Oxide nanosheets as seed layers for epitaxial growth of complex oxides

F. Baudouin[1], A. Boileau[2], J.J. Manguele[2], M. Dallocchio[2], S. Ollivier[1], P. Turban[3], J.C. Le Breton[3], B. Lépine[3], C. Cibert[2], S. Hurand[4], A. David[2], U. Lüders[2], G. Poullain[2], B. Bérini[5], Y. Dumont[5], V. Bouquet[1], S. Députier[1], W. Prellier[2], M. Guilloux-Viry[1], A. Fouchet[2], V. Demange[1]

[1] *Univ Rennes, CNRS, ISCR – UMR 6226, ScanMAT – UMS 2001, F-35000 Rennes, France*
[2] *Normandie Univ, ENSICAEN, UNICAEN, CNRS, CRISMAT, 14000 CAEN, France*
[3] *Univ Rennes, CNRS, IPR – UMR 6251, F-35000 Rennes, France*
[4] *Institut Pprime, UPR 3346 CNRS-Université de Poitiers-ENSMA, SP2MI, 86962 Futuroscope-Chasseneuil Cedex, France*
[5] *GEMaC, Université Paris-Saclay, UMR 8635 CNRS- Université de Versailles Saint-Quentin en Yvelines, Versailles, France*

Functional properties such as ferroelectric, multiferroic or transparent conducting oxide in complex oxide thin films are key components in modern devices. Their properties are related to their orientation and to their structural and microstructural qualities in relation with the crystal growth. Epitaxial films are obtained on single-crystalline oxide substrates (such as $SrTiO_3$) that present chemical compatibility and small in-plane lattice parameters mismatch with the film. However these substrates are expensive and size-limited. On the other hand, direct growth of functional oxides on low-cost substrates with large area as silicon or glass leads to amorphous or polycrystalline films with poor properties. Therefore, introduction of a buffer layer is necessary on such substrates in order to achieve the epitaxial growth of complex oxides. Among other candidates, oxide nanosheets have been identified for several years as seed layers to induce the preferential growth of complex oxides with a high crystalline quality, on several low-cost substrates as silicon, glass, mica, polymers and metallic foils [1,2]. These nanosheets are obtained by exfoliation of layered oxides, as $KCa_2Nb_3O_{10}$, $K_{0.8}Ti_2O_4$, $K_4Nb_6O_{17}$ and $Cs_6W_{11}O_{36}$ phases. They possess either 2D square, rectangular or hexagonal lattices, allowing regrowth of [001], [011] and [111] preferentially oriented perovskite oxides. The nanosheets are transferred on low-cost substrates by Langmuir-Blodgett and drop casting methods [3], which allow a high surface coverage of the substrate. As example of epitaxial growth, we will show the possibility to integrate complex oxide perovskites thin films, such as $La_{0.67}Sr_{0.33}MnO_3$ [4], $KNbO_3$ [5] and $BiFeO_3$ [6] on glass, silicon and mica. Significant results have also been recently obtained on the integration of $SrVO_3$ and $CaVO_3$ perovskite as transparent conducting films on glass substrates [7]. In addition, nanosheets can also be used to grow (111)Pt electrode on silicon at very low temperature [8]. As a perspective, we will present first results of attempts to obtain self-supported films by the means of nanosheets.

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