11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Micro-Pattern Forming of $Zr_{65}Al_{10}Ni_{10}Cu_{15}$ BMG Alloy

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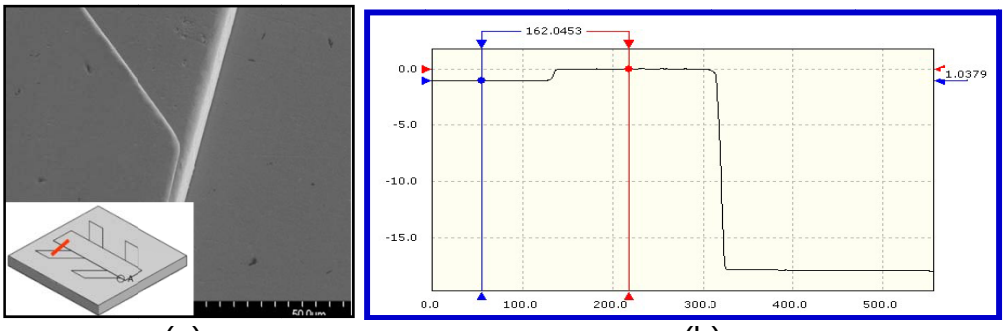
Abstract – In this study, micro-scaled forming of $Zr_{65}Al_{10}Ni_{10}Cu_{15}$ BMG was conducted. Some micro-channel and spinning pattern with depth of 1, 16 ㎛ and 2.5, 5 ㎛ respectively, could be successfully produced (Fig. 1a). Result of depth profile, as shown in Fig. 1b for the micro-channel, revealed that BMG has an applicable potential for micro parts. The sensitive formability of $Zr_{65}Al_{10}Ni_{10}Cu_{15}$ BMG appeared depending on deformation parameters.

Nowadays, many reports are consisting of applicable possibility of BMG (Bulk Metallic Glass)` micro parts forming including nano-scaled grain materials. Some bulk metallic glasses show superior plastic-formability at an elevated temperature range, since they exhibit superplasticity in the supercooled liquid region defined by the difference between glass transition temperature (T_g) and crystallization temperature (T_x). This character of BMG`s deformation is Newtonian viscous flow behavior similar to that of polymer`s deformation. The $Zr_{65}Al_{10}Ni_{10}Cu_{15}$ alloy is one of the bulk metallic glass materials capable of exhibiting the Newtonian viscous flow behavior in a limited time at around 696K. In a previous work, it is reported that some dynamic crystallization phenomenon was observed in the present BMG alloy during the superplastic deformation [1]. In this study, some micro-scaled forming of $Zr_{65}Al_{10}Ni_{10}Cu_{15}$ BMGs was conducted. (Fig. 1a) The sensitive formability of $Zr_{65}Al_{10}Ni_{10}Cu_{15}$ BMG, which depends on temperature and load, was observed during micro-scaled deformation. In addition, a variation of crystallization degree was also observed depending on deformation rate, even though the sample was exposed at the same temperature during the deformation.



(a) (b)

Figure 1. Micro-channel pattern(a) of $Zr_{65}Al_{10}Ni_{10}Cu_{15}$ BMG with depth of 1, 16 ㎛, respectively, and depth profile of the pattern.

References

[1] W. J. Kim, H. G. Jeong, Intermetallics, vol 14 (2007) 1391 ~ 1396.