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Terahertz acoustic and optical control of spin dynamics in nanostructures

Initiative: Trilaterale Partnerschaften – Kooperationsvorhaben zwischen Wissenschaftler(inne)n aus der

Ukraine, Russland und Deutschland

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The trilateral project aims on development of the ultrafast, robust and energy-effective methods for spin manipulation at the nanoscale by means of picosecond acoustic, femtosecond optical, and picosecond THz pulses. Experimental approaches are based on picosecond acoustics techniques and its combination with ultrafast optical and THz pulses. The particular spin systems under study are multilayer ferromagnetic structures, semiconductor microcavities and low-symmetry semiconductor heterostructures. Ultrafast acoustic pulses provide spatial and temporal strain with 100 nm and 10 ps, respectively, and related stress of 100 Mbar. The sensitivity of the spin systems to strain is stipulated by distinct physical mechanisms, which gives rise to specific spin dynamics. Also the combined action of terahertz strain and optical pulses will be used to control the spin dynamics and spin switching. In ferromagnetic metal structures, which magnetic properties are set by the structure design and determined by indirect exchange interaction between ferromagnetic layers, the control of their state will be based on ultrafast altering exchange coupling. In semiconductor microcavities spin dynamics of cavity polaritons (composite boson quasi-particles of coupled excitons and photons) and switching of the polariton condensate spin between bistable states by picosecond strain pulses will be examined. In doped semiconductor heterostructures with low-symmetry the project consortium will address charge carrier spins by coherent phonons modifying the carrier orbital states. Spin-galvanic effect will be used here for detection of the induced spin currents.

Projektbeteiligte

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