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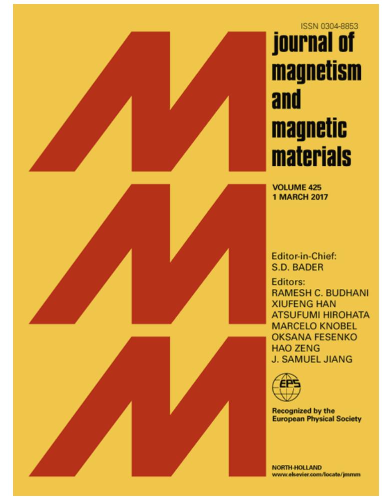

Unique influence of heating rate on the magnetic softness of $Fe_{81.5}Si_{0.5}B_{4.5}P_{11}Cu_{0.5}C_2$ nanocrystalline alloy

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Unique influence of heating rate on the magnetic softness of $Fe_{81.5}Si_{0.5}B_{4.5}P_{11}Cu_{0.5}C_2$ nanocrystalline alloy

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Abstract

$Fe_{81.5}Si_{0.5}B_{4.5}P_{11}Cu_{0.5}C_2$ nanocrystalline alloy with high Fe concentration possesses a finely uniform nanocrystalline structure and numerous α-Fe crystals with a mean grain size of ~17 nm based on XRD patterns. Such crystals precipitated from the amorphous matrix. Favorable soft magnetic properties, small value of coercivity (H_c) of ~4.8 A/m, and high magnetic flux density (B_s) of ~1.53 T can be achieved by slow heat treatment (heating rate of ~10 °C/min). In this case, one-step annealing at a low heating rate is truly antipodal to Fe–Si–B–P–Cu alloy. We analyzed the nanocrystallized mechanism during annealing with various heating rates in $Fe_{81.5}Si_{0.5}B_{4.5}P_{11}Cu_{0.5}C_2$ alloy, which inevitably simplified the industrial crystallization process by one-step annealing at a low heating rate.

Keywords: soft magnetic, coercivity, amorphous/nanocrystalline, heating rate

1. Introduction

Energy conservation is one of the most important issues on a global basis. Soft magnetic materials are widely used for power transformers, motors, communications devices, and microelectronics [1-4]. The efficiency of energy conversion and storage by using these devices should be improved. In addition, heating produced by electrical energy loss of these devices can damage the neighboring device. Excellent