плёнок в течение 1 часа. Температура отжига варьировалась в пределах 100-400°C. Тензомагниторезистивные свойства полученных структур измерялись на специализированной установке EMPD-2 в условиях контролируемой деформации. Гистерезисные свойства контролировались по магнитооптическим петлям гистерезиса, измеренным с помощью Керр-микроскопа Evico-magnetics.

В результате представлены систематические экспериментальные данные, показывающие, что отжиг существенно влияет на TMP-свойства многослойных плёнок. На их основе определены оптимальные условия термомагнитной обработки, которые, в частности, позволяют увеличить чувствительность пленочных элементов к деформации более чем на 100% при минимальном гистерезисе полезного сигнала.

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MAGNETIZATION CONFIGURATIONS IN SOFT MAGNETIC Fe-Nb-Cu-Si-B FILMS WITH PERIODIC NANOSCALE CURVATURE

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Barrier layers of porous alumina were used as substrates for depositing the Finemet alloy providing a flexible control over the curvature parameters. Investigation of macroscopic and local magnetization processes on samples with curvature diameter of 105 and 320 nm revealed the increased coercivity comparing to the flat films with similar magnetization reversal mechanism. The conditions for vortices formation were determined using micromagnetic modelling and verified experimentally.

Introduction of the curvature to the planar surface in a controlled way provides a new possibility of functionalization by tailoring the geometry rather than material properties. This approach makes possible topologically driven magnetization distribution which is particularly useful in many emerging areas of spintronics and magnonics [1]. Curvilinear geometry at nanoscale leads to a variety of exotic configurations including skyrmionic systems, vortices, and magnonic crystals [2]. In this work we investigate magnetization processes in thin films deposited onto the substrates with nanoscale curvature, consisting of hexagonally-packed semispheres with precisely controlled parameters. To determine and verify the conditions for the appearance of vortex-like configurations we employed micromagnetic modelling as well a variety of experimental methods.

Samples were synthesized by depositing 5 to 30 nm thick films of the Finemet alloy with Fe-Nb-Cu-Si-B composition by magnetron sputtering onto the glass (reference sample) or anodic alumina substrates. Periodically arranged semispheres appeared on a barrier layer of porous alumina oxide layer as a result of anodization process. The diameter and the distance between the centers of the nearest semispheres were controlled by choosing the appropriate anodization and varied between 105 nm and 320 nm. Hysteresis loops were measured using the vibrating sample magnetometer or the Kerr microscope, which was also employed for visualizing the magnetic domain structure on the mesoscopic scale. Local magnetization configurations were studied using the magnetic force microscopy. Micromagnetic simulations were performed using the GPU-accelerated program mumax^3 [3].

Using the micromagnetic simulation, we determined a phase diagram showing regions of film thicknesses and semispheres diameters where vortex configurations can be stabilized. The presence of magnetic interconnections between the semispheres were demonstrated to strongly reduce the size of such region. The minimal diameter for getting stable vortices was shown to be around 300 nm with thickness less than 30 nm. The hysteresis loop typical for vortex configuration, however, was observed for only for separate semispheres, whereas for continuous film the loop had regular rectangular shape with reduced remanence. These results were confirmed experimentally for Finemet films with semispheres diameter of 105 and 320 nm: hysteresis loops had enhanced coercivity and no stable vortices were detected by magnetic force microscopy. In conclusion, at the current stage no stable vortices were observed experimentally, but, according to the results of micromagnetic simulations, they can be stabilized more easily by using semispheres of large diameter (around 500 nm), or by weakening the connection between semispheres by using the oblique deposition.

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