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Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Enthalpy relaxation in the Ag_3PS_4 glass prepared by mechanochemical synthesis

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Keywords: Enthalpy relaxation; Mechanochemical synthesis; Chalcogenide glass

Mechanical milling can be used to amorphize certain kinds of crystalline materials. The thus-derived glassy materials cannot be synthesized using conventional methods, e.g., melt quenching. Despite some progress in understanding the nature of these milling-generated glasses, several important aspects such as the sub-T_g relaxation, glass formation and glass transition of such glasses are still far from being understood. In this work, we explore these aspects by 1) preparing a new type of glass - the Ag_3PS_4 glass via a high-energy ball-milling process, 2) by annealing it below T_g, and 3) by measuring the thermal responses using differential scanning calorimeter (DSC). The DSC results show an interesting sub-T_g relaxation feature in the as-produced sample. i.e., the occurrence of multiple enthalpy relaxation events below T_g during a dynamic heating protocol. In this work we reveal the origin of these multiple events by analyzing structural heterogeneity, glass formation mechanism, relaxation modes, polyamorphism, and surface characteristics. We also discussed the relationship between milling energy and enthalpy relaxation. This study provides insight into the structure-functionality relation in this new type of mechanically amorphized material.

Acknolwlegement: NSFC(No. 51372180), NCET(No. NCET-11-0687), NSF of Hubei Province(No. 2013CFA008), the Fundamental Research Funds for the Central Universities (Wuhan University of Technology, No. 155201004) and the key technology innovation project of Hubei Province (No. 2013AEA005).