Vertically self-assembled epitaxial nanostructures: growth, structure and properties

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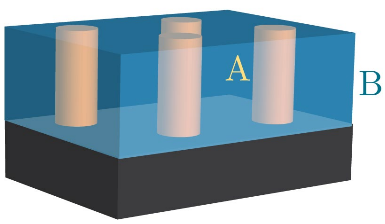

Self-assembled vertically aligned nanocomposites (VANs) have recently emerged as a novel playground for strain engineering of physical properties in nanostructures. In contrast to thin films obtained by classical planar heteroepitaxy, VANs consist of two (or more) intertwined phases, coupled along vertical interfaces (as illustrated in the Figure, in the case of a two-phases A-B composite). Their unique nanoarchitecture, which can be tuned by choosing appropriate growth conditions, results in deformations that cannot be easily attained in traditional flat geometries [1].

In this contribution, we will show how nanometer-sized acicular inclusions of magnetic 3d metals in various oxide host matrices can be obtained via sequential pulsed laser deposition [2]. We will then present experimental results on the strain state of the VANs, obtained by x-ray diffraction and transmission electron microscopy, and discuss the mechanisms involved in the relaxation of strain in VANs [3-4]. We will demonstrate how the magnetic properties of the thin films can be controlled accurately by relying on the strain applied along the backbone of the nanowires [5].

We will finally present possible extensions of the sequential growth approach to more than one embedded phase and sketch some of the remaining challenges that must be overcome to create novel functional nanoarchitectures.

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