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Spin-photonics for Energy efficient information Technologies

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The 21st century digital economy and technology is presently facing fundamental scaling limits (heating and the superparamagnetic limit) as well as societal challenges: the move to mobile devices and the increasing demand of cloud storage leads to an enormous increase in energy consumption. These developments require new strategies and paradigm shifts, such as spin-based technologies and the introduction of photonic processors. Since the demonstration of magnetization reversal by a single 40 femtosecond laser pulse, the manipulation of spins by ultra-short laser pulses has become an intruiging fundamentally challenging topic with a potentially high impact for future spintronics, data storage and manipulation and quantum computation. The ability to control the macroscopic magnetic ordering by means of femtosecond laser pulses provides an alternative and energy efficient approach to magnetic recording. The realization that femtosecond laser induced all-optical switching (AOS) as observed in ferrimagnets exploits the exchange interaction between their sublattices, has opened the way to engineer new and rare-earth-free magnetic materials for AOS. Expansion to hybrid magnetic materials, multilayers and FePt is an ongoing effort to expand AOS to future magnetic recording media technology. Recent developments using plasmonic antennas and optical waveshaping indicate the possibility to even scale the technique of AOS down to the nanoscale. This makes AOS a potential candidate to replace HAMR in the near future, but that will require the convergence of the emerging fields of opto-magnetism and spintronics with electronic and photonic integration technologies.

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