Nanocomposites and nanomaterials

Conditions of forming nanocrystallites for β-Sn in the amorphous semiconductor matrix based on GaSb

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Using a method of the flesh evaporation in vacuum, the films have been prepared, from previously synthesized powder GaSb-Sn, with the thickness approximately 50 nm. Glass, ceramic and spallings NaCl monocrystals were served as substrates. Structure, substructure, concentration areas of existence of metastable solid solutions and an amorphous state and kinetics of structural transfomations were studied by methods of electronography and transmission electron microscopy. The composition of films is more convenient to represent using the formula $(GaSb)_{1-x}(\alpha\text{-}Sn_2)_x$ because in the investigated system solid thin-film solutions are formed by substitution. The temperature of a substrate supported in a precipitation process of films has dominant effect on structure formation of explored films. Films precipitated on substrates at room temperature were amorphous up to 30% of Sn_2 concentration. Two-phase polycrystalline films (β-Sn and GaSb) are formed at higher concentrations of Sn. The linear relation of the proximate interatomic distance (from 0.272 nm in a-GaSb to 0.276 nm in a-$(GaSb)_{0,7}(Sn_2)_{0,3}$) in amorphous films from composition is observed. The linear relation of the proximate interatomic distance in coordinate Sn_2 specifies random distribution of atoms with forming "alloyed " structure such as a solid solution.

Amorphous films at heat crystallized, but phases of a solid solution it is not observed. Initial crystallization phases are crystal grains β-Sn. The growth of crystallite sizes of β-Sn takes place with the temperature increase. A speed of continuous heating has essential influence on the density and sizes of metallic crystallites of β-Sn formed in the amorphous semiconductor matrix based on GaSb. With the increase of temperature of a substrate there is a forming the nonuniform amorphous films. With the further increase of temperature of substrates on the isotropic substrates, polycrystalline films of a metastable solid solution of substitution are formed for the concentration up to 20% of Sn_2, and on spallings NaCl monocrystals textured and epitaxial films are formed. Disorder of solid solutions on phases GaSb and Sn at temperatures is higher 500K is observed.