Nanocomposites and nanomaterials

Crystallization behavior of nanostructured Ge-Ga-Se glasses

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Ge-Ga-Se chalcogenide glasses (ChG) have shown many advantages for potential applications of optical modulator or frequency converter, efficient laser host materials, and fiber-optical amplifier in the IR spectral region [1]. In the present paper, we imply, the positron annihilation lifetime spectroscopy complete with doppler broadening of annihilation radiation and atomic force microscopy (AFM) methods to study of crystallization behaviour in $80GeSe_2$-$20Ga_2Se_3$ ChG caused by thermally-activated treatment above-*Tg* annealing for 10, 25, 50 and 80 h [2]. It is shown that the structural changes caused by crystallization can be adequately described by positron trapping modes. The observed changes in defect-related component in the fit of experimental positron lifetime spectra for annealed glasses testifies in a favour of structural fragmentation of larger free volume entities into smaller ones with preceding nucleation in the initial stage.

With increasing annealing time from 10 h to 25 h and further to 50 and 80 h, the well-pronounced crystalline peaks at $2\theta \sim 28°$ are observed. The positions of this peak are in good agreement with $GeGa_4Se_8$ phase indexation. The size of nanocrystalline inclusions is near 9–10 nm in sizes. Crystallization of $GeSe_2$ phases in form of nano-wires with length near 250 nm is surface phenomenon. The crystallization of these phases presents an advantage for transparency of glasses.

1. *Calvez L., et al.* Influence of gallium and alkali halide addition on the optical and thermo–mechanical properties of $GeSe_2$-Ga_2Se_3 glass // Appl. Phys. A.-2007.-**89**.-P.183-188.
2. *Shpotyuk O., et all.* Thermally-induced crystallization behavior of $80GeSe_2$–$20Ga_2Se_3$ glass as probed by combined X-ray diffraction and PAL spectroscopy // J. Alloys and Compounds.-2014.-**582**.-P. 323–327.