***Synthetic and alloy ferrimagnetic films for spintronic device applications***

The development of electronics, including spintronics (for spintronic devices the movement of electrons is controlled not only by its charge but also by its spin) and information technology (IT), determines the progress in many important areas such as health protection, safety, communication, automation, robotics. Progress in electronics and IT is determined by the progress in material engineering. Among them, magnetic materials in form of thin films play an important role. Advances in the technology of these materials have created innumerable possibilities: the ability to switch the direction of magnetization not only by magnetic field, but also by current, voltage or light pulses; the controlled creation and propagation of skyrmions (chiral magnetic structures with a nanoscopic size); or the discovery of new effects such as giant and tunnel magnetoresistive effects (respectively GMR and TMR). The last two have already found important applications. For instance, the GMR effect in spin valves and TMR in tunnel junctions are used in various types of sensors and in the read heads of magnetic hard discs. They are also a basic element of magnetic RAM (Random Access Memory). Structures consisting of thin layers of different materials are used in the studies of these effects and exemplary applications. An important feature of such structures is that their properties differ from their bulk counterparts because of the limited thickness of individual sublayers, which is often below one nanometer. The reason for this is the strong contribution of surface properties and the significant role of the interaction between the sublayers. Thus, the effective properties of such structures are determined by the thickness of the individual sublayers as well as by the choice of material. Until recently, ferrimagnetic (FI) sublayers composed of rare earth (RE) and transition metal (TM) alloys were rarely used in these layered structures, although their properties were known. The most attractive quality of FI films is the possibility to control their magnetic properties (e.g. magnetization, anisotropy, coercive field, compensation temperature of magnetic moments of the RE and TM sublattice) by changing the concentration of the RE element in the FI alloy. In the last few years we have observed a renewed interest on FI films, but now they are investigated as part of multilayered structures instead of separately. Investigations of such structures show the possibility to realize magnetization reversal of the FI sublayers by light pulses or spin-polarized currents. The possibility of skyrmions creation and propagation in such structures has also been demonstrated. These achievements are important for new applications in spintronics and for IT. The investigation of layered systems with RE-TM ferrimagnetic sublayers is also relevant in the work that I carry on during my doctoral studies. Some results have been recently published in Scientific Reports. There, I have studied F/NM/FI layered structures (i.e. systems consisting of a ferromagnet (FM), a nonmagnetic metal (NM) and a ferrimagnetic (FI)). My results indicate that, by appropriate selection of the FI layer composition, the magnetization reversal of F layer can be modified in a wide range. During the implementation of this project, I will continue the studies concerning fabrication and characterization of layered systems containing FI sublayers. The results will be published in international journals and will become the basis for development of new spintronic devices.