



GEMaC

Groupe d'Étude
de la Matière Condensée

FUNCTIONAL OXIDES AND OXIDE FUNCTIONALISATION

Atomic Layer Epitaxy

The team is interested in the ALD/ALE growth of functional ternary oxides such as SrTiO_3 and BiFeO_3 . This vapor phase technique is a particular method of alternating flow deposition. The originality of our Annealsys MC50 machine also lies in the choice of the liquid precursor injection.

Research projects in progress

Flagship Labex NanoSaclay "AXION" (2016-2020), for the development of nano-oxytronics and the realization of functional oxide heterostructures on large surfaces.

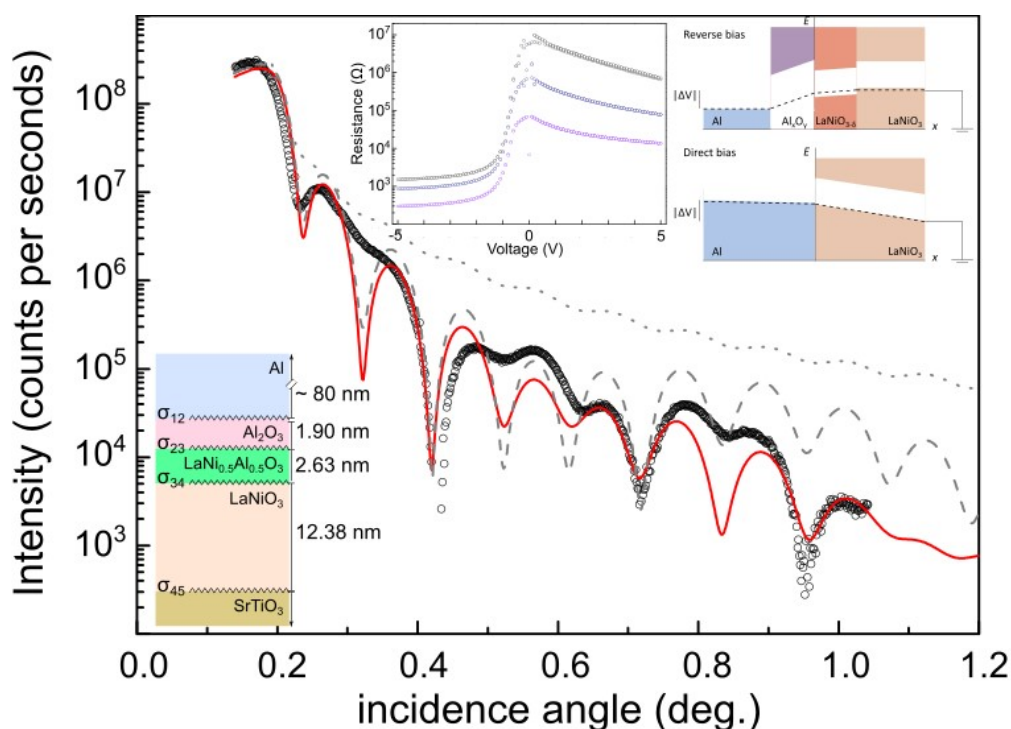
Ga₂O₃

We are studying the growth of the Ga_2O_3 compound by MOCVD. This is a new field of

research, common with the FOX team at GEMAC, which is in continuity with our know-how on transparent conductive oxides. In particular, Ga₂O₃ has a strong potential for power electronics.

Functionalization of oxides

Recent progress in methods for the elaboration and characterization of thin oxide films has made it possible to achieve very fine control in terms of composition and morphology. This new control makes it possible to take advantage of interface effects: the numerous surface and interface properties (field effect, charge transfer, electrical or magnetic polarization, bi-axial mechanical stress, orbital degeneration levers, solid phase chemical reactions) are all levers that can be activated by an external stimulus of low energy. This is called functionalization.



By combining a transmission electron microscopy experiment with electron energy loss spectroscopy and X-ray reflectometry measurements (main figure, see arXiv:1804.07574 published with FOX team), it was possible to reconstruct the morphology of the Al /LaNiO₃ interface and to highlight the atomic scattering occurring in the solid phase over a thickness of 4.5 nm (interface diagram bottom left). This diffusion results from the combined effects of an oxidation-reduction reaction and solid-phase diffusion of the metallic elements. The reversibility of this reaction is illustrated by the electroresistance curves (for three oxide samples of different thicknesses, top middle). The two electrical

states are interpreted by a Schottky type charge transfer mechanism, increased by a migration of oxygen ions under the effect of the difference in oxidation-reduction potential (band diagrams, top right).