

Effect of Fe/Co ratios on Thermal and Magnetic Properties at Co-Fe-B-Si-Ta Alloys system

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1. Introduction

A lot of soft magnetic alloys have been researched as promising materials until now. Especially, amorphous alloys can be good candidates in several application industries therefore many research groups have studied various combinations of alloys recently. [1-3] Co-based and Fe-based alloys have a good possibility in several applications, for instance sensors, power devices, transformers, motors and energy converting supplies [4,5]. Furthermore, adding the 4 at. % Ta alloying to the Co-Fe composition enhance the glass forming abilities (GFA) [6]. In previous research, we studied the thermal and magnetic properties by making a small quantity of Cr and Ta addition to Co-Fe alloys [7]. In this examination, we researched the thermal and magnetic properties of the $(\text{Co}_{1-x}\text{Fe}_x)_{72}\text{B}_{19.2}\text{Si}_{4.8}\text{Ta}_4$ ($0 \leq x \leq 1$) alloys more specific than previous study.

2. Experiment

In this examination, $(\text{Co}_{1-x}\text{Fe}_x)_{72}\text{B}_{19.2}\text{Si}_{4.8}\text{Ta}_4$ ($0 \leq x \leq 1.0$) multi-component ingots were made of pure elements, such as Co (99.95 %), Fe (99.95 %), B (99.5 %), Si (99.999 %) and Ta (99.95 %), and total mass is 6 g. Co-Fe-B-Si-Ta alloy systems were made by vacuum arc melting furnace under argon atmosphere and re-melted at least six times for homogeneity of alloys. The ribbons were rapidly solidified by a copper roller vacuum melt-spinning method under an argon gas atmosphere with roller speed of 39.27 m/s. And the width of ribbons is 2×10^{-3} - 3×10^{-3} m and the thickness of ribbons is about 30×10^{-6} - 40×10^{-6} m. After preparing of ribbons, we identified the thermal and magnetic properties of alloys by using various measuring equipment. First, the structure of alloys is confirmed by X-ray diffraction (XRD). Second, the thermal properties, such as crystallization temperatures (T_x) are measured by using differential scanning calorimeter (DSC). Last, the magnetic properties are established by vibrating sample magnetometer (VSM).

3. Result and discussion

In this study, we conducted more research on Co-Fe-B-Si-Ta system than earlier research in order to study deep into the thermal and magnetic properties of Co-Fe based alloys. In XRD results, the curves have broad hump trace of amorphous phase, but the curves have several peaks which are conjectured crystalline phase. The thermal stabilities of melt-spun ribbon samples are revealed from the increase of the T_x and the detection of two exothermic peaks. The soft magnetic properties of the Co-Fe-B-Si-Ta ribbons are indicated by the shape of hysteresis loop. So these melt-spun ribbons are suitable for diverse applications which require the good thermal stability and good soft magnetic properties.

4. References

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