Future concepts and materials for magnetic data storage

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Due to the increasing demand in high-density recording media, magnetic thin films with high magnetic anisotropy are widely studied in order to overcome the superparamagnetic effect. To fulfill the requirements of thermal stability, hard magnetic alloys, i.e. FePt alloys in the $L1_0$ phase are promising candidates as storage layer. However, owing to the large magnetic anisotropy, the magnetic field required to reverse the magnetization of the media may become higher than the field provided by a conventional recording head. To solve this, so-called writeability issue, the concepts of exchange-coupled composite (ECC) media as well as bit patterned media based on $L1_0$ FePt were suggested, which will be discussed in this presentation.

Furthermore, ultrafast magnetization switching is at the heart of both modern information storage technology and fundamental science. In this regard, it was recently observed that ultra-fast magnetization reversal processes can be induced by circularly polarized laser pulses in amorphous ferrimagnetic GdFeCo alloy thin films [1]. This novel observation resulted in a broad range of exciting and challenging fundamental questions, and may enable new applications based on ultra-fast spintronics. An overview of our activities on all-optical switching in amorphous ferrimagnetic Tb-Fe alloy films [2-4] (see Fig. 1) will be presented.

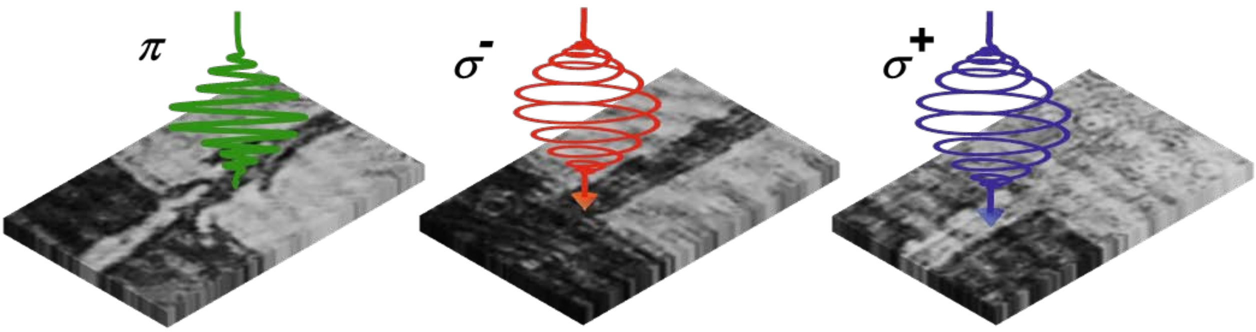

Fig. 1: *Demonstration of helicity dependent all-optical switching (AOS) in amorphous $Tb_{30}Fe_{70}$ thin films: The magnetization perpendicular to the sample surface is imaged by the Faraday effect. In the gray area the magnetization is pointing out of the sample plane (M+), while in the black area magnetization is pointing into the sample plane (M-). Linear polarization (π) results in formation of a disordered multidomain state. Left circularly polarized (σ-) laser pulses cause a magnetization reversal, visible as a dark stripe (M-) written in the gray area (M+). Right circularly polarized (σ+) laser pulses erase the written area and write a gray stripe (M+) into the dark region.*

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[2] B. Hebler et al., Frontiers in Materials 3, 8 (2016).
[3] A. Hassdenteufel et al., Adv. Mater. 25, 3122 (2013).
[4] A. Hassdenteufel et al., Phys. Rev. B 91, 104431 (2015).