Soft magnetic amorphous and nanocrystalline bilayer ribbons for sensor applications

I. Škorvánek,[1] F. Andrejka,[1] B. Kunca,[1] J. Marcin,[1] and P. Švec[2]

[1] *Institute of Experimental Physics, Slovak Academy of Sciences, Košice, Slovakia*

[2] *Institute of Physics, Slovak Academy of Sciences, Bratislava, Slovakia*

Rapidly solidified amorphous and/or nanocrystalline bilayer ribbons are interesting for their intrinsically graded properties, which can be used in design of magnetic sensors or actuators. A double-nozzle planar flow casting technique offers the possibility of simultaneous formation of two mechanically solid connected layers with different composition and uniform thickness of tenths of microns along the ribbon length. It makes possible combining unlike alloys with selected properties and unique overall behavior. A special attention of our work was devoted to bilayers with different magnetic and magnetoelastic properties. The composition of the individual layers was chosen from the Fe-Cu-Nb-Si-B, Fe-Nb-Si-B, Fe-Ni-Nb-B, Fe-Co-Nb-B and Co-Si-B alloy systems, respectively. By using of proper heat treatment, it was possible to transform the separate layers or entire bilayers to nanocrystalline state. In order to optimize the application performance of prepared bilayers, a thermal processing under presence of external magnetic field was employed. We show that besides the effects of field-annealing, the magnetic behavior in such bilayers is strongly influenced by interlayer stresses, which are induced in material due to different thermal expansion of two mechanically coupled individual layers. This can lead to very large induced magnetic anisotropies. The magnetostatic bias effects between layers with different magnetic softness can also play an important role in magnetization reversal process. Examples of our recent work on development of new rapidly quenched bilayer ribbons with improved soft magnetic and/or magnetoimpedance characteristics will be presented and the added value of such materials for use in magnetic sensors will be briefly highlighted.

This work was supported by the projects APVV-19-0369, VEGA 2/0171/19 and JRP-MAGSAT.