Strain Induced Self-Assembly in Complex Oxide Thin Films

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Oxide thin films often exhibit a tendency toward self-organized growth forming regular arrays of three dimensional nanostructures. This behaviour offers enormous potential for the implementation of new nanodevices, while at the same time attracts great attention due to their rich physics. Among them, manganese perovskites showing colossal magnetoresistance and half metallic characteristics have emerged as promising candidates for miniature spintronic devices. Complex oxide thin films are often elastically strained, due to film-substrate lattice mismatch, and this lattice strain can, in some cases, select preferential growth modes leading to the appearance of different self-organized morphologies.

In this work we report on the controlled fabrication of self-assembled nanostructures in highly epitaxial $La_{2/3}Sr_{1/3}MnO_3$ (LSMO) thin films [1, 2]. By carefully controlling growth rate dramatic changes of the surface morphology of LSMO films grown on top of $SrTiO_3$ substrate can be induced: from very flat surface, through nanometric mounds and antidots (Figure 1. left) to hatches [1]. All nano-objects form long-range ordered arrays running in the steps direction defined by the miscut angle of underlying substrate [2]. Therefore, it is manifested that self-organization process is directly promoted by the topological features of the substrate and indicate the importance of kinetic effects (adatom diffusion process on surface terrace, over substrate steps, along edges,…). On the other hand, the influence of the lattice strain on antidots formation is studied [3] using different substrates ($LaAlO_3$, $NdGaO_3$, $La_{0.3}Sr_{0.7}Al_{0.35}Ta_{0.35}O_9$) and analyzed within an energetic model proposed by J. Tersoff and F.K. LeGoues [4]. The implementation of self-assembled gold nanoparticles on the top of the nanostructured antidots is explored.

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References
[1] Z. Konstantinović, J. Santiso, D. Colson, A. Forget, Ll. Balcells, B. Martínez, J. Appl. Phys. 2009, **105**, 063919.
[2] Z. Konstantinović, J. Santiso, Ll. Balcells, B. Martínez, Small 2009, **5**, 265.
[3] Z. Konstantinović, J. Santiso, Ll. Balcells, B. Martínez Nanotechnology 2010, **21**, 465601.
[4] J. Tersoff and F.K. LeGoues, Phys. Rev. Lett. 1994, **72**, 3570.