MOCVD deposition strategies to obtain Solid Oxide Fuel Cell thin films with improved functional properties

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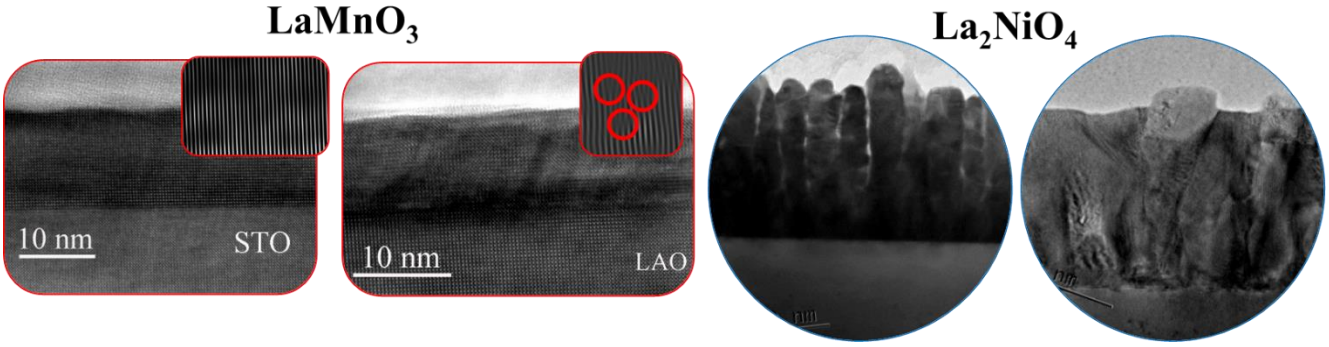
Ionic transport is of primary importance for the development and miniaturization of numerous devices such as solid oxide fuel cells and electrolyzers, oxygen separation membranes, and memristive devices. When prepared in the form of thin films, the functional properties can largely vary in comparison to the intrinsic bulk ones. There is thus a large interest in understanding and controlling the influence of parameters such as epitaxy, substrate-induced strain, and nano-structure, for the use of ionic conducting oxides in applied functional devices. Using Pulsed-Injection Metalorganic Chemical Vapor Deposition we have developed different strategies to control the growth of perovksite, and perovskite-related thin films, such as $LaMnO_{3\pm\delta}$[1] and $La_2NiO_{4+\delta}$[2]. The oxygen stoichiometry, oxygen diffusion, and both the intrinsic and apparent oxygen exchange activity can be tailored in these thin films by tuning the deposition parameters, leading to differences in the amount of point and extended defects in the films, to different strain states, as well as to diverse controlled nano-architectures (dense, nano-columnar, nano-hierarchical). Ultimately by selecting the appropriate deposition conditions a substantial enhancement of the ionic transport properties in the films is achieved.



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[1] R. Rodriguez-Lamas, C. Pirovano, A. Stangl, D. Pla, R. Jónsson, L. Rapenne, E. Sarigiannidou, N. Nuns, H. Roussel, O. Chaix-Pluchery, R.-N. Vannier, and M. Burriel, “Epitaxial LaMnO<inf>3</inf>films with remarkably fast oxygen transport properties at low temperature,” J. Mater. Chem. A, vol. 9, no. 21, pp. 12721–12733, 2021.

[2] A. Stangl, A. Riaz, L. Rapenne, J. M. Caicedo, J. de Dios Sirvent, F. Baiutti, C. Jiménez, A. Tarancón, M. Mermoux, and M. Burriel, “Tailored nano-columnar La2NiO4 cathodes for improved electrode performance,” J. Mater. Chem. A, no. ii, 2022.