Materials Science & Engineering Seminar Series

# Carnegie Mellon University
## Materials Science & Engineering

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# Temperature Memory Effect of Soft Magnetic Amorphous Ribbons

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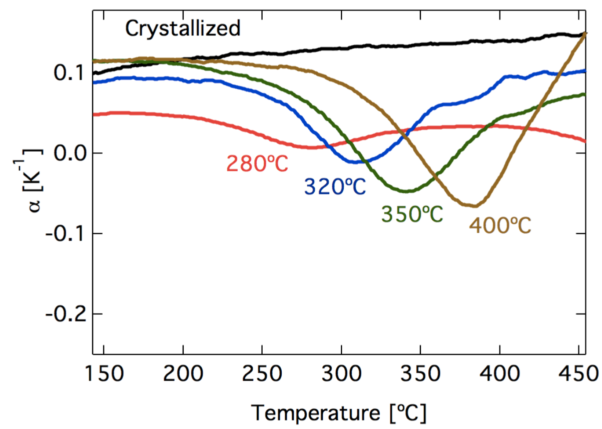


Fig. 1 Temperature dependence of LTE coefficient, α, of amorphous $Co_{72.5}Fe_{1.5}Mn_4Si_5B_{17}$ ribbons with the different annealing temp. indicated in the graph.

The microstructure of amorphous alloys attracted many researchers for more than 40 years. Several types of local structures, such as short and/or medium rage ordering have been proposed. Recent computer simulations have made visible spatial distribution of free volume. However, since all these heterogeneities occur on a very small scale, their effect on the material properties is usually too small to be detected experimentally. However it can be enhanced by heat treatment under an “external field”. One typical example is the formation of a creep induced magnetic anisotropy when a ferromagnetic amorphous ribbon is annealed under tensile stress. We found by X-ray diffraction and linear thermal expansion measurements (LTE) [1, 2] that this induced magnetic anisotropy originates in local strains frozen-in at room temperature after the annealing stress is released. Thus, a shrinking of the ribbons is observed during post annealing due to the releasing of the frozen-in elastic strain. Figure 1 shows temperature dependence of LTE coefficient, α. All curves show a minimum around the temperature used for the first creep heat treatments. This can be explained by a spatial distribution of the viscosity, η(T). When the alloy is heated to a certain temperature, some regions are still stiff and behave like solid (small η(T)) while the adjacent regions with larger η(T) deform easily. The difference of η(T) is enhanced by the difference in local glass transition temperature. The regions with larger η(T) “glue” the elastic strain in the regions with small η(T) and, hence, freeze it in. The temperature memory effects indicate that the distribution of η(T) does not change during the first annealing. Thus η(T) of the glue regions become large again and these regions start to deform again when the original annealing temperature is reached during post annealing. Consequently, the elastic strain in the regions with small η(T) is released. The effects of annealing time and the size of heterogeneity will be discussed in this talk.

**Reference:**

[1] M.Ohnuma, G.Herzer, P.Kozikowski, C.Polak, V.Bundinsky, S.Koppoju, Acta Materialia 60 (3) (2012)1278-1986. [2]P.Kozikowski, M.Ohnuma, G.Herzer, C.Polak, V.Budinsky, S.Koppoju, M.Lewandowska, K.J.Kurzydlowski, Scripta Materialia 67, (2012) 736-766

**Scaife Hall 220, 11:00AM**
**Friday, June 1, 2018**