



**HAL**  
open science

## Durability study of the nanostructured LaPrNiO 4+d electrode for solid oxide cells

Elisabeth Djurado, Nur Istiqomah Khamidy, Dario Ferreira Sanchez, Federico Monaco, Jérôme Laurencin

► **To cite this version:**

Elisabeth Djurado, Nur Istiqomah Khamidy, Dario Ferreira Sanchez, Federico Monaco, Jérôme Laurencin. Durability study of the nanostructured LaPrNiO 4+d electrode for solid oxide cells. Journées Plénières de la Fédération de recherche Hydrogène, CNRS, May 2023, St Gilles de la Réunion, France. hal-04123274

**HAL Id: hal-04123274**

<https://hal.univ-grenoble-alpes.fr/hal-04123274v1>

Submitted on 9 Jun 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Durability study of the nanostructured LaPrNiO<sub>4+δ</sub> electrode for solid oxide cells

**Elisabeth Djurado<sup>1</sup>, Nur Istiqomah Khamidy<sup>1,2</sup>, Dario Ferreira Sanchez<sup>3</sup>, Federico Monaco<sup>2</sup>, Jérôme Laurencin<sup>2</sup>**

<sup>1</sup>Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, Grenoble INP, LEPMI, 38000 Grenoble

<sup>2</sup>Univ. Grenoble Alpes, CEA/LITEN, 17 rue des Martyrs, 38054, Grenoble, France

<sup>3</sup>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<sub>4+δ</sub>, 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<sub>0.9</sub>Gd<sub>0.1</sub>O<sub>2-δ</sub> (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/cm<sup>2</sup>, 700 °C for 960 h), as well as on a complete cell (-200 mA/cm<sup>2</sup> 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<sub>4+δ</sub> (LPNO) as a durable oxygen electrode for electrolysis cells has been proven to be promising.

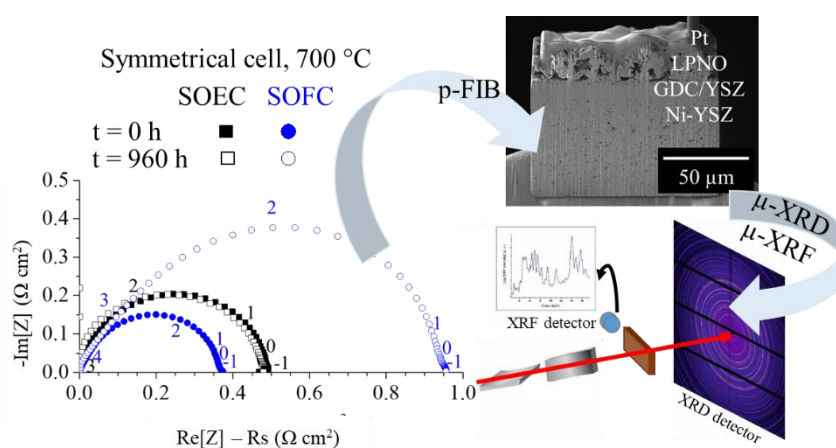


Figure 1. Electrochemical, microstructural, and structural investigation of the durability of LPNO at 700 °C for 960 h.

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