ABSTRACT:

This work is dedicated to the study of spin dynamics in systems based on the semiconductor gallium arsenide (GaAs) that are suitable for use in spintronic devices. We explored two types of model structures using experimental methods of ultrafast laser spectroscopy and transport measurements.

In the ferromagnetic semiconductor (Ga,Mn)As, we investigated laser-induced magnetization precession. We found out that transfer of both energy and angular momentum from the circularly polarized laser light can trigger magnetization precession, the latter one being identified as a new phenomenon, the “optical spin transfer torque”. Furthermore, we demonstrate the possibility to control the energy-transfer-induced magnetization dynamics both optically and electrically using piezo-stressing.

When dealing with purely non-magnetic structures for spintronics, we studied the Spin-Injection Hall Effect (SIHE) in GaAs/AlGaAs heterostructures with a special type of spin- orbit (SO) coupling that are lithographically patterned to create nanodevices. We managed to observe precession of the electron spin in the SO field directly in the space domain by extending the original detection method. This finding, together with the direct detection of a pure spin current, helped to propose a working spin Hall effect transistor.