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RAPID SOLIDIFICATION OF Ni-49at.%Ti SHAPE MEMORY ALLOY

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Abstract - It is important to control the martensitic transformation start temperature (Ms) of Ti–Ni alloys because it determines the temperature range over which the shape memory effect and superelasticity appear. Many physical properties of melt-spun ribbons as well as their microstructures sensitively depend on the values of the processing parameters such as the wheel speed, gas pressure, melt temperature and nozzle–wheel gap, etc. In the present study, the shape memory behavior of Ti–49 at.%Ni alloy ribbons fabricated at different cooling rates by the melt spinning and the influence of rapidly solidified on shape memory behavior was studied.

The ingot of the Ti–49Ni (at.%) was placed into quartz crucibles, placed in the chamber of the melt spinning system that was evacuated to less than $1x10^{-4}$ Pa, heated and ejected. The study of martensitic transformation behaviors of the ribbons was in the differential scanning calorimetry (DSC).

The velocity of wheel was changed from 30 to 50 m/s while the melt spinning temperature was fixed at 1350 ^{o}C. Fig. 1 shows DSC curves of the as-spun ribbons fabricated at the different wheel velocities. The ribbons fabricated at the wheel velocity of 30 m/s showed one exothermic and two endothermic peak on cooling and heating of DSC curves. The splits in DSC peaks in Fig. 2(a) probably corresponding to the B2 parent phase and the B19 martensite. This means that the B2–B19 transformation occurs in ribbons fabricated at the wheel velocity of 30 m/s. This splitting of DSC peaks was also found in the Ti–49 at.% Ni alloy ribbons prepared by melt spinning at the wheel velocity of 30 m/s, which was attributed the fact that two-stage transformation of the occurred in the alloy ribbons heavily strained by rapid solidification process.

The splits in DSC peaks in Fig. 1(a) may be ascribed to an inhomogenity in microstructures in the ribbons. The ribbons fabricated at the wheel velocity of 50 m/s showed only one exothermic and endothermic peak on cooling and heating of DSC curves. The splits in DSC peaks in Fig. 1(b) probably corresponding only the B19 martensite. When the ribbon is produced at a higher wheel velocity in melt spinning, the degree of undercooling becomes high because of its thinner thickness. Therefore, the amount of crystalline layer decreases with wheel velocity. The B2–B19 transformation occurs in ribbons fabricated at the wheel velocity of 30 m/s, while only B19 martensite transformation occurs in ribbons fabricated at the wheel velocity of 50 m/s. When the ribbon is produced at a higher wheel velocity in melt spinning, the degree of undercooling becomes high because of its thinner thickness and the amount of crystalline layer decreases with wheel velocity [1].

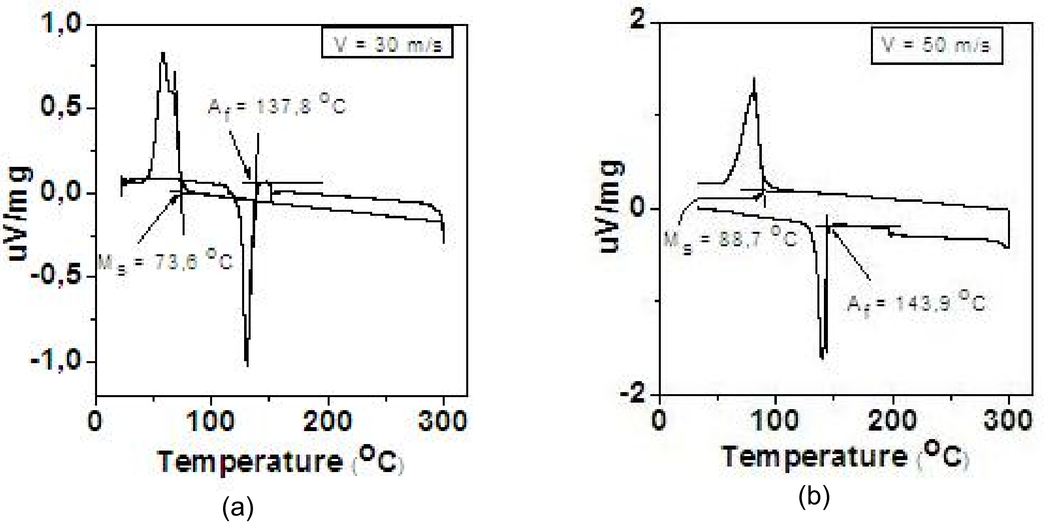

Fig. 1 - DSC curves of the ribbons fabricated at the wheel velocities of: (a) 30 m/s and (b) 50 m/s.

[1] Y. Kim, Y. Yun, T. Nam, Materials Science and Engineering A 438–440 (2006) 545–548