Effect of annealing on magnetic properties and domain wall dynamics of Fe-Ni based magnetic microwires

Arcady Zhukov[1,2,3], Juan Maria Blanco[2], Galina Abrosimova[4], Alexandr Aronin[4], Margarita Churyukanova[5], Mihail Ipatov[1,2], Sergey Kaloshkin[5], and Valentina Zhukova[1,2]

[1] Dpto. de Física de Materiales, Fac. Químicas, UPV/EHU, 20018, San Sebastian, Spain
[2] Dpto. de Física Aplicada, EUPDS, UPV/EHU, 200018, San Sebastian, Spain
[3]IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain
[4]Insituteof Solid State Physics, RAS, Chernogolovka, 142432, Moscow region[34]National Research
[5]National University of Science and Technology «MISIS», 119049, Moscow, Russia
[56]Institute of
arkadi.joukov@ehu.es

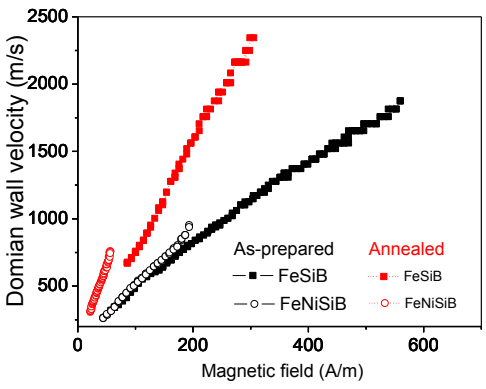
Abstract Glass-coated ferromagnetic microwires intensively studied during last two decades exhibit magnetic properties quite attractive from the point of view of technical applications, such as magnetic bistability, excellent magnetic softness and giant magneto-impedance, GMI, effect [1,2]. Conventional route for optimization of magnetic properties is related to choosing of adequate chemical composition of the metallic nucleus [1,2]. On the other hand optimization of most interesting magnetic properties, such as velocity of single DW propagation during the magnetization switching is limited by the materials defects and magnetoelastic anisotropy. The DW velocity linearly increases with applied magnetic field, *H,* until the multiple DW nucleation on defects happens. Therefore the extension of the magnetic field range for single-DW propagation regime limits the DW velocity [3]. This extension is limited by the minimum value of local nucleation field, H_{nmin}, determining the threshold between single and multiple DW propagation regimes[3]. The local defects are responsible for the spontaneous DW nucleation in different places of the microwire. The origin of these defects is still unclear, although recently we reported that annealing can change the local nucleation fields [3].

We studied the magnetic properties and domain wall (DW) dynamics of $Fe_{47.4}Ni_{26.6}Si_{11}B_{13}C_2$ and $Fe_{77.5}Si_{7.5}B_{15}$ microwires. Both samples present rectangular hysteresis loop and fast magnetization switching. Domain wall dynamics is considerably affected by the annealing. Linear region on dependence of domain wall velocity on magnetic field in $Fe_{47.4}Ni_{26.6}Si_{11}B_{13}C_2$ sample is considerably shorter. Consequently we studied the structure of as-prepared and annealed $Fe_{47.4}Ni_{26.6}Si_{11}B_{13}C_2$ sample using X-ray diffraction and analyzed the effect of annealing on DW dynamics.

References

[1]. M. Vazquez, H. Chiriac, A. Zhukov, L. Panina and T. Uchiyama, Phys Stat Sol. A **208**, (2011) 493.
[2] A. Zhukov, M. Ipatov and V. Zhukova, Advances in Giant Magnetoimpedance of Materials, Handbook of Magnetic Materials, ed. K.H.J. Buschow, Volume **24** (2015) 139
[3] A. Zhukov, J. M. Blanco, M. Ipatov, and V. Zhukova Sensor Letters **11** (1) (2013) 170.

Figures



Dependences of domain wall velocity, *v*, on magnetic field, *H* measured in $Fe_{77.5}Si_{7.5}B_{15}$ and $Fe_{47.42}Ni_{26.6}B_{12.99}Si_{1.99}$ microwires.