All-optical control of magnetization in various metallic magnetic systems

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While historically magnetism was controlled by an external magnetic field there are many new and emerging ways to control magnetic order on the nano-scale. One of them that attracted the growing attention is manipulating magnetic systems, cleanly with ultra-short laser pulses as short as 40 fs is known as all-optical switching (AOS). This method takes the advantage of the interplay of light and magnetism and enables light to both read and write (magnetization reversal) at sub-picosecond timescales, characteristic to the rate of exchange interaction between the spins of the atomic sub-lattices present in the multi-magnetic system. AOS was first observed in rare-earth/transition-metal amorphous ferrimagnetic thin-film alloys. However, we have recently demonstrated AOS in multilayer structures, rare-earth free ferrimagnetic compounds [1], and in ferromagnetic thin-films, multi-layers and even granular films designed for next generation magnetic recording media [2]. These findings shows that optical control of magnetic materials is a much more general phenomenon than previously assumed and may have a major impact on data memory and storage industries through the integration of optical control of ferromagnetic bits. I will highlight recent experiments on all-optical magnetization reversal that probe the underlying mechanisms involved in optical control of ferromagnetic materials.

References:

[1] Mangin *et al*., Nat. Mater. **13**, 286 (2014).
[2] Lambert *et al*., Science **345**, 1337 (2014).

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