Tuning the nanoscale architecture in NdFeB ultrathin films with varying buffer layer

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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 [1-2], microelectromechanical systems and actuators [3] and novel spintronic devices [4]. These next-generation micro-/nano- permanent magnet systems require exploring new synthesis paths that move beyond conventional methods and allow their study with a detailed control over composition, interfaces and microstructure [5]. Our study focuses on the understanding of the mechanisms involved in the formation of the $Nd_2Fe_{14}B$ phase in thin films (5-15 nm) grown by Molecular Beam Epitaxy (MBE) and the possibility of tuning their magnetic response. For this purpose, different buffer layers (Molybdenum and Iron) on MgO (001) have been explored to induce different lattice strains on the NdFeB lattice.

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 (XPS and UPS, respectively) 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 [6])

References

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Figures

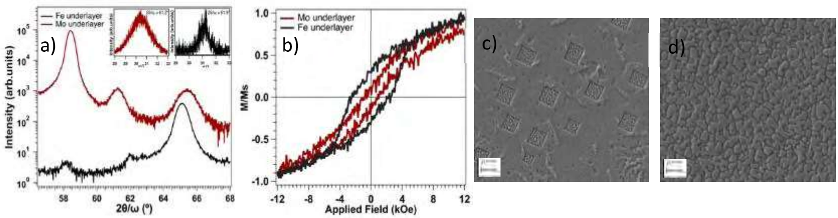

Figure 1: a) XRD pattern of a NdFeB thin film with Fe and Mo underlayer and ω scan of NdFeB (008), b) Out of plane hysteresis loop, c) SEM image of NdFeB with a Fe underlayer and d) SEM image of NdFeB with a Mo underlayer

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