Influence of Nb-doping on the structural and electrical properties of lanthanum molybdates, $La_{5.4}MoO_{11.1}$

Adrián López-Vergara[1,*], José M. Porras-Vázquez[1], Einar Vøllestad[2], Jesús Canales-Vazquez[3], Enrique. R. Losilla[1], David Marrero-López[4]

1 Universidad de Málaga, Dpto. de Química Inorgánica, Cristalografía y Mineralogía, 29071-Málaga, Spain.

2 University of Oslo, Department of Chemistry, Centre for Materials Science and Nanotechnology, FERMiO, Gaustadalleen 21, 0349 Oslo, Norway

3 Renewable Energy Research Institute, University of Castilla-La Mancha, 02071-Albacete, Spain

4 Universidad de Málaga, Dpto. de Física Aplicada I, 29071-Málaga, Spain.

**adrilv@uma.es*

Nowadays, hydrogen is receiving a great deal of attention as an energy carrier. Commonly, it is obtained by hydrocarbons reforming, such as natural gas, coal and biomass. However, the resulting hydrogen needs to be purified to remove by-products and impurities, increasing the production costs. An alternative for hydrogen production is proton-conducting ceramics, where hydrogen separation takes place via a chemical potential gradient across the membrane.[1, 2]

In this work, Nb-doped $La_6MoO_{12-\delta}$-based compounds have been investigated as part of a new family of materials very competitive as SOFC electrolyte and hydrogen separation membranes.[3]

These materials, $La_{5.4}Mo_{1-x}Nb_xO_{11.1-x/2}$ (x = 0.05, 0.10, 0.15 y 0.20) were synthesized by the freeze-drying precursor method and calcination conditions have been optimized to obtain single phases. A complete characterization has been carried out using X-Ray powder diffraction and scanning and transmission electron microscopy. The total conductivity was determined by complex impedance spectroscopy at different atmospheres.

Different polymorphs are obtained as a function of the cooling rate and the dopant amount. The samples cooled by quenching are cubic with a fluorite-type structure ($Fm\bar{3}m$) and the ones cooled at 50 y 0.5 ºC·min^{-1} are rhombohedral (R1 and R2 polymorphs). For niobium contents higher than x = 0.10 the R1 polymorph is stabilised at cooling rates equal or inferior to 50 ºC·min^{-1}.

For all three series, the incorporation of niobium into $La_{5.4}MoO_{11.1}$ increases the conductivity, reaching the best values for x=0.10 and the sample obtained by quenching.

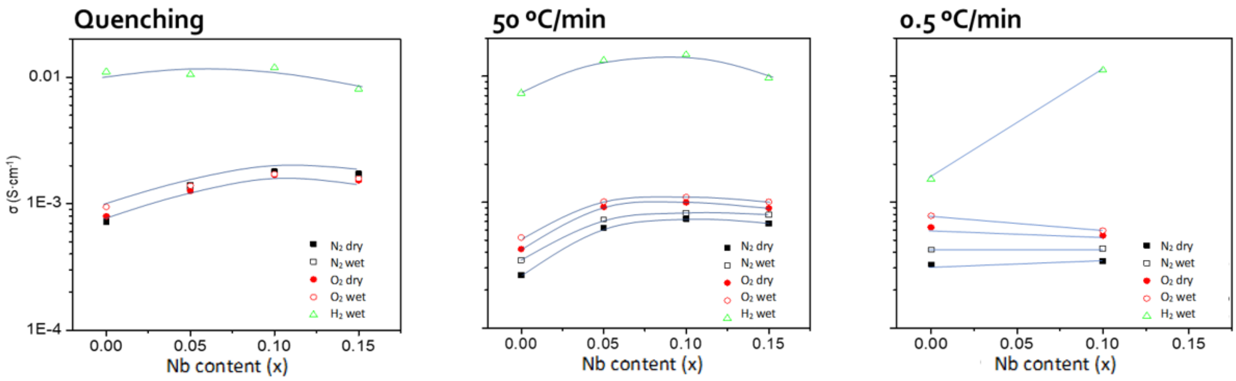

Figure 2. Total conductivity plots versus Nb content for all samples at different cooling rates: quenching (left), 50ºC·min-1 (right) and 0.5ºC·min-1 (bottom) in different atmospheres at 800ºC.

References:

[1] López-Vergara, A; Porras-Vazquez, J.M.; Infantes-Molina, A.; Canales-Vázquez, J.; Cabeza, A.; R.Losilla, E.; Marrero-López, D. Chem. Mater. **2017**, 29, 6966-6975.

[2] Vollestad, E.; Vigen, C. K.; Magrasó, A.; Hausgrud, J. Membr. Sci. **2014**, 461, 81-88.

[3] Amsif, M.; Magrasó, A.; Marrero-López, D.; Ruiz-Morales, J. C.; Canales-Vázquez, J.; Núñez, P. Chem. Mater. **2012**, 24, 3868-3877.