INTERNAL FRICTION ON Cu-Zr-Al BULK METALLIC GLASS

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1. Introduction

Bulk metallic glasses (BMG) exhibit some properties as high strength and hardness that can be associated to the cohesive strength between atoms and/or atomic clusters [1]. In the recent decades, some works have investigated the atomic clusters and their dynamic by experiments, simulations and theoretic analysis [2] that may help to elucidate the yielding, fracture behavior and plastic deformation mechanisms in BMG. On this study, a $Cu_{54}Zr_{40}Al_6$ BMG alloy had its anelastic properties characterized by mechanical spectroscopy, which can be defined as an energy absorption technique, where waves of mechanical stress interact with a solid, and the result obtained is the energy absorption, known as internal friction [3].

2. Experimental

The amorphous sample $Cu_{54}Zr_{40}Al_6$ was produced by suction cast technique (IMR- Tohoku University/Japan). Internal friction spectra were obtained in an rectangular shape with dimensions of about 23.5x6.0x0.6 mm^3, flexural vibration of the first tone of sample was employed using in acoustic elastometer system (Vibran Technologies, AE 102 model) operating in the temperature range of 150 K to 510 K with a heating rate of 1 K/min and vacuum better than 10^{-5}torr. For ultrasonic pulse-echo measurements, a cylindrical sample was cut of 9.84 mm height and 6.00 mm diameter, and a MATEC ultrasonic system was used with Y-cut quartz transducer generating transversal waves of 5 MHz while the material was cooled from room temperature to 150 K and then heated to 285 K, at a rate of 1 K/min.

3. Results and Discussions

Internal friction (Fig. 1), in the first run, show the broad peak related to the unusual relaxation process termed *β'* relaxation and second peak, which was attributed to the conventional slow *β* relaxation. The second run shows the decrease of the *β* relaxation and the increase of the unusual *β'* relaxation. Ultrasonic attenuation spectra (Fig. 2), show four measurements runs that were carried out in the sample. The aging process that decrease the peaks (I) and increase the peak (II), suggests that the mechanical wave interacts with amorphous structure increasing the supercluster and molecular-like formation that tends to suppress the flow units, enhancing the growth of nanocrystalline structure into the amorphous alloy. This behavior occur inside the *β'* relaxation region.

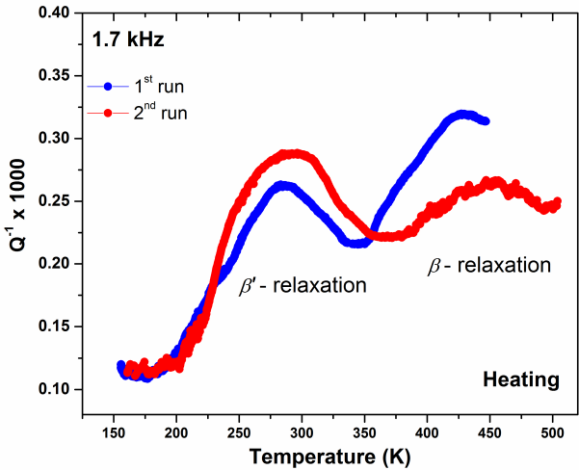

Fig. 1. *Internal friction versus temperature for the $Cu_{54}Zr_{40}Al_6$ obtained by flexural vibrations*

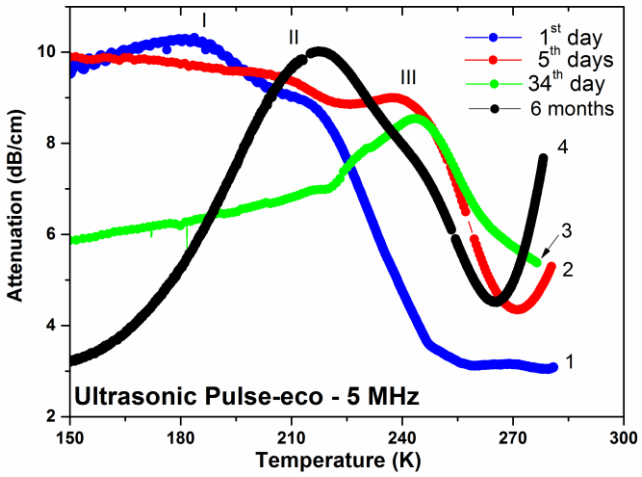

Fig. 2. *Ultrasonic attenuation versus temperature for the $Cu_{54}Zr_{40}Al_6$ during four runs obtained with transversal wave.*

4. References

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