DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

The main objective of the project is to find of novel magnetic states using experimental investigations of the magnetization dynamics in amorphous magnetic microwires. Microwires have a metal core and a crystal skin, in other words, they have a glass coating. We planned to investigation the wires with different composition and nucleus radius between 100 nm and 50 μm. In this project, the basic research are the following steps:

In the first step, will be studied of the magnetization reversal process under different configurations of magnetic fields and electric current with varied of the amplitude and frequency. The idea of our experiments is to use the electric current flowing along the microwire to produce the circular magnetic field via the Oersted effect. The magnetic domain structure modifications, resulting in magnetization switching and DW motion, will be analyzed by means of the time-resolved magneto-optical Kerr effect both magnetometry and microscopy.

In the second, will be investigation of the magnetization dynamics at a wide frequency range of circular magnetic field within 1 Hz – 40 GHz range. One of the aims of this project is the study of the magnetization reversal in the microwire in the presence of high-frequency and super-high-frequency circular magnetic fields that is important for the elucidation of GMI mechanism. The nature of GMI can be understood in terms of the surface effect in conjunction with the magnetization component induced by a passing high-frequency current. Thus, we can compare the dependence of parameters of magnetic domain structures on the frequency of circular magnetic field close to GMI frequency, because the origin of magnetic domains in amorphous microwires is connected with the surface effect.

Finally, will be investigation of very high-velocity domain wall (DW) motion under low magnetic fields. Using magneto-optical observation of domain structures we will find the novel magnetization states with anomalous domain wall in the cylindrical shape of the wires. We planned verification of the hypothesis of unusual magnetic structures in wires during increase of the DW velocity close to the Walker limit. We suppose that these microwires are an amazing object to excite extreme values of the DW velocity, about few km/s. A description of the propagation of DWs with different chirality in axial and circular magnetic fields would allow us to get insight about actual mechanism governing high-speed motion of DWs in microwires. To our best knowledge up to now it is not clear how the magnetostatic, magnetic anisotropy and Zeeman energies, which mainly drive the domain wall velocity, affect the domain wall to overcome the local pinning potential landscape in low field regime.

The magnetization dynamics and magnetic domain wall dynamics significantly contributes to fundamental research by deepening the knowledge of the key question concerning finding of novel magnetization states and mechanism of the magnetization switching of one-dimension systems under magnetic field or electric current. The interest on magnetization dynamics and domain wall velocity in different magnetic wires is related with proposals for magnetoelectronic devices. One of the possibly best-known applications with respect to microwires is that they can be used as sensors in the electronic compasses of mobile phones. Such kind of sensors are currently being used in the automotive industry in traffic surveillance vehicles. Thus, the sensitivity of these sensors is very important for practical applications. The microwires which are object of our project have extremely high DW velocity. Consequently understanding of underlying mechanisms of high-speed DW motion and the physical phenomena in magnetic microwires can be important for sensors developing.