Developpement of bi-layer electrolyte to enhance the SOFC/SOEC performances

Thesis director: Ass. Prof. P. Briois ***tel: +33 3 84 58 37 01 E-mail: pascal.briois@utbm.fr***

CONTEXT:

The energy sector is a very active research domain today. Due to the global depletion of fossil resources, it seems inevitable to find alternative energy sources. Among the different possible technologies, fuel cells show a significant interest due to their energy efficiency and nature of clean energy production (hydrogen). Among the various types of fuel cells, this thesis is focused on the solid oxide fuel cells operating at intermediate temperatures (IT-SOFC) around 700 °C. The aim and interest of IT-SOFC technology is at lowering the solid oxide fuel cell operating temperature from 1000 °C to 700 °C without affecting the fuel cell performance.

THESIS WORK:

The high operating temperature of solid oxide fuel cells generates a high thermal stress and corrosion rate in the fuel cell body (anode/electrolyte/cathode), which significantly reduces their lifespan and, therefore, their potential use in their current state. The proposed work in this thesis involves the development of a thin layer based single solid oxide fuel cell (IT-SOFC) on anode support. The proposed method that constitutes all the fuel cell elements in very thin layers reduces the related electrolyte resistance and increases the active catalyst interface. This IT-SOFC model will be use to improve and validate the IT-SOFC designs by predicting the single fuel cell behavior under different operating conditions during tests.

The objectives of this thesis are:

- Development of a thin film IT-SOFC bi-layer electrolyte (about 5 µm) and a cathode (approximately 10 µm) by reactive magnetron sputtering,
- Structural characterization of each element,
- Characterization of the developed IT- solid oxide fuel cell in real operating conditions.

REFERENCES:

1. "Morphological Evolution of La_2NiO_4 Coatings Synthesized by Reactive Magnetron Sputtering (RMS) at High Pressure as Cathode for Intermediate Temperature Solid Oxide Fuel Cell (IT-SOFC)"
X. Ye, H. Luo, M. Hou, P. Bertrand, A. Billard, P. Briois, Coatings 13 (2023) 1113, (doi.org/10.3390/coatings13061113)

2. "Synthesis of Yttria Stabilized Bismuth Oxide by DC Reactive Magnetron Sputtering (RMS) for SOFC Electrolyte"
X.Ye, L. Yang, H. Luo, P. Bertrand, A. Billard, P. Briois, *Crystals 12 (2022) 1585 (doi.org/10.3390/cryst12111585)*

3 **"Manufacturing and testing of a metal supported Ni-YSZ/YSZ/La_2NiO_4 ITSOFC synthesized by physical surface deposition processes"**
J. Fondard, P. Bertrand, A. Billard, S. Fourcade, P. Batocchi, F. Mauvy, G. Bertrand, P. Briois, *Solid State Ionics, 310 (2017) 10-23*