Perpendicular Magnetic Anisotropy on W-based Spin-Orbit Torque CoFeB | MgO MRAM Stacks

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Spin-Orbit Torque Magnetic RAM (SOT-MRAM) is a novel memory concept recently proposed [1], promising a fast access, energy-efficient, scalable, high density non-volatile memory technology. A typical SOT-MRAM stack is composed of a Magnetic Tunnel Junction (MTJ), two ferromagnetic layers separated by an insulating oxide, grown on top of a metal with high spin-orbit coupling, which acts as the read/write current line. The structures principally studied are Ta | CoFeB | MgO | CoFeB stacks, due to the high spin-orbit coupling of Ta, the readily obtainable perpendicular magnetic anisotropy (PMA) of CoFeB and the more effective spin-dependent tunnelling through the monocrystalline MgO barrier [2]. Recently, there has been a focus on W for use as current line metal, due to its reported giant spin-orbit coupling [3]. In this context, we study W | Ta | $Co_{20}Fe_{60}B_{20}$ | MgO and WTa-alloy | $Co_{20}Fe_{60}B_{20}$ | MgO half-MTJ sputter deposited stacks. Series of samples with CoFeB thickness between 0.6 nm and 1.8 nm have been deposited and thereafter annealed in high vacuum for 1 hour, at temperatures between 200ºC and 350ºC. X-ray diffraction (XRD) and anomalous Hall effect (AHE) magnetometry have been performed to characterize the samples. AHE magnetometry reveals a clear PMA for the samples deposited on top of W/Ta underlayers, with CoFeB thickness between 0.9 and 1.2 nm. We will present a systematic study of these half-MTJs providing further insight on the CoFeB | MgO system.

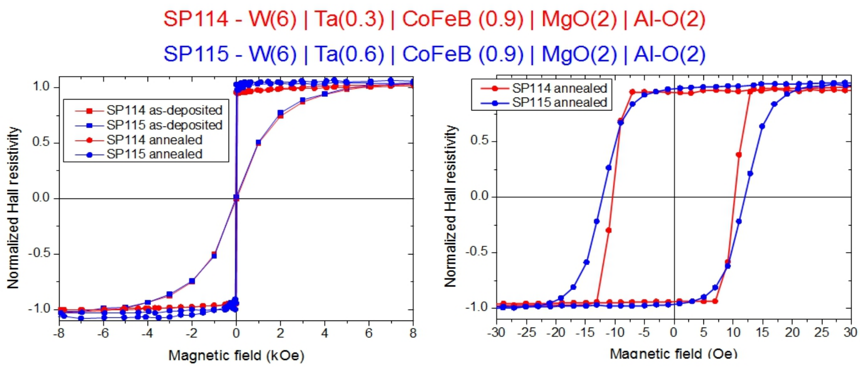

Figure: Anomalous Hall effect magnetometry of W | Ta | $Co_{20}Fe_{60}B_{20}$ | MgO stacks before and after annealing at 350ºC. The magnetic field is applied perpendicular to the sample.

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References

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