

What a glass memorizes about its past

With the support by the National Natural Science Foundation of China and the Ministry of Science and Technology of China, the research team led by Prof. Wang Weihua (汪卫华) at the Institute of Physics, Chinese Academy of Sciences, reported “The Memory Effect Manifested by a Boson Peak in Metallic Glass”, which was published in *Physical Review Letters*.

A glass memorizes its past concerning not only the disordered structural arrangement, but also the anomalous low-frequency atomic vibration. Glass is nonequilibrium and continually relaxes toward the metastable equilibrium state by structural rearrangement, but what is mysterious is that its past is always memorized. Glass is also disordered and owns markedly different atomic vibration from the ordered crystals. These two features are central to understanding the nature of glass but generally investigated separately. In our paper, we investigate if the atomic vibrational state can be memorized just like the structural arrangement in a metallic glass. Interestingly, we find that they evolve in line with each other and both exhibit history-dependent behaviors of memory effect. Thus the slow structural rearrangement by atomic motion and the fast atomic vibrational state have been experimentally shown to be correlated with each other, which presents a clearer picture for the profound understanding of the two dynamic behaviors, memory effect in glass and may also arouse more and deeper thinking.

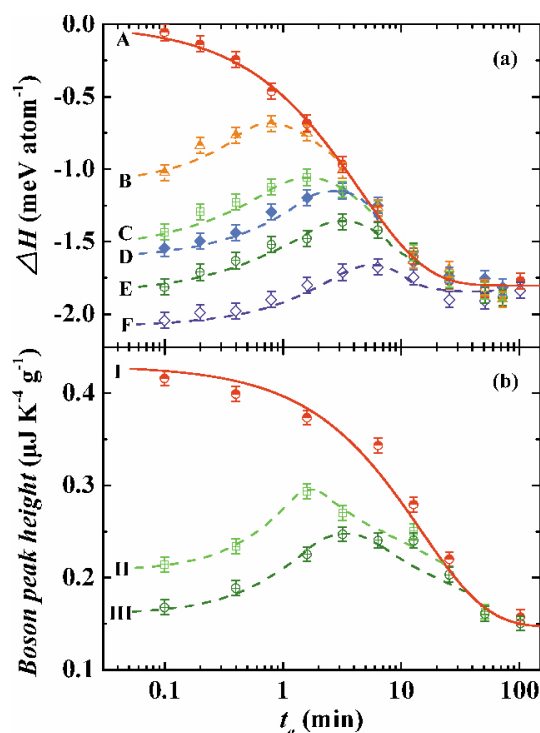


Figure (a) Relative enthalpy change ΔH against the aging time t_a for single-step (curve A) and double-step isothermal aging (curves B–F). For double-step aging, the pre-aging temperatures T_0 for cases B–E were 638, 648, 658 and 668 K, respectively, the pre-aging time $t_0 = 20$ min. Case F with $T_0 = 668$ K and $t_0 = 30$ min, (b) Boson peak height against the t_a for single- (curve I) and double-step isothermal aging ($T_0 = 648$ K for curve II and $T_0 = 668$ K for curve III, $t_0 = 20$ min). $T_a = 688$ K for all cases. The lines are drawn as a guide for the eyes.