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The Effect of Temperature and Frequency on Magnetic Properties of the $Fe_{81}B_{13}Si_4C_2$ Amorphous Alloy

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Abstract:

In this study it was investigated influence of temperature and frequency on permeability, coercivity and power loses of $Fe_{81}B_{13}Si_4C_2$ amorphous alloy. Magnetic permeability measurements performed in nonisothermal and isothermal conditions was confirmed that efficient structural relaxation was occurred at temperature of 663 K. This process was performed in two steps, the first one is kinetic and the second one is diffuse. Activation energies of these processes are: E_{a1} = 52.02 kJ/mol for kinetic and E_{a2} = 106.9 kJ/mol for diffuse. It was shown that after annealing at 663 K coercivity decrease about 30% and therefore substantial reduction in power loses was attained. Investigated amorphous alloy satisfied the criteria for signal processing devices that work in mean frequency domain.

Keywords: *Amorphous alloys; Structural relaxation; Annealing; Improving soft magnetic properties*

1. Introduction

The amorphous alloys (metallic glasses) are advanced functional materials due to a specific combination of properties. These materials are characterized by structure with absence of the distant order atom arrangement and characterized by high degree of anisotropy of physical properties [1-3].

The amorphous state of matter is, however, structurally and thermodynamically unstable and very susceptible to partial or complete crystallization during thermal treatment. The crucial limitation with respect to using metal glasses for high temperature applications arises from their restricted thermal stability. The onset of exothermic crystallization results in the formation of highly stable, but brittle intermetallic compounds. Further, for amorphous alloys that exhibit excellent magnetic properties the crystallization represents the limit at which these properties begin to deteriorate. For the case alloys that exhibit excellent magnetic properties in the two-phase nanocrystal-amorphous matrix structure, control of the crystallization kinetics allows the ability to tailor desired structure [4-6]. Therefore, the knowledge of alloys stability in a broad range of temperature due to different crystallization processes which occur during annealing is crucial [7].

Among these materials, the amorphous alloys of Fe and B have been very interesting because of the combination of soft ferromagnetic properties and high saturation magnetic flux

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