# Stability of epitaxial heterostructured materials

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Heterostructured materials are a new family of artificial compounds where the electronic and ionic properties can be modulated by varying the characteristics of the different material layers. These properties arise from the formation of structural oxygen defects in the crystal lattice that result in the activation of charge electrical carriers. Oxygen-deficient perovskite oxides, such as $La_{1-x}Sr_xCoO_{3-\delta}$ (LSC), present mixed oxide/electronic conduction; however, the long-term instability due to superficial carbonation of LSC-based cathodes is a crucial drawback for their practical application.

In this study, thin film-heterostructures of alternating layers of $La_{0.6}Sr_{0.4}CoO_{3-\delta}$ and $Ce_{0.8}Gd_{0.2}O_{2-\delta}$ (CGO) were deposited on (110) $NdGaO_3$ (NGO) single crystal substrates by pulsed laser deposition (PLD). The number of interfaces and the thickness were varied to obtain epitaxial structures with highly coherence layers. Moreover, two different kinds of architectures, without and with a CGO termination layer, were prepared in order to study the stability of the samples under different thermal cycles in air.
Structural characterization was made by using Rocking Curve and Reciprocal Space Mapping techniques. CGO layers are rotated 45º respect to the substrate and LSC ones due to the different sizes of cell parameters. The quality of the samples was examined by HR-TEM and all of them presented well defined interfaces (Figure 1). Electrical characterization confirms that the conductivity can be modulated by varying the number of interfaces and thickness. Samples without CGO termination are unstable in air atmosphere due to surface carbonation, which was confirmed by XPS and HR-TEM.

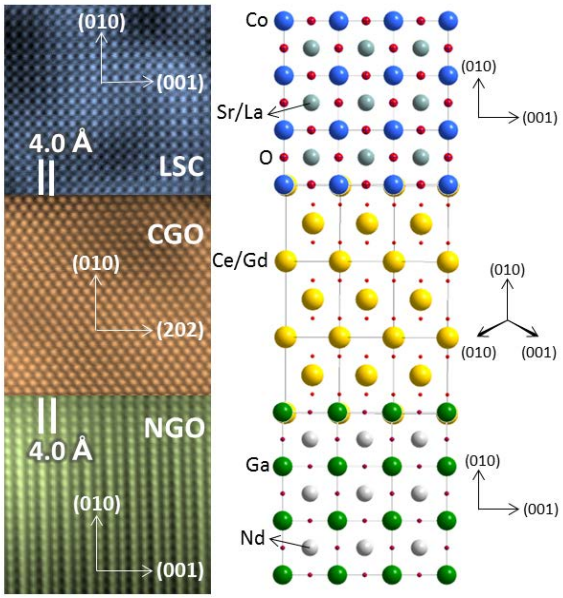


**Figure 1.** HR-TEM image of the LSC/CGO heterosturctures and a sketch of the epitaxial relation between the NGO, CGO and LSC layers.

## References

[1] dos Santos-Gómez, L.; Sanna, S.; Norby, P.; Pryds, N.; Losilla, E. R.; Marrero-López, D.; Esposito, V. Nanoscale 2019, DOI:10.1039/C8NR08528E.