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Influence of Structural Transformations on Electric and Magnetic Properties of $Fe_{81}B_{13}Si_4C_2$ Amorphous Alloy

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Abstract:
The structural transformations of the $Fe_{81}B_{13}Si_4C_2$ amorphous alloy under non-isothermal as well as under isothermal conditions were studied. The amorphous alloy was stable up to a temperature of about 450°C when the structural transformations began. The primary crystallization starts by forming Fe_3Si as main phase (more than 80 wt %), and two minor phases Fe_2B and Fe_3B. With the increase of the temperature the phase composition as well as ratio of present phases is changed and above 600°C it was confirmed the presence only two stable phases, Fe_3Si and Fe_2B. It was shown that all observed structural transformations have significant influence on the electric and magnetic properties of alloy. The electric resistivity of the crystallized alloy is lower than the amorphous one. The crystallized alloy possesses better magnetic susceptibility and retains the ferromagnetic properties in whole investigated temperature range.
Keywords: *Amorphous Materials, Metallic Glasses, Metals and Alloys, Phase Transition, Thermal Analysis, X-ray diffraction spectra.*

Introduction

Amorphous alloys, also known as "metallic glasses" are materials obtained by rapid quenching of melt at cooling rate of about 10^5-10^6 K s^{-1} in conditions where the crystallization is suppressed [1]. These materials possess a disordered distribution of atoms in the cooled melt and an excellent combination of physical properties which are very important technological applications [2]. The soft magnetic amorphous alloys are based on the ferromagnetic elements, Fe, Co and Ni and contain the glass forming elements such as Si, B, C and P [3-6]. The most stable amorphous alloys contain about 80 at. % of transition metal (ferromagnetic elements) and 20 at. % metalloid components (glass forming elements). From the practical point of view, these materials compared with the crystalline materials possess series of advantages such as the isotropy of magnetic properties, high magnetic softness combined with high mechanical hardness, high mechanical strength, low ribbon thickness and high electrical resistivity providing excellent soft magnetic materials properties for high frequency applications involved with very low loses [7,8]. The amorphous alloys are metastable materials and the elevated temperature as well as the prolonged performance could induce the process of change of their microstructure [9,10]. The formed microstructure involves the nanocrystals about 10 nm in size embedded in an amorphous matrix possessing soft magnetic properties superior to the amorphous and conventional crystalline magnetic

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