce_{0.9}Gd_{0.1}O_{2-\delta}$ (GDC) electrolyte is thermally aged at 700 °C for ~1000 hours. Long-term durability tests under anodic and cathodic polarizations and versus temperature are also carried out on a symmetrical cell (±300 mA/cm², 700 °C for 960 h), as well as on a complete cell (-200 mA/cm² for 900 h) in the electrolysis mode. The complete cell is prepared by depositing LPNO on a half-cell of GDC barrier layer/8YSZ/Ni-YSZ. The performances of the LPNO electrode are not changed when operated under electrolysis current whereas a degradation is observed in fuel cell mode (**Fig. 1**). All the tested electrodes are then characterized by laboratory XRD, synchrotron µ-XRD, and µ-XRF on a beamline at Swiss Light Source (SLS), Paul Scherrer Institute (PSI), Switzerland. Complementary quantitative microstructural analyses are carried out by FIB-SEM tomography. The results are then compared to a pristine symmetrical cell to study the phase stability after aging. For the first time, the distribution of the electrochemically active secondary phases is determined from the electrolyte/electrode interface to the surface of the electrode. To conclude, the suitability of $LaPrNiO_{4+\delta}$ (LPNO) as a durable oxygen electrode for electrolysis cells has been proven to be promising.

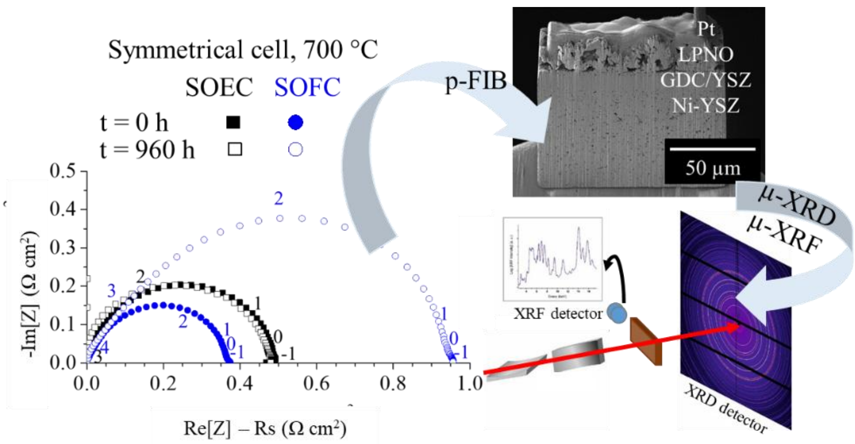

Figure 1. Electrochemical, microstructural, and structural investigation of the durability of LPNO at 700 °C for 960 h.

[1] Khamidy N.I., Laurencin J., Djurado E., *Journal of Electroanalytical Chemistry* **2019**, *849*, 113373.

[2] Khamidy N.I., Laurencin J., Ferreira-Sanchez D., Monaco F., Charlot F., Djurado E., *Journal of Power Sources* **2020**, *450*, 227724.