Nanocomposites and nanomaterials

DC-bias stable nanocrystalline magnetic cores made of $Fe_{73}Nb_3Cu_1B_7Si_{16}$ ribbon with induced transverse magnetic anisotropy

A.V. Nosenko, T.M. Mika, O.Yu. Rudenko, M.S. Nizameyev, O.M. Semyrga, I.K. Yevlash, V.K. Nosenko

G.V. Kurdyumov Institute for Metal Physics of NAS of Ukraine, Academician Vernadsky Boulevard 36, Kyiv, Ukraine
E-mail: Itrij@ukr.net

Today soft magnetic nanocrystalline alloys of Fe-Nb-Cu-Si-B system *[1] are widely used in magnetic cores of various inductive components (of transformers and chokes). It is known that formation of Fe(Si) nanocrystals in these alloys during heat treatment improves their soft magnetic properties. Volume fraction of nanocrystals in them is 75-80 % and their size is about 10 nm. Hysteresis loop shape can be controlled in these alloys and analogous ones by inducing uniaxial magnetic anisotropy in them during annealing under tensile stress* [2]. Magnetic cores made of ribbons with induced magnetic anisotropy have a number of advantages, main of them are high stability of magnetic permeability and low specific core loss in the frequency range of the most widespread use (1-100 kHz) *[3]*. This work shows one more advantage of these magnetic cores: tensile stress increase from 0 up to 180 MPa results in enhanced DC-bias stability of magnetic permeability. The comparative analysis of DC-bias stability of magnetic permeability of cut (with nonmagnetic gap) magnetic core and new ones made of ribbons heated under tensile stress was carried out. The new magnetic cores (at the same value of initial magnetic permeability of the cut and new magnetic core - 500) were revealed to have ten times improved DC-bias stability of initial magnetic permeability. The obtained characteristics allow expecting effective use of the new magnetic cores made of $Fe_{73}Nb_3Cu_1B_7Si_{16}$ ribbon in high-power reactors and linear chokes of filters of switch-mode power supplies.

1. *Herzer G*. Modern soft magnets: Amorphous and nanocrystalline materials // Acta Materialia.-2013. **61**.-P. 718–734
2. *Herzer G*. Creep induced magnetic anisotropy in nanocrystalline Fe-Cu-Nb-Si-B alloys // IEEE Transactions on Magnetics.-1994, **30**.-P. 4800-4802.
3. *Nosenko A, Mika T, Rudenko O, Yarmoshchuk Y, Nosenko V*. Soft magnetic properties of nanocrystalline $Fe_{73}B_7Si_{16}Nb_3Cu_1$ alloy after rapid heating under tensile stress // Nanoscale Research Letters.-2015, **10**.-P. 136.