SELF-ORGANIZED GROWTH IN MANGANITE THIN FILMS

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Oxides are one of the largest families of new materials which attract great attention due to their rich physics. Among them, the manganese perovskites showing colossal magnetoresistance and half metallic characteristics have emerged as good candidates for miniature spintronic devices. Well defined structures at nanometric scale present an increasing interest due to their unique physical properties and potential applications. Fabrication of artificial nanostructures of oxide materials requires sophisticated technology and has been recognized as a hard-attainable issue. For these reasons, the tendency of some oxides toward self-organized growth, forming regular arrays of three dimensional nanostructures, offers enormous potential for the implementation of new nanodevices, while at the same time constitutes a real scientific challenge.

Complex oxide thin films are often elastically strained 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 grown on top of SrTiO (100) oriented substrates. All nano-objects (mounds, antidotes, hatches) form long-range ordered arrays running in the steps direction defined by the miscut angle of underlying substrate. The antidots[1] have typical diameter around 50 nm and depth around 10 nm with the average density of ~150 antidots/μm^2 (Fig.1). The evolution of the structural and magnetic properties as a function of different parameters, such as deposition parameters, substrate miscut angle and annealing treatments, is analyzed with the goal to clarify the growth mechanism leading to the formation of this self-assembled network of antidotes[1]. The out-of-plane hysteresis loops (H‖(001)) are significantly changed due the existence of the antidote array, while the in-plane counterpart (H‖(100)) is almost unchanged. The sample exhibits a strong anisotropic character with in-plane easy magnetization direction.

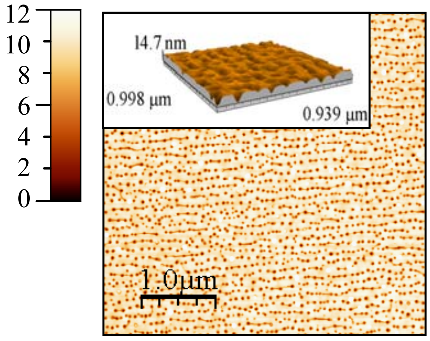

Figure 1: Atomic force microscopy images of LSMO film. Insets show the 3D AFM small area.

[1] Z. Konstantinovic, J. Santiso, Ll. Balcells, B. Martínez, Small **5**, 265 (2009).