RESEARCH OF SPIN-ORDERED MATERIALS BY LIGHT

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The investigation of electron spin-related phenomena is a rapidly evolving field. It is motivated by the fact that the classical charge-based electronics is approaching its physical limits as the circuit features are reaching nanometer scale [1]. For further substantial increase of computing performance new physical phenomena have to be employed in electronic devices. Exploiting electronic spin to store, transfer and manipulate information represent very promising alternative.

As we show in this contribution on several examples, light is a versatile tool for the research of spin order in materials. These techniques are non-destructive, contactless and enable to reach high spatial ($\lesssim 1$ µm) and temporal (~ 10 fs) resolutions. We exploit the coupling between light and spin (magnetism) in both directions – to excite the spin dynamics as well as to detect it via magneto-optical effects in a single pump-probe experiment. As we demonstrated recently in a diluted ferromagnetic semiconductor GaMnAs, absorption of light can excite magnetization precession on a picosecond timescale via relativistic spin-orbit coupling [2]. Later we enhanced the spatial resolution of our pump-probe setup by a microscope objective and we exploited the light-matter spin transfer to optically control a magnetic domain wall motion in a microstructure [3,4]. In another experiment the simultaneous high spatial and temporal resolution of our pump-probe setup enabled us to observe a long-range and high-speed spin transport in a non-magnetic GaAs/AlGaAs structure [5]. Such a long-term conservation of spin-encoded information is a necessary prerequisite for realization of spin-based computing circuits.

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