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Middle range order and elastic properties of non-stoichiometric chalcogenide glasses in the AsS_3 - GeS_4 system

D. Tsiulyanu [a], S.A. Kozyukhin [b], M. Ciobanu [a]

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Abstract

Longitudinal elastic modulus of glasses $(GeS_4)_x$ $(AsS_3)_{1-x}$ has been determined from experimentally measured density and ultrasound velocity with respect to the "first sharp diffraction peak (FSDP)" of the XRD halos, ascribed to intermediate range ordering. Quantitative analysis of FSDP allowed estimation of the size of correlated middle range ordered domains and inter domain distances dependent on glass composition. It was revealed that interdomain distance and average domains size are strongly correlated, both reaching the minimal value at composition that comprises 7,7 at.% Ge, therefore the domain concentration of this composition appears to be maximal. It was not found an apparent correlation between density or ultrasound velocity and middle range ordering parameters of the glass. However, a clearly visible correlation was found between Young' modulus and concentration of structural domains: Young' modulus linearly increases with domain concentration, with an exception of an only case occurring at low Ge concentration (~x223C 4 at.%). The results are explained in terms of deep structural transformation in the middle range order caused by molecular reorganization, which controls the physical properties, including the elastic ones of the glass. The study has pointed out the light glasses of the AsS_3-GeS_4 system possessing enhanced elastic and sound characteristics available for application.

Keywords

Chalcogenide glasses; XRD; Medium range order; Young's modulus

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