Mechanical Spectroscopy Study of Nanoclusters and Nanocrystalline Dynamics in BMG $Cu_{54}Zr_{40}Al_6$ and $Cu_{47.5}Zr_{45.5}Al_5Er_2$

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As is well known Bulk Metallic Glasses (BMG) exhibit different properties such as high strength and hardness that can be associated with the cohesive strength between atoms and/or atomic clusters. Despite advances in research, mainly in numerical simulation of BMG in recent years, the structural evolution of atomic clusters and their interactions mechanisms is still unclear. The Mechanical Spectroscopy (MS) technique appears as [illegible]
The MS can be defined as an energy absorption technique, where the anelastic spectrum generated is commonly used to study phase transformations and structural rearrangement in crystalline materials. This technique has been used to investigate dynamical processes related to the elastic and electronic contributions of atomic motions and clusters, as well as other changes in the atomic bonds of BMG. In this study, the anelastic spectra of amorphous $Cu_{54}Zr_{40}Al_6$ and $Cu_{47.5}Zr_{45.5}Al_5Er_2$ were obtained using kHz to MHz frequencies, by flexural measurements and ultrasonic pulse-echo respectively. Analysis of the interaction between amorphous structure and mechanical oscillations, realized in the temperature interval 100K to 300K at different cycles of cooling-heating of the sample, provide information concerning the movement of flow units and to the growth of nanostructures, as superclusters and nanocystalls. The MS spectra suggest that the mechanical excitation interact with nanostructures such as cluster type, supercluster and chain-like structure. This interaction, added to the cryogenic stresses in the BMG, lead to the growth of microalloy, which may give rise to the medium-range order structure as well as increase the small nanocrystalline region scattered into the glassy structure. The observation of martensitic transformations, increasing with measurement cycles, confirm the existence of a nanostructure of clusters growing with the measurement process, in concordance with theoretical proposals.