DEVELOPMENT OF ULTRA-THIN GLASS-COATED AMORPHOUS MICROWIRES FOR HF MAGNETIC SENSORS APPLICATIONS

A. Zhukov[1], M. Ipatov[1], V. Zhukova[2], J. Gonzale1z, J.M. Blanco[2],
Dpto. de Física de Materiales, Fac. Químicas, Universidad del Pais Vasco, 20009, San Sebastián, Spain
Dpto. de Física Aplicada, EUPDS, Universidad del Pais Vasco, 20018, San Sebastián, Spain
E-mail: wupzhuka@sp.ehu.es

The recent tendency in miniaturization of the magnetic sensors requires the development of extremely thin magnetic wires with enhanced magnetic softness. The solution of this problem can be the composite wires produced by the Taylor-Ulitovsky method (1 - 30 μm in diameter) consisting of metallic nucleus coated by glass [1]. Recent significant progress in tailoring of magnetically soft Co-rich glass coated microwires with metallic nucleus diameter of about 20 μm fabricated by this method enabled to enhance significantly the GMI ratio (up to about 600%) [2]. Such thin microwires are very useful for designing of the microsensors. Particularly it is an important task to develop thin wires, because of the effect of the demagnetizing factor on GMI effect. It is demonstrated that if the microwire diameter is about 15 μm the demagnetizing factor can affect their remagnetization process for the samples length below 2 mm [3]. Therefore if sensor size is about 1 mm, the microwires with the diameter below 10 μm are very useful.

In this paper we report novel results on magnetic properties and GMI effect at frequencies between 10 MHz and 500 MHz in ultra-thin Co-Fe-rich amorphous glass-coated microwires with nearly-zero magnetostriction constant with metallic nucleus diameter ranging between 5 and 22 μm. $Co_{67.05}Fe_{3,84}Ni_{1,44}Si_{14,47}B_{11,51}Mo_{1,69}$ glass-coated amorphous microwires with the metallic nucleus diameter ranging between 5 and 22 μm and total diameter between 10 and 23 μm with vanishing magnetostriction constant of the order of $-(1\text{-}3)\cdot10^{-7}$) fabricated by the Taylor-Ulitovsky method have been studied. Most of studies samples exhibiting excellent soft magnetic behavior and high GMI effect. Off –diagonal components, real and imaginary part of the GMI have been analyzed.

Even in the thicker sample (metallic nucleus 22 μm) the penetration skin depth calculated from the GMI curves at 30 MHz is about 1 μm. Therefore the surface magnetization process and surface defects are of special importance to achieve good HF properties in this wires.

References:

[1] A. Zhukov and J. Gonzalez, "Amorphous and Nanocrystalline Soft Magnetic Materials", in *Advanced Magnetic Materials, book 3* "***Processing of advanced magnetic materials."*** Edited by Y. Liu, D.J. Sellmyer and D. Shindo, (Kluwer Academic Publishers, Norwell, MA, USA, 2004) **Vol.3,** Chaper 5, p. 115-181.

[2] V. Zhukova, A. Chizhik, A. Zhukov, A. Torcunov, V. Larin and J. Gonzalez, IEEE Trans. Magn. 38, 5, part I, (2002) 3090.

[3]. A. P. Zhukov, M. Vázquez, J. Velázquez, H. Chiriac and V. Larin, J. Magn and Magn, Mater, 151, (1995) 132.