

NATO Science for Peace and Security Series B: Physics and Biophysics 2011, pages 103-110

Nanovoids in glasses and polymers probed by positron annihilation lifetime spectroscopy

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Abstract

Nanovoids in As₂S₃-based glasses (As₂S₃, (As₂S₃)₈₅Ag₁₅, and (As₂S₃)₈₅(AgI)₁₅), a polymer and a As₂S₃-polymer nanocomposite were studied using the positron annihilation lifetime spectroscopy (PALS) technique. After computer treatment of the PALS data recorded, it was found that only two components τ_1 (short-lived) near 0.2 ns and τ_2 (long-lived) near 0.4 ns are resolved for the As₂S₃-based glasses. At the same time, in the case of the polymer sample two components τ_2 near 0.3 ns and τ_3 (pick-off annihilation of ortho-positronium) near 2.8 ns were detected, while for the As₂S₃-polymer nanocomposite three components τ_1 near 0.2-0.3 ns, τ_2 near 0.4-0.5 ns and τ_3 near 2.4 ns were established. The volume of nanovoids in the materials studied was determined, and the fractional free volumes of the As₂S₃-polymer nanocomposite and the polymer matrix were compared. The results obtained are important to utilize As₂S₃-based glasses and polymer nanocomposites for advanced sensor applications. © 2011 Springer Science+Business Media B.V.

<http://dx.doi.org/10.1007/978-94-007-0903-4-11>

Keywords

Chalcogenide glasses, Nanovoids, Polymers, Positron annihilation lifetime spectroscopy