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**Abnormal three-steplike sub- $T_g$  enthalpy relaxation pattern in hyperquenched metallic glasses****Hu, Lina<sup>2</sup>**; Yue, Yuanzheng<sup>1</sup>

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Our recent work observed a quite different relaxation pattern, i.e., the abnormal three-steplike sub- $T_g$  relaxation in CuZrAl GRs[1]. However, the generality and the origin of this remarkable thermodynamic anomaly remain enigmatic. By hyperquenching strategy, the present work investigated the dependence of thermal history on the sub- $T_g$  enthalpy relaxation pattern (ERP) of  $\text{Cu}_{46}\text{Zr}_{46}\text{Al}_8$  glasses, as well as  $\text{La}_{55}\text{Al}_{25}\text{Ni}_{20}$  for comparisons. It has been found that the presence of the three-steplike sub- $T_g$  ERP of  $\text{Cu}_{46}\text{Zr}_{46}\text{Al}_8$  closely relates to the fictive temperature  $T_f$ , whereas no such anomaly is observed in  $\text{La}_{55}\text{Al}_{25}\text{Ni}_{20}$  GRs. However, the correlation between  $T_f$  and the activation energy for initiating the energy releasing during thermal scanning is three-steplike for  $\text{La}_{55}\text{Al}_{25}\text{Ni}_{20}$ , revealing the similar phenomenon with the abnormal ERP of  $\text{Cu}_{46}\text{Zr}_{46}\text{Al}_8$ . These unexpected phenomena have been well explained by the models based on the competitions between the low-temperature and high-temperature clusters used in the terms of the fragile-to-strong (F-S) transition. By analysis on the different chemical feature between  $\text{Cu}_{46}\text{Zr}_{46}\text{Al}_8$  and  $\text{La}_{55}\text{Al}_{25}\text{Ni}_{20}$  alloys, it is believed that such anomaly of thermodynamic evolution exists generally in metallic glass-forming liquids, and corresponds to the different extent of the F-S transition.

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[1]. Lina Hu & Yuanzheng Yue, APL **98**(2011) 081904