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Study of Stress-Annealing Enhancement of Magnetoimpedance Effect in $Fe_{89.8}Ni_{1.5}Si_{5.2}B_3C_{0.5}$ Metallic Glass Ribbons

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In this study, the magnetoimpedance effect in magnetically soft $Fe_{89.8}Ni_{1.5}Si_{5.2}B_3C_{0.5}$ metallic glass ribbon samples with significant decrease in atomic percentage of metalloids content (less than 10 at.%) was investigated. Thermal treatments were performed by stress-annealing technique of up to 693 K/475 MPa/30 min. The critical frequency of about 600 kHz was observed as the point with the initial increase in magnetoimpedance ratio. Significant improvement of magnetoimpedance-response reaching the value $\Delta Z/Z = 25\%$ after stress-annealing at 693 K/130 MPa/30 min was recorded in samples with still amorphous structure at driving frequency of 4 MHz. The highest magnetoimpedance-element sensitivity was found for low magnetic field intensity ($H \leq 1$ kA/m), where values of about 12%/kA/m were attained.

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1. Introduction

One of the most interesting phenomena observed in amorphous ribbons and wires of soft magnetic alloys is magnetoimpedance (MI) effect. MI refers to the change in impedance of magnetic material sample that is exposed to the influence of external magnetic field (H). MI effect can be tailored by the changes of electrical resistivity (ρ) and magnetic permeability (μ), i.e. two material properties that in classical skin effect determine the penetration depth (δ_{m}), i.e. $\delta_{\mathrm{m}} = [(\rho/\pi)\mu f]^{1/2}$ [1]. For ribbon geometry the improvement of transverse magnetic anisotropy is crucial