NANOSPINTRONICS OF TOPOLOGICAL MATERIALS

Tomasz Dietl

International Research Centre for Interfacing Magnetism and Superconductivity with Topological Matter – MagTop and Laboratory of Cryogenic and Spintronic Research, Institute of Physics, Polish Academy of Sciences, PL-02668 Warszawa, Poland; Advanced Institute for Materials Research, Tohoku University, Sendai, Japan,
*e-mail: dietl@MagTop.ifpan.edu.pl

Presently commercialized nanospintronic devices make use of tunnel junctions consisting of ferromagnetic electrodes separated by a thin insulator layer. A dependence of the junction resistance on a relative magnetization orientation in the two electrodes serves for information reading, whereas sufficiently strong current is employed to reverse magnetization (magnetization writing) *via* a transfer of spin-momentum from spin-polarized current to spins in one of the magnetized electrodes. These junctions, when integrated with VLSI Si chips, form spin-transfer random access magnetic memories (ST-MRAMs) or in-built memory cells in the case of microprocessors.

It has been recently realized that a pallet of relativistic effects makes one possible to fabricate even more performant nanospitronic devices. In particular, a relativistic spin-orbit interaction generates a spin-orbit torque enabling reversing direction of macroscopic or staggered magnetization in ferromagnets and antiferromagnets, respectively with a relatively small energy dissipation per operation. Furthermore, spin-locking specific to topological materials **--** primarily semiconductors with inverted band structures brought about by relativistic mass corrections -- results in highly polarized spin currents allowing to reduce energy consumption by nanoelectronic systems. These aspects of topological materials and their ferromagnetic variants [1] will be reviewed emphasizing also their importance in sensing and metrology.

1. T. Dietl and H. Ohno, *Rev. Mod. Phys.* **86**, 187 (2014); T. Dietl *et al., Rev. Mod. Phys*. **87**, 1311 (2015).