Effect of Co Substitution on Structure and Magnetic Properties of High Induction $Fe_{85-(x+y)}Cu_xCo_yB_{15}$ Metallic Glasses

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Previously, Rajat K. et al. presented results for $(Fe_{1-x}Co_x)_{84}(B_{1-y}Si_y)_{13}Nb_2Cu_1$alloys, that exhibit promising high induction >1.8T for sample with content of Co = 5 at% [1]. Similar results were also obtained for alloys $(Fe_{1-x}Co_x)_{79}Si_{8.5}B_{8.5}Nb_3Cu_1$ and $Fe_{80-x}Co_{20}B_x$ [2-3]. However, the literature lacks a description of the influence of a small Co substitution and the heat treatment process on the crystal structure and magnetic properties of the material.

In this work the effect of substitution of Fe by Co on the crystallization kinetics, crystal structure and magnetic properties of high induction(Bs>1,6T) $Fe_{85-xy}Cu_xCo_yB_{15}$ (x = 0.6, 1.2; y= 2.5, 5, 7.5) amorphous and nanocrystalline alloys was investigated. The amorphous alloys in the form of ribbons were obtained by melt spinning technique. The kinetics of the crystallization process were determined based on differential scanning calorimetry (DSC) measurements performed at heating rates from 10 to 100 °C/min. To obtain the best soft magnetic properties (Hc, Bs and Ps) at frequency 50 Hz, the wound toroidal cores were isothermally annealed in a vacuum for 20 minutes at a various temperatures based on DSC measurement. In addition, an annealing process in air at optimal temperature was also carried out to check the effect of surface oxidation on magnetic properties. The crystal structure of as-spun and annealed materials were verified by X-ray diffraction and transmission electron microscopy observations. The complex magnetic permeability in the frequencies 10^{6}-10^{9}Hz for the materials annealed at optimal temperatures was measured. Finally, all the results have been correlated to explain the Co substitution effect.

References:

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