Characterization of Fe-based soft magnetic amorphous alloy system with high saturation magnetization

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1. Introduction

There has been an increasing interest in Iron-based (Fe-based) ferromagnetic amorphous materials due to their attractive properties such as low material cost, ultrahigh strength and high corrosion resistance. In addition, Fe-based soft magnetic amorphous materials have good soft magnetic properties including high saturation magnetization (M_s), low coercivity (H_c) and high permeability [1-6]. It is important to choose appropriate component element and composition of Fe-based alloy system for suitable properties [7]. We added Cobalt, because Fe-Co system exhibits the high saturation magnetization and the permeability in comparison to Fe-only and Co-only systems. We also added minor Boron to improve the thermal and structural stability. However, it could decrease the saturation magnetization. Similar to the Boron, Zirconium can promote the glass-forming ability. The goal of this study is to obtain optimum composition of the Fe-based alloy system with high saturation magnetization.

2. Experiment

The ingots of a new collection of Fe-based soft magnetic alloy were prepared by arc-melting. By using a melt-spinning technique, we fabricated thin ribbons of amorphous alloys. Also we used a x-ray diffraction to characterize the glassy structure of our ribbons. The thermal characterization was carried out by using a differential scanning calorimeter. The soft magnetic properties including the saturation magnetization and the coercivity were measured by using a vibrating sample magnetometer.

3. Result and discussion

The hysteresis loops of these amorphous ribbons were measured by using a vibrating sample magnetometer in order to study magnetic properties. The hysteresis loops of the as-spun Fe-Co-based ribbons with width of 2 $\times$ 10^{-3}m. From these data, the values of M_s and H_c are obtained and we will present in the conference. The Fe-Co-Ti-Zr-B alloy system has good soft magnetic properties including a low H_c (~1 Oe) for good soft magnetic amorphous alloy. In this system, we acquired the highest M_s (1.67T) that is the best saturation magnetization in recent study.

4. Conclusion

In conclusion, in this system, Fe-Co-Ti-Zr-B ribbons have better soft magnetic properties than other soft magnetic amorphous ribbons in our previous study. The specimens used in this experiment have been prepared by the melt-spinning technique without annealing treatment. Therefore, ribbons of the Fe-Co-Ti-Zr-B alloy system is expected to improve their characterization after annealing process. In conclusion, Fe-Co-Ti-Zr-B alloy system studied here are good candidates for practical and functional applications as the soft magnetic materials.

5. References

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