

Analysis of Thermal and Magnetic Properties by adding Mo to Co-based and Fe-based Amorphous Alloys

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1. Introduction

Fe-based amorphous alloy systems have attracted interest for the low material cost, and good soft magnetic properties [1-3]. Particularly, improving the soft magnetic properties and glass forming ability of Fe-based amorphous alloy systems has been studied for the several applications [4,5]. These (Co, Fe)-B-Si alloy system was developed in 1974 and used in field of application development for its good soft magnetic properties and high-strength compared with other Fe-B-Si systems [6,7]. Therefore, we have selected this system. Adding Mo in the Fe-B-Si systems enhances glass-forming ability (GFA) and thermal stability. In this study, we researched on effects of replacing Co by Fe and the part of small Mo additions, in Fe-Co-B-Si-Mo alloy system. We examined the thermal and magnetic properties of $(\text{Co}_{1-x}\text{Fe}_x)_{72}\text{B}_{19.2}\text{Si}_{4.8}\text{Mo}_4$ ($0 \leq x \leq 1$) by amorphous ribbons in detail.

2. Experiment

$(\text{Co}_{1-x}\text{Fe}_x)_{72}\text{B}_{19.2}\text{Si}_{4.8}\text{Mo}_4$ ($0 \leq x \leq 1$) alloys were prepared by an arc-melting furnace with high purity metals under Ti-gettered Argon atmosphere. In addition, these ingots were re-melted four times respectively, in order to be homogeneous alloys. Then, these samples, ribbons with width of 2mm were prepared by single copper roller melt spinning machine in 39.27m/s. After processing of ribbons, we identified ribbons' thermal and magnetic property by multiple measuring equipment. The structure of amorphous is confirmed by X-ray diffraction (XRD). We conducted an analysis of the results by differential scanning calorimeter (DSC) to identify the thermal properties such as the crystallization temperature (T_x), the glass transition temperature (T_g), and the super cooled liquid region ($\Delta T_x = T_x - T_g$) and the magnetic properties measured by using vibrating sample magnetometer (VSM).

3. Result and discussion

In this research, we performed diverse study on Co-Fe-B-Si-Mo system in order to identify that adding Mo element enhances glass-forming ability and thermal stability. Also we want to study into the thermal and the magnetic properties for Co-Fe based amorphous alloys with Mo in depth. $(\text{Co}_{1-x}\text{Fe}_x)_{72}\text{B}_{19.2}\text{Si}_{4.8}\text{Mo}_4$ ($0 \leq x \leq 1$) amorphous ribbons showed good thermal stability with large super-cooled liquid regions. Furthermore, the amorphous ribbons of these composition exhibited good soft magnetic properties. Thus the addition of a small quantity of Mo will have beneficial effects on the thermal stability and soft magnetic properties.

4. References

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