The Surface Spin Flop in Fully Tunable Synthetic Antiferromagnets with Perpendicular Magnetic Anisotropy

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Antiferromagnets (AFs) are of emerging interest due to their wide variety of useful properties at the micro and nanoscale. Despite the macroscopically vanishing magnetic remanent moment and therefore high stability with respect to external magnetic field, AFs may provide other unique magnetic static states as well as promising characteristics for dynamic applications like high domain wall velocities and excitation frequencies up to the THz regime [1, 5].

Synthetic antiferromagnets (SAFs), consisting of AF-coupled ferromagnetic layers via thin non-magnetic spacer layers [2], maintain the main characteristics of intrinsic AFs. Additionally, SAFs offer a high degree of tunability and easy integration, thus making them interesting for a wide range of applications [3-5].

One unique AF phenomenon, whose observation became possible through the emergence of SAFs, is the Surface Spin Flop (SSF) [6, 7]. Here, for an even number of AF-coupled layers at sufficiently high field, a vertical AF domain wall is nucleated at one of the surfaces of the SAF and then, as the external field is further increased, propagates towards the center of the SAF. For even higher fields, the vertical AF domain wall expands into the Bulk Spin Flop state with a canting between adjacent magnetic layer moments [8]. So far, the observation of the SSF in SAFs was limited to epitaxial systems with in-plane uniaxial magneto crystalline anisotropy.

We will present the SSF for the first time in SAFs with perpendicular magnetic anisotropy caused by the interfaces of Co/Pt multilayers (Fig. 1). The fact that single crystalline substrates are no longer needed, paves the way for further investigations of the SSF state as well as for applications. Furthermore, we demonstrate the possibility to stabilize the vertical AF domain wall even at remanence, thereby making it readily available also for low field investigations and applications.

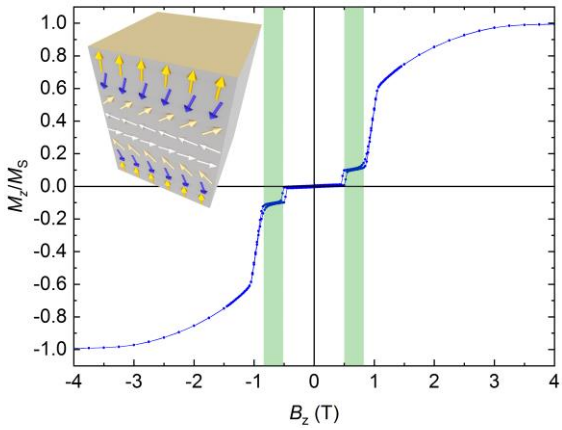

Figure 1: Magnetization curve with the Surface Spin Flop (SSF) states occuring in the green regions. The laterally homogeneous vertical AF domain wall originating from the SSF is indicated in the inset.

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