

Free-volume nanostructurization in Ga-modified As₂Se₃ glass

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Ga-modified glasses are of high importance in view of potential using in IR photonics as active media with improved properties, revealed when these glasses are doped with rare-earth activators [1]. But at high contents, Ga demonstrates strong trend to phase separation and crystallization, these processes being dependent on preferential chemical environment [2]. Crystallization is accompanied by complicated changes stretching over atomic-specific and atomic-deficient levels. The latter is related to free-volume entities, when some inner holes are agglomerated to form spaces of reduced electron density needed for orientation stabilization of growing crystallites [3] or, conversely, they are fragmented on smaller parts ensuring energetically favorable localization.

Free-volume evolution was studied in As₂Se₃ glass affected by different amounts of Ga (up to 5 at. %), using positron annihilation lifetime spectroscopy. It was shown that under 3 at. % of Ga, when glass formation was not violated, the glass structure was changed due to free-volume void agglomeration. At greater Ga content (over 3 at. %), the crystallization occurs, this process being associated with stabilized void volumes and slightly enhanced content like in pure As₂Se₃.

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