Ultrafast current-induced DW motion in Pt/Co/Re thin films

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Spintronics offers a great way of development towards ultrahigh energy efficient data storage. Domain walls (DWs) motion through Spin orbit torques (SOT) in materials with perpendicular magnetic anisotropy (PMA) demonstrated high efficiency and stability in data manipulation [1]. The movement of DWs in PMA material requires the DWs to be Néel-type, stabilized by chiral Dzyaloshinskii-Moriya interaction (DMI) [2]. For fast device operations optimizing the speed of the current-induced DWs motion is crucial. In the literature, DWs studies focused on metallic multilayers with elements from the 3d (ex. Co), 4d (ex. Pd) and 5d (ex. Pt, Ta, W) deposited via sputtering [3]. This results in amorphous or polycrystalline films that lead to diffuse interfaces and strong pinning sites. In this work, we explore Pt/Co/Re thin films deposited via Molecular Beam Epitaxy (MBE), which allows for highly crystalline films with sharp interfaces. These stacks have been previously studied and exhibited very high DMI [4] and strong potential for SOT-driven devices [5]. MBE growth ensures minimal pinning and allows maximizing the DMI for SOT applications. The focus of this work is on the design and the characterization of devices capable of ultrahigh SOT-induced DW speed. The devices are patterned through photolithography, which is closely aligned with industrial methods, and characterized by Hall Effect and MOKE measurements. We show reliable generation and motion of DWs with speeds of up to 220 m/s at 1.4 x 10^12 A/m^2, which is the highest reported speeds in Pt/Co ferromagnets [6]. These results highlight the importance of maximizing the DMI and the novelty of introducing Re into the system with the purpose of efficient SOT-driven spintronics.

References:

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