E-07

Near-Surface Magnetic Properties of Double layer Co/Fe-based Amorphous Ribbons Prepared by Single Melt-Spun Method

Dongsheng Sun, Seongmin Hong*, Jin Lan, Hanmin, Jin*Cheolgi Kim, Chongoh. Kim
Department of Materials Engineering, Chungnam National University
* Research Center for Advance Magnetic Materials, Chungnam National University

Introduction

Amorphous and nanocrystalline materials have been investigated for application in magnetic devices requiring magnetically soft materials such as transformer, sensors, inductive devices and power electronic etc. [1,2]. Recently, Co-based amorphous and Fe-based nanocrystalline magnetic materials are very attractive for their excellent soft magnetic properties. Single-roll melt spun method is an efficient way to prepare the amorphous ribbons. Whereas all of the ribbons prepared by this method are only one layer(one nozzle), one amorphous phase, we prepared $Fe_{76.5}Cu_1Si_{13.5}B_9/Co_{66}Fe_4Nb_3Si_{15}B_{12}$ (bottom layer) double layer ribbons according to use twin nozzles and investigate their magnetic properties.

Experiments:

The ingots with the composition $Co_{66}Fe_4Nb_3Si_{15}B_{12}$ and $Fe_{76.5}Cu_1Si_{13.5}B_9$ were prepared by high frequency furnace in argon atmosphere. And then it was crashed to small size to suit the next process. The twin rectangular nozzle with a size of 3mm×0.3mm was used to prepare the Fe/Co double layer ribbon. The wheel speed was controlled at about 2000 m/min and the injection pressure is 200 mmHg. The distance between wheel surface and nozzle is about 0.1 mm. The double layer ribbons were annealed at 450 ℃, 1 hour and 500 ℃, 1 hour.

The surface and volume magnetic properties were examined by vibration sample magnetometer(VSM) and rapid-annealed ribbons was carried out using magneto-optical micromagnetometer(MOKE). The microstructure was measured by x-ray diffraction(XRD).

Result and discussion:

Fig.1 shows the volume magnetic properties of the Fe/Co double layer ribbons measured by VSM. For the as-quenched double layer Fe/Co ribbon, the magnetic field for saturation can reach 300 Oe and coercivity is 0.12 Oe. Whereas for the annealed at 450 ℃, 100 Oe is enough for saturation and coercivity is 0.16 Oe, which can be due to the internal stress relaxation. The hysteresis loops like one phase for the as-quenched and annealed at 450 ℃, 1 hour. But for the annealed ribbons at 500 ℃, 1 hour, the two phase effect is observed and coercivity can reach 24 Oe, which can be due to the crystalline increase sharply for the $Fe_{76.5}Cu_1Si_{13.5}B_9$ annealed at 500 ℃, 1 hour. The coercivity of $Co_{66}Fe_4Nb_3Si_{15}B_{12}$ and $Fe_{76.5}Cu_1Si_{13.5}B_9$ annealed at 500 ℃, 1 hour are 0.024 Oe and 64.1 Oe. The Fe-based and Co-based amorphous magnetic hysteresis loops are observed in fig.2 and fig.3. Fig.4 and Fig.5 show the near-surface hystesis loops of the free side and wheel side for the Fe/Co double layer ribbons annealed at 450 ℃, 1 hour. It is obvious to see the two phase effect on the wheel surface hysteresis loop in fig.5.

Conclusion:

The two phase effect in volume magnetic properteis is observed for the Fe/Co double layer ribbons annealed at 500 ℃, 1 hour. Whereas the two phase effect in wheel side surface magnetic properties is observed for the Fe/Co double layer ribbons annealed at 450 ℃, 1 hour.

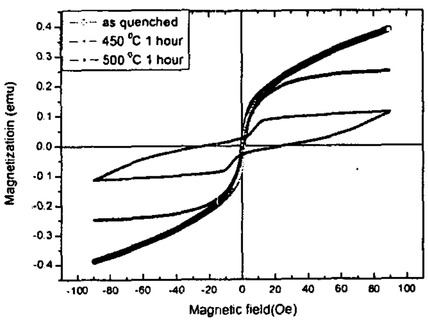

Fig.1

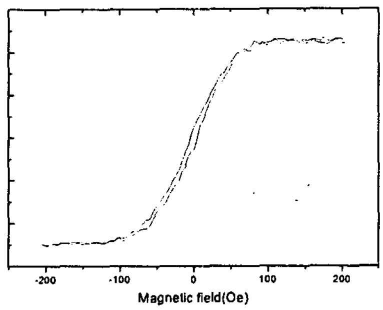

Fig.2

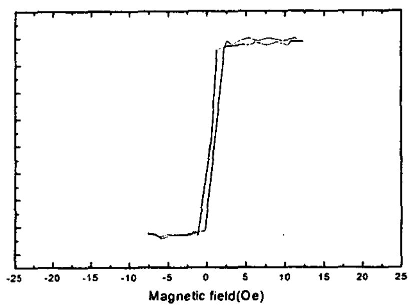

Fig.3

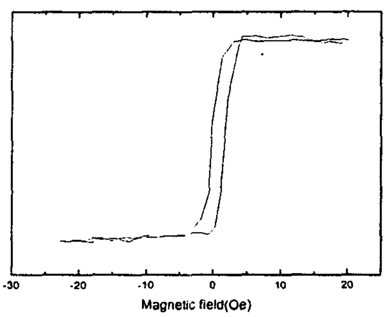

Fig.4

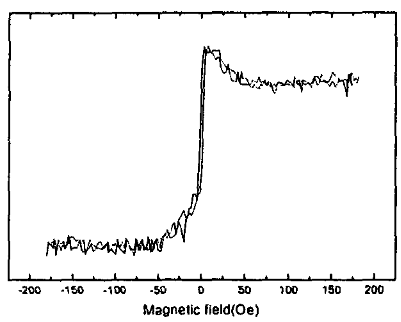

Fig.5

Reference:

[1] Michael E. McHenry, Matthew A. Willard, David E. Laughlin, Progress in Materials Science 44(1999) 291-433.

[2] C.G. Kim, K.J. Jang, H.C. Kim, S.S. Yoon, J. Appl. Phys. 85 (1999) 5447