Proc. of the Intl. Conf. on Nanotechnology for Better Living, 2016
Editors K. K. Kar, A. Shah and R. Sharma
Vol. 3, No. 1, p. 159
doi:10.3850/978-981-09-7519-7nbl16-rps-159

NBL-2016

Magnetic studies in conducting oxide/ CoFeB/MgO multilayers

Suraj T S[1,2 *], K. Sethupathi[2] and M.S.Ramachandra Rao[1]

[1]Department of Physics, Nano Functional Materials Technology Centre and Materials Science Research Centre, Indian Institute of Technology (IIT) Madras, Chennai-600036
[2]Low temperature Physics Laboratory, Department of Physics, Indian Institute of Technology (IIT) Madras, Chennai-600036
*Email: surajanphysics@gmail.com

Spin degree of freedom of electrons can be employed for logic switching and this has revolutionized data storage capacities during the last decade [1]. Spintronics promises non-volatile memory devices which are smarter and energy efficient [2]. An insulating layer sandwiched between two ferromagnetic layers is used as the basic element for logic switching called magnetic tunnel junction (MTJ). CoFeB/MgO/CoFeB is the best structure for the same due to its high tunnel magnetoresistance (TMR) of 604% [3]. But *in-plane* magnetized MTJs are not industrially viable due to its poor scalability, thermal stability and high power consumption [2].

Ultra-thin CoFeB films, in which perpendicular magnetic anisotropy (PMA) has been observed, is of immense importance due to their scalability, low switching current and thermal stability as compared to *in-plane* magnetized MTJs. Low switching current makes them ideal candidates for spin transfer toque based switching mechanism. Fabricating MTJs with metallic buffer layers has been the focus of research in recent years. Interfacial electronic structure and chemical state play crucial role in enhancing the PMA [4]. The interface of CoFeB and MgO shows high PMA due to Fe-O hybridization of 3d and 2p orbitals of Fe and O forming at the interface after annealing [5]. More pronounced PMA were observed with metallic buffer layers like Mo, Ta, Hf and W [6]. Temperature varying magnetic measurements on CoFeB thin film (30nm) show strong ferromagnetic ordering (Figure 1 and 2).

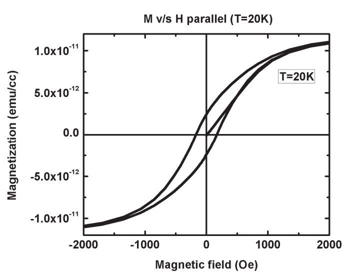

Figure 1: M-H Curve for CoFeB (30 nm) thin film at very low temperature (20 K)

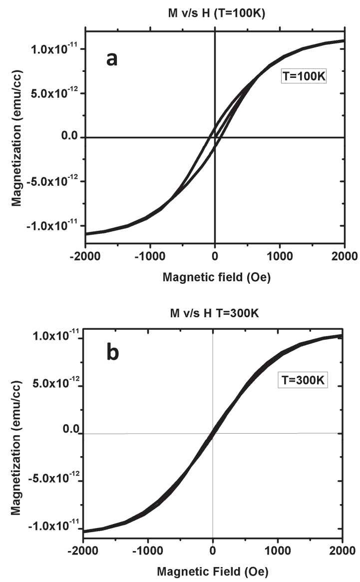

Figure 2: M-H Curve for CoFeB (30 nm) thin film at temperatures (a) 100 K and (b) 300 K

We investigate on how the interface magnetic anisotropy depends on the conducting oxide buffer layers. Pulsed laser deposition (PLD) and magnetron sputtering have been employed to fabricate these multilayers. Squid VSM and ferromagnetic resonance (FMR) techniques have been used to obtain the effective anisotropy of these multilayers. We have optimized the growth parameters for CoFeB thin films. Results will be discussed in detail.

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