Underlayer dependence of ultrathin films of NdFeB grown by Molecular Beam Epitaxy

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Rare-earth transition metals thin films attract a lot of attention due to their high magnetic anisotropy (accompanied by a relatively high saturation magnetization) that makes them the preferred choice for several applications including high density magnetic recording [1-2], microelectromechanical systems and actuators [3] and a wide range of spintronic devices [4]. Further miniaturization of the devices require exploring new synthesis paths that move beyond conventional methods and allow the study of these materials 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 ultrathin films grown by Molecular Beam Epitaxy (MBE) and the influence of the buffer layer used on the structural and magnetic properties in a thickness range of 5-15 nm. At this range, the dimensions are of the order of the characteristic length scales allowing unique magnetism to arise in a process dominated by the thickness of the films differing from the bulk magnets properties. 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 aimed in the framework of this project [6].

NdFeB films (5-15 nm) have been grown by co-deposition of each element by MBE. Different buffer layers (Molybdenum, 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. 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 (XRD and UPS, respectively) also providing values of the work function of the system not found previously reported in the literature.

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