Thermal, Mechanical and Magnetic Properties of the Co-Fe based Alloys for various Fe/Co Ratios

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1. Introduction

Many soft magnetic alloys have been researched as promising materials. Especially, amorphous alloys can be good candidates in several application industries therefore many research groups have studied various combinations of alloys recently. [1-3] Adding the 4 at. % Ta alloying to the Co-Fe composition enhances the glass forming abilities (GFA) [4]. Our group has studied the thermal and the magnetic properties of Co-Fe based alloys by making a small quantity of Mo, Nb, Cr and Ta addition [5-7]. In this research, we examined the thermal and magnetic properties of the $(Co_{1-x}Fe_x)_{72}B_{19.2}Si_{4.8}Ta_4$ ($0 \leq x \leq 1$) alloys more specific than previous study.

2. Experiment

In this examination, multi-component ingots were made of pure elements 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. After preparing of ribbons, we identified the thermal, mechanical 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). Third, mechanical properties are measured by using Thermo Mechanical Analyzer(TMA) and Nanoindentation. Finally the magnetic properties are established by vibrating sample magnetometer (VSM) and dc B-H loop tracer.

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. 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 mechanical properties of the melt spun ribbons are indicated by nanoindentation hardness($H_{nanoindentation}$) and elastic modulus(E). 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 various applications which require the good thermal stability and good soft magnetic properties.

4. References

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