Crystallization kinetics of amorphous melt-spun mischmetal-ferroboron ribbons

K. Y. Ko

School of Mechanical Engineering, West Campus, Ulsan College, Ulsan Metropolitan City, 680-749, Korea

*Corresponding author: e-mail: kyko@mail.ulsan-c.ac.kr, Phone: +82 52 279 3122, Fax: +82 52 279 3137

The crystallization kinetics of partial amorphous melt-spun mischmetal(MM)-FeB and MM-FeB-(Ti, Co, Al) ribbons have been investigated by differential scanning calorimetry(DSC), X-ray diffractometry, transmission electron microscopy. The major phase in all samples is the tetragonal R(R=rare earth)$_2$Fe$_{14}$B phase with lattice parameters of about a=8.77Å, c=12.20Å. As the wheel velocity increased, the peak intensities decreased and a completely amorphous phase is assumed for high velocity above 40 m/s. The melt-spun ribbons with wheel velocity of 40 m/s used in this study exhibited co-existence of amorphous and crystallization phases. TEM electron diffraction patterns for melt-spun MM-FeB ribbon with wheel velocity of about 25 m/s showed diffuse diffraction ring, which is an existence of an amorphous phase. Also, diffraction patterns from polycrystal overlapped. DSC results of melt-spun ribbons with wheel velocity of 40 m/s showed that crystallization consists of one stage. Significant composition dependence of the thermal stability against crystallization is found, and decrement of the peak temperature (Tp) on melt-spun MM-FeB-Ti ribbon is observed. The exothermic MM-FeB-Ti curve, related to the crystallization reaction is sharper and narrow than these in MM-FeB and MM-FeB-(Co, Al) for suggesting higher kinetics of crystallization, probably due to a increase in the grain growth rate. An exothermic peak starting around 510°C/170°C are thought to corresponding to the crystallization of $R_2Fe_{14}B/R_2(Fe, Ti)_{14}B$ phase from the amorphous phase. The activation energies obtained using Kissinger equation [1] were E=241.1(kJ/mol), E=97.0(kJ/mol), E=194.0(kJ/mol), E=182.9(kJ/mol) for melt-spun MM-FeB, MM-FeB-Ti, MM-FeB-Al, MM-FeB-Co-Al ribbons, respectively. The grain growth rate was increased by partial substitution of Ti for Fe on MM-FeB permanent magnets.

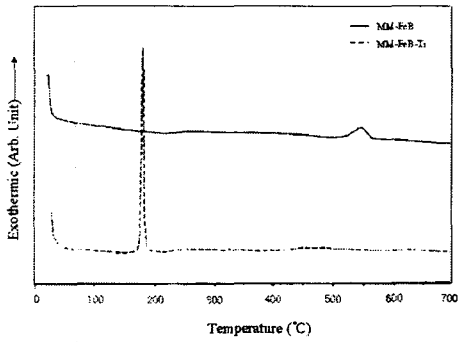

Fig.1. DSC curves of melt-spun MM-FeB and MM-FeB-Ti ribbons.

References

[1] H. E. Kissinger, J. Res. NBS **57**, 217(1956).