Understanding the initial growth stages in NdFeB films: epitaxial films prepared by Molecular Beam Epitaxy with varying buffer underlayers

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Rare-earth transition metals thin films have attracted 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]. Our study focuses on the understanding of the mechanisms involved in the formation of the $Nd_2Fe_{14}B$ phase in thin films and the influence of the buffer layer material on the structural and magnetic properties in an extremely low thickness range of 5-10 nm. This range will be likely below that required to fully develop the hard magnetic properties in NdFeB films, but it is extremely important to understand and optimize the initial growth stages in NdFeB when aiming at its integration in novel miniaturized devices (e.g. microdevices for *in vivo* microsurgery applications, as aimed in the framework of this project [5]).

NdFeB films (5-10 nm) have been grown by co-deposition of each element by Molecular Beam Epitaxy (MBE). Different buffer layers (Vanadium, Iron and Iridium) on MgO (001) have been explored in order to induce different lattice strains on the NdFeB lattice and influence the magnetic response of the system. Structural integrity of the samples has been corroborated by X-Ray Diffraction (XRD) and *in situ* Low Energy Electron Diffraction (LEED) measurements (Fig 1 a,b,c,e). Magnetic characterization (Fig 1.d) has been carried out using Vibrating Sample Magnetometer (VSM) demonstrating the possibility of inducing a strong magnetic anisotropy in good accordance with the single crystal nature of the films. A thorough stoichiometric and electronic characterization has been carried out by using both X-ray and Ultra-Violet Photoelectron Spectroscopy (XRD and UPS, respectively) with the later permitting values of the work function of the thin

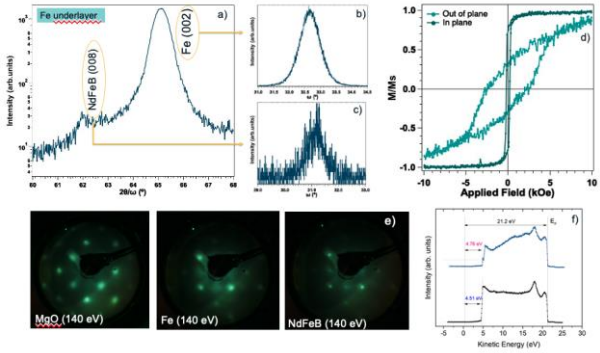

Figure 1: a) XRD pattern of a NdFeB thin film with an Fe underlayer, b) rocking curve measurement of Fe (002), c) rocking curve of NdFeB (008), d) room temperature hysteresis loop, e) LEED pattern of MgO substrate, Fe buffer layer and NdFeB film, f) work function measurements of Fe buffer (bottom) and NdFeB film (top).

film systems to be extracted (Fig. 1e)).

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