Influence of the buffer layer on the nanoscale architecture in NdFeB ultrathin films

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Rare-earth transition metals thin films attract a lot of attention due to their high magnetic anisotropy that makes them excellent candidates for several applications including high density magnetic recording [1], MEMS and actuators [2] and novel spintronic devices [3]. These next-generation permanent magnets require exploring new synthesis paths that move beyond conventional methods and allow a study with a detailed control over composition, interfaces and microstructure [4]. Our study focuses on the understanding of the mechanisms involved in the formation of the $Nd_2Fe_{14}B$ phase in thin films grown by Molecular Beam Epitaxy (MBE). Different buffer layers (Mo and Fe) on MgO (001) have been explored to induce different strains on the NdFeB lattice and influence the magnetic response of the system in a low thickness range of 5-15 nm.

The epitaxial character of the samples has been corroborated by X-Ray Diffraction (XRD) and *in situ* Low Energy Electron Diffraction (LEED) measurements. Magnetic characterization has been carried out by Vibrating Sample Magnetometer (VSM) demonstrating the possibility of inducing a strong magnetic anisotropy in good accordance with the epitaxiallity of the films. A thorough stoichiometric and electronic characterization has been carried out by both X-ray and Ultra-Violet Photoelectron Spectroscopy also providing values of the work function of the system which, to authors' knowledge, were not previously reported in the literature. Scanning Electron Microscopy (SEM) shows meaningful differences by changing the underlayer: from arrays of highly oriented nanoislands (Fe underlayer, Fig.1c) to low roughness quasi-continuous films (Mo underlayer, Fig.1d). The understanding and optimization of the nanoscale architecture in these NdFeB thin films is essential when aiming at its integration in novel miniaturized devices (e.g., microdevices for *in vivo* microsurgery applications, as [5]).

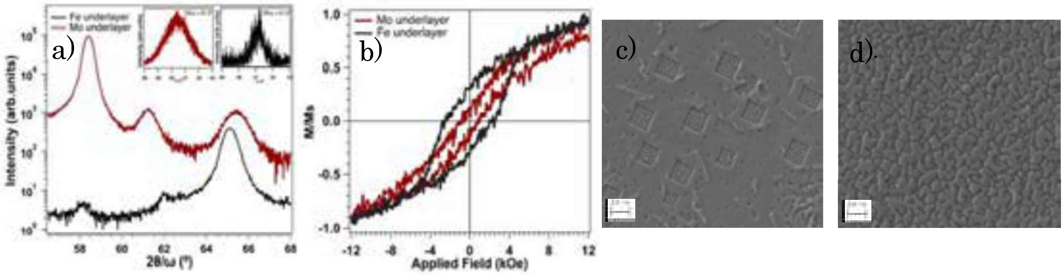

Figure 1: a) XRD pattern of an NdFeB thin film with Fe and Mo underlayer and ω scan of NdFeB (008), b) Out of plane hysteresis loop, c) SEM image of NdFeB with a Fe buffer and d) SEM image of NdFeB with a Mo buffer

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