Soft chemistry assisted nanostructured functional oxides on Si integrated systems

Adrian Carretero-Genevrier

Institut d´Électronique et des Systèmes (IES) UMR 5214, Bâtiment 5, 860 rue Saint Priest, 34090 Montpellier, France

The ability to combine standard wafer-scale semiconductor processing with the excellent properties of functional oxides opens the possibility to realize innovative and more efficient devices with high value applications that can be produced at large scale. However, the precise control of interfaces and crystallization mechanisms of dissimilar materials rest extremely challenging. As an example, the integration of high quality epitaxial oxide nanostructured thin films on silicon need to be further developed.

In this regard, I will present successful strategies developped at the Institut d'Electronique et des Systemes (IES) that integrate functional oxides nanostructures on silicon via chemical solution deposition (CSD) approach. Divers examples will be presented separated in two different approaches i.e: (i) perovskite oxides with enhanced physical properties performed by combining soft chemistry and molecular beam epitaxy techniques, such as epitaxial nanostructured $BiFeO_3$, $BaTiO_3$ or $La_{0.7}Sr_{0.3}MnO_3$ thin films on silicon [1,2], and (ii) oxide nanomaterials entirely performed by the combination of soft chemistry and top down lithographic techniques, such as nanostructured piezoelectric quartz thin films on silicon [3] or ferroelectric oxide nanowires thin films epitaxially grown on silicon [4].

The methodologies presented here exhibit a great potential and offers a pathway to design novel oxide compounds on silicon substrates by chemical routes with unique optical, electric, or magnetic properties.

[1] Electric and Mechanical Switching of Ferroelectric and Resistive States in Semiconducting $BaTiO_{3-\delta}$ Films on Silicon. A. Gómez, J. *et al. Small, 1701614 (2017)*

[2] Integration of functional complex oxide nanomaterials on silicon. J. Vila-Fungueiriño *et al. Frontiers in Physics 3, 38 (2015)*

[3] Soft chemistry based routes to epitaxial α-quartz thin films with tunables textures. A.Carretero-Genevrier *et al. Science. Vol 340. Pp 827-831 (2013)*

[4] Direct Monolithic Integration of Vertical Single Crystalline Octahedral Molecular Sieve Nanowires on Silicon. A. Carretero-Genevrier *et al. Chemistry of Materials 26 1019 (2014)*