"Nanocomposites and nanomaterials"

Soft Magnetic Properties of Nanocrystalline $Fe_{73}B_7Si_{16}Nb_3Cu_1$ Alloy with Creep-induced Magnetic Anisotropy

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An amorphous $Fe_{73}B_7Si_{16}Nb_3Cu_1$ alloy ribbon has been nanocrystallized during rapid heating by passing an electric current, with nanostructures being formed under simultaneous tensile stress σ applied along the ribbon axis. This results in a strong transverse creep-induced anisotropy of the ribbon. This magnetic anisotropy caused by magneto-elastic anisotropy of nanograins is formed due to the effect of the tensile stress of anelastically deformed amorphous matrix [1].

Nanocrystallization of amorphous ribbons occurres with the formation of α-Fe 10÷12 nm grains. The volume fraction of α-Fe nanocrystals in the amorphous matrix is 80% [2]. It is shown that the creep-induced anisotropy hardly affects the structure of nanocrystalline alloy: the sizes and densities of the nanocrystals remain unchanged.

Measurements of dynamic magnetic properties of annealed and deformation-subjected ribbons were carried out after ribbons being wound into toroidal cores. It was shown that the increase of tensile stress (σ=0→160 MPa) leads to the increase of anisotropy and to the decrease of the initial permeability (μ_i=9200→400), squareness ratio ($B_r/B_{m(10/400)}$=0.53→0.003) and losses in the core ($P_{(10/1000)}$= 5.13→2.5 W/kg). These magnetic properties allow us to count on efficient use of these cores in manufacturing of reactors and chokes.

1. *Herzer G.* Creep Induced Magnetic Anisotropy in Nanocrystalline Fe-Cu-Nb-Si-B Alloys // IEEE Transactions on Magnetics.-1994.-**30**.-P. 4800-4802.
2. *Maslov V, Nosenko V, Taranenko L, Brovko A.* Nanocrystallization in Finemet-type alloys // PMM.-2001.-**91**, N 5.-P. 47-55. (in Russian)