Nanocomposites and nanomaterials

Chalcohalide Ge-Ga-S-CsCl glass-ceramics studied with positron annihilation methods

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Chalcohalide glass-ceramics receive considerable interest for their particular properties leading to numerous applications in different domains such as optical, communications, infrared sensing, ion selective electrodes etc. [1]. One of the best techniques capable to probe fine free volumes in solids is the positron annihilation lifetime (PAL) technique. The PAL technique in the measuring mode of Doppler broadening of annihilation line (DBAL) allows additional identification of dominant positron trapping sites possible in the tested objects. In this work, we shall analyses possibilities of PAL and DBAL technique to study free-volume entities in $(80GeS_2–20Ga_2S_3)_{100–x}(CsCl)_x$ glass-ceramics with x = 0;5;10;15.

It is shown that changes in the atomistic structure caused by addition of CsCl are accompanied by corresponding modification in the atomic-deficient (void) structure, the latter being defined by chemically-specific trapping characteristics due to other void environment. The changed free volumes of inner voids influence the trapping rate of positrons. The concentration of positron trapping voids plays a decisive role in the overall process of annihilation, which becomes similar to positron trapping caused by the same type of extended defects.

So, PAL and DBAR technique can be used for study of free-volume changes in Ge-Ga-S glass matrix caused by CsCl additives. The results testify in a favor of rather unchanged nature of corresponding free-volume voids responsible for positron trapping in the studied glasses, when mainly concentration of these traps is a subject to most significant changes with composition. These results serve as a basis for new direction in the characterization of inner free-volume structure of chalcohalide glass-ceramics conditionally declared as Positronics.

1. *Masselin P., Coq D.L., Calvez L., Petracovschi E., Lépine E., Bychkov E., Zhang X.* CsCl effect on the optical properties of the $80GeS_2–20Ga_2S_3$ base glass // *Appl. Phys. A.*- 2012.-**106**.-P. 697–702.