# Surface and Interface Aspects of Perovskites Oxides Heterostructures

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Thin films of perovskite-type oxides ($ABO_3$) have always been considered as a strong impactful class of materials in the "beyond silicon electronics" perspective. Integration of functional thin film materials with adapted properties is essential for the development of new paradigms in information technology. In this context, monitoring functional oxides surfaces appear crucial and essential.

In this presentation, I will present different aspects related to $SrTiO_3$ (STO) surface considered as the perovskite oxide reference material, from cleaning with Gas Cluster Ion Beam [1], to etching [2] and integration in $LaAlO_3/SrTiO_3$ (LAO/STO) heterostructures [3]. These devices are of particular interest since a quasi-2-dimensional electron gas is formed at the interface between these two insulators. We particularly studied the influence of a low energy ion beam irradiation on the LAO/STO interface by combining x-ray photoelectron spectroscopy (XPS) and electrical transport measurements. We demonstrate, here, that a short-time argon cluster ion exposure of the LAO surface induces significant modifications in the chemical and electronic properties of the buried STO substrate: (1) lowering of Ti atoms oxidation states (from $Ti^{4+}$ to $Ti^{3+}$ and $Ti^{2+}$) correlated to the formation of oxygen vacancies (2) creation of new surface states for Sr atoms after atom migration and (3) increase of the electrical conductivity at the LAO/STO interface.

We will also show major and significant results on $SrVO_3$ (SVO) thin films. SVO is a transparent and conductive perovskite oxide, presenting excellent electronic conductivity and a very low work function. Moreover, when deposited in ultra-thin layers (below 2 nm), a metal insulator transition (MIT) is revealed. An important drawback is the sensitivity of SVO to external stimuli such as oxygen pressure or air exposure. Using XPS depth profiling, we show that SVO upper layer strongly differs from the rest of the film [4]. In comparison to STO, the spectral signature of SVO obtained by photoemission techniques is much less described in the literature. So, we will extensively describe photopeaks of SVO samples grown by PLD and their evolution upon water exposure and air ageing. We will highlight the "effective" SVO spectral signature and the SVO surface termination thanks to complementary angle resolved XPS and Low Energy Ion Scattering (LEIS) experiments.

Furthermore, I will show that SVO phases can be selectively etched [4, 5] and allow the use of this particular oxide as a sacrificial layer to transfer epitaxial oxides [6].

## Abstract (5 lines max, justified, in english):

Perovskite-type oxide heterostructures are good candidates for the promising field of "Oxitronics". In this context, we will focus on the consequences of argon cluster ion beam irradiation on the chemical and electrical properties of the $LaAlO_3/SrTiO_3$ heterostructures. In addition, the effective spectral signature of $SrVO_3$ thin films obtained by joint photoemission techniques will be fully described. Finally, we demonstrate how to use this particular oxide as a sacrificial layer to transfer epitaxial oxides on silicon.

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