THE USE OF MAGNETIC MICRO - AND NANOWIRES FOR "HYPERTERMIA"

S. A. Baranov[1,*], A. I. Dikusar[1], O. V. Yaltychenko[1], E. Yu. Kanarovskii[1] , M. Codescu[2]
[1]*Institute of Applied Physics, Academy of Sciences of Moldova, Akademiei 5, Chisinau (Kishinev), MD-2028, Republic of Moldova*
[2]*National Institute for R&D in Electrical Engineering ICPE-CA, Bucharest, Romania*
*E-mail: baranov@phys.asm.md

It is known that a cast amorphous micro - and nanowire in glass encapsulation (coated) (CAMNWGC) with positive magnetostriction possesses a rectangular hysteresis loop and its magnetization is reversed by a large Barkhausen jump (LBJ), the coercive force of which can be regulated by both the residual and external mechanical stresses[1-5]. Heat generation depends on the magnetic losses which are associated with the coercive force [1-8].

Glass-coated amorphous magnetic micro- and nanowires are produced by the Ulitovsky - Taylor method [1-8]. Glass-coated magnetic micro- and nanowires are characterized by a nucleus out of a magnetic alloy, structurally amorphous and metallic conductor, with diameter between around 0,1 to 20 μm, covered by a Pyrex-like coating 0,1 to 10 μm thick. That coating, besides insulating the metallic nucleus from corrosion and electrical points of view, induces strong mechanical stresses in that nucleus that couple with magnetostriction to determine large magnetoelastic anisotropy, and consequently a unique magnetic behavior. Particularly, the strong magnetoelastic anisotropy in magnetostrictive Fe-Co-Ni- rich alloys amorphous microwires gives rise to the existence magnetic bistability characterized [1-8].

The etymological meaning of the word "Hyperthermia" is generation of heat and with respect to cancer therapy; the term is used to imply treatment based on generation of heat at the tumor site. The approach involves raising the temperature of local environment of a tumor resulting in changing the physiology of diseased cells finally leading to apoptosis [9-11].

With the possibility to convert dissipated magnetic energy into thermal energy, the application of magnetic materials for hyperthermia treatment of cancer was first proposed in 1957 [9-11].

Since then, this approach has become a well-researched area in connection with the introduction of magnetic micro - and nanowires in the area in the eventual defeat of cancer metastases.

In our experimental work demonstrated the ability to cast amorphous micro - and nanowires in a glass encapsulation (with cover) is heated inductively in the alternating field (1 kA / m, 500 kHz) at a rate which is required for "hyperthermia" ie generating heat for cancer therapy.

[1] S. A. Baranov, M. Yamaguchi, K. L. Garcia and M. Vazquez. *Moldavian Journal of the Physical Sciences*. **9,** 1, (2010). 76 – 82.
[2] S. A. Baranov. *Technical physics letters*, 24, 7, (1998). 549 – 551.
[3] S. A. Baranov. *Technical physics*, 43, 1, (1998). 122 – 125.
[4] S. A. Baranov. *Journal of Communications Technology and Electronics*, 48, 2, (2003). 226 – 231
[5] S. A. Baranov, V. N. Berzhanski, S. K. Zotov, V. L. Kokoz, V. S. Larin, and A. V. Torkunov. *Fiz. Met. Metalloved.* **67**, 1, (1989). 73 – 82.
[6] S. A. Baranov, S. K. Zotov, V. S. Larin, and A.V. Torkunov, *Fiz. Met. Metalloved*. **69**, 12, (1991). 172 – 176.
[7] A. N. Antonenko, S. A Baranov, V. S. Larin, and A. V. Torcunov. *Supplements to Journal "Materials Science and Engineering" A,* (1997). 248 – 254.
[8] S. A. Baranov, V.S. Larin, A. V. Torcunov and. A. N. Antonenko, *J. Phys. France.* **8**, (1998). Pr2- 265 – 270.
[9] M. Johannsen, U. Gneveckow, L. Eckelt, et al., *Int. J. Hyperthermia*, **21(7)**, (2005) 637.
[10] O. A. Kuznetsov, N. A. Brusentsov, A. A. Kuznetsov, and N. Y. Jurchenko, J. Mag. Mag. Mater., **194**, (1999) 83.
[11] A. Jordan, R. Scholz, P. Wust, et al., *J. Mag. Mag. Mater*., **201**, (1999). 413.