

Ultrafast Magnetism and THz Spintronics

M. Münzenberg

Institute of Physics, Greifswald University, Germany

Magnetization manipulation is an indispensable tool for both basic and applied research. I will discuss some of the knobs to tune dynamics at ultrafast time scales and show in my presentation an actual overview over actual achievements in the developing field of ultrafast magnetism and THz spintronics of the last 20 years [1], with focus on those in which we were directly involved.

The dynamics of the spin response depends on the energy transfer from the laser excited electrons to the spins within the first femtoseconds. A special material of interest for magnetic storage development is FePt. The electron temperature shoots to higher values above the Curie temperature and used for all-optical writing [1, 2]. Not only magnetic nanoparticles can be reversibly written. Also vortex, antivortex networks can be written in standard thin Fe films [3].

On the other side, due to the non-equilibrium electron distribution in layered nanoscale spintronic devices, ultrafast spin currents are generated and contribute to the laser driven spin dynamics. Ultrafast laser-driven spin currents can be converted via the spin-Hall effect into a charge current burst [4] that can even compete with state-of-art THz emitters [5].

[1] J. Walowski and M. Münzenberg, *J. Appl. Phys.* **120** 140901 (2016).

[2] R. John, et al. *Sci. Rep.* **7**, 4114 (2017).

[3] T. Eggebrecht, et al. *Phys. Rev. Lett.* **118**, 097203 (2017).

[4] T. Kampfrath, et al. *Nature Nanotech.* **8** (2013) 256.

[5] T. Seifert, et al. *Nature Photonics* **10**, 483–488 (2016).

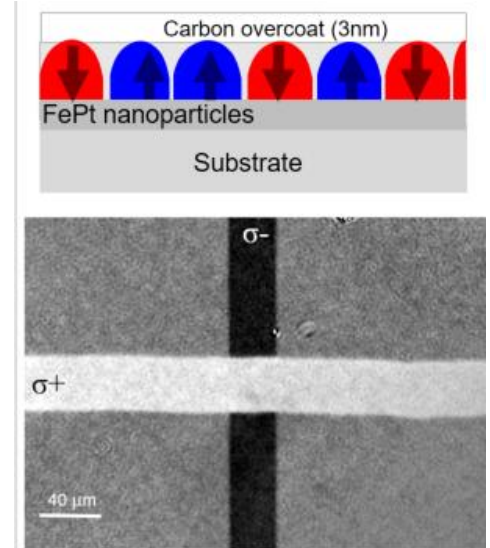


Fig. 1. Writing and overwriting of a magnetization in a FePt-hard disc medium using femtosecond laser pulses.