Selected spin-orbit driven phenomena in 2DEG with Dresselhaus spin-orbit interaction

P. Majek[1] and A. Dyrdał[1]

[1] *Faculty of Physics, Adam Mickiewicz University, ul. Umultowska 85, 61-614 Poznań, Poland*

All-electrical control of magnetic moments in solids is possible due to spin-orbit interaction which is the origin of various spin and transport phenomena such as anomalous and spin Hall effects, current-induced spin polarization and spin-orbit torques.
We consider theoretically magnetized and nonmagnetized two-dimensional electron gas with Dresselhaus spin-orbit interaction that appears in semiconductor heterostructures when the growth direction of the quantum well is along the [100] crystallographic axis. Within the zero-temperature Green functions formalism and linear response theory we have obtained some analytical and numerical results describing the anomalous and spin Hall effects as well as the current-induced spin polarization. Our results are in agreement with those obtained earlier in the quasi-ballistic limit (extremely long relaxation time). However, they are more general as are applicable also for finite relaxation rate. We have also shown, among others, that the current-induced spin polarization in a nonmagnetic case is oriented in the plane of 2DEG and is aligned with the current flow direction.